



# Attention-Deficit/Hyperactivity Disorder

A Community Presentation

Dr. Michael Stevens and Morgan Beatty



**Thank you for joining us today.**

**The information provided today is educational in nature and intended for your general knowledge only.**

**It is not a substitute for a medical appointment or treatment for specific medical conditions. Please consult your healthcare provider with any questions or concerns you may have regarding your condition.**

**If you have a medical emergency, call your doctor or 911 immediately.**

2023

## If you have ADHD, you...

- Are 1.53X more likely to be injured accidentally..... *Ruiz et al., 2018*
- Are at a 37% higher crash-risk as a driver ..... *Curry et al., 2019*
- Have a higher chance of engaging in criminal activity ..... *Young & Cocallis, 2021*
- Are more likely to abuse alcohol (1.7X), marijuana (2.5X),  
and cocaine (2X) ..... *Lee et al., 2011*
- Will have a 25% lower net worth by retirement ..... *Pelham III et al., 2020*
- Are likely less satisfied with your life ..... *Gudjonsson et al., 2009*
- Are at a higher risk of committing suicide ..... *Giupponi et al., 2018*



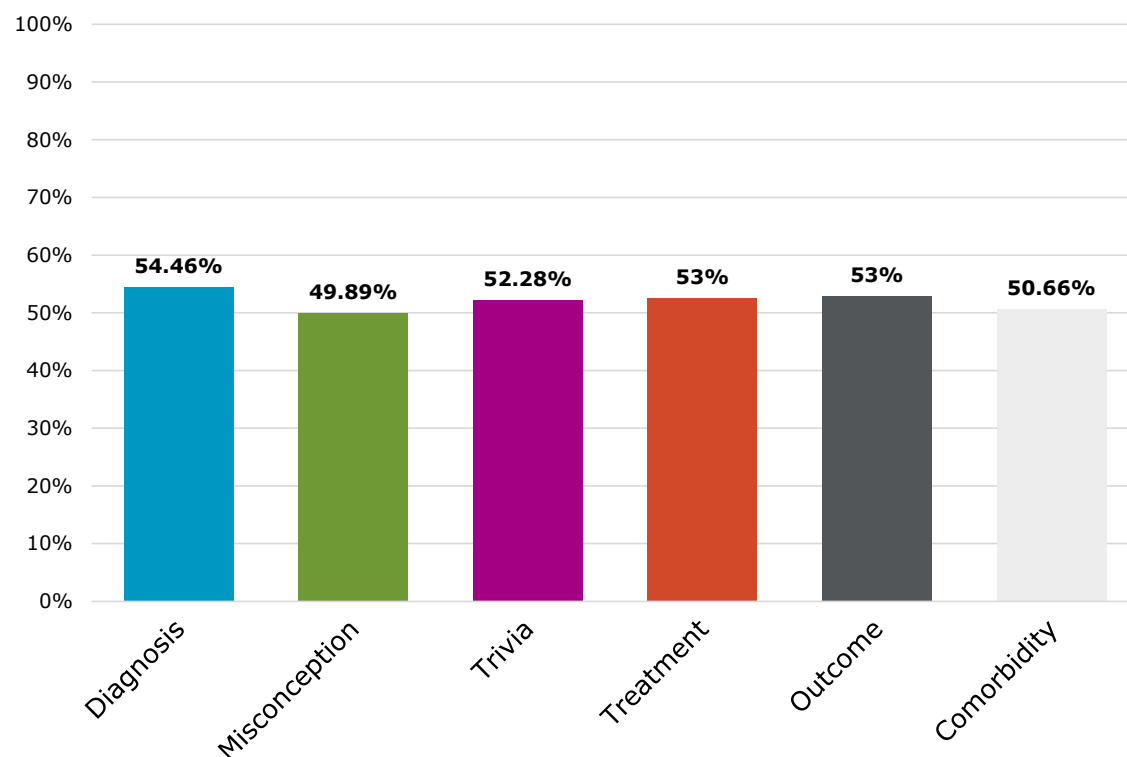
*The national cost of untreated ADHD is staggering:*  
The annual societal cost of ADHD is predicted to be between **\$143-266 billion**. This is largely driven by educational, healthcare, and caregiving costs, working out to **\$8,349 per adolescent**.

*Doshi et al., 2012; Schein et al., 2022*

## Our National Survey ( $n = 1,028$ )

- Participants were given the chance to identify 29 well-established statements about ADHD as 'TRUE', 'FALSE', or 'IDK'.
- Respondents had the opportunity to acknowledge their ignorance, yet they confidently answered a huge proportion of questions incorrectly.
- Accuracy is barely above chance for most question categories.

Accuracy Across Question Categories



## Survey sample – *high performance questions*

*3 of the 29 questions were answered with an average accuracy greater than 55%*

<b>Question</b>	<b>Answer</b>	<b>% Correct</b>
Kids with ADHD who do well in school are less likely to have their ADHD diagnosed.	True	55.8%
An estimated 10% of children in the U.S. have ADHD.	True	56.1%
ADHD medications don't cure the disorder, they only control the symptoms and must be taken every day.	True	60.7%

## Survey sample – *low performance questions*

*8 of the 29 questions were answered with an average accuracy of less than 40%*

<b>Question</b>	<b>Answer</b>	<b>% Correct</b>
There are many more people with ADHD now than 30 years ago, and ADHD rates are increasing.	False	26.4%
Unmedicated people with ADHD are more likely to be obese.	True	36.8%
Using ADHD medications makes it more likely that someone will abuse alcohol or drugs later in life.	False	38.1%
Symptoms of ADHD must be present before age 12 in order to be diagnosed.	True	38.9%

# This Presentation

## Misconceptions

- Clarifying common myths and misconceptions.

## Changing ideas about ADHD

- What is ADHD?
- How we've understood the disorder throughout time.
- How we understand the disorder now.

## Diagnosis

- Best practice for ADHD diagnosis.
- Comorbidities.
- Barriers.

## Treatment

- Review of empirical evidence.
- Pros/Cons of studied treatments.
- Experimental options.

# Misconceptions

Misconceptions are myths / misrepresentations that people often walk around with. While 'misconceptions' can span a huge variety of topics, the ones we've identified for our national survey are ideas that have been disproven for *years*.

**Despite this, people scored at less than chance levels for questions in the misconception category, with an accuracy of 37%.**

## **Why are misconceptions such a big deal?**

The continued prevalence of misconceptions can negatively affect treatment of the disorder by:

- a) Promoting bias by clinicians/researchers
- b) Perpetuating stereotypes that dissuade patients from seeking treatment
- c) Misguiding patients in treatment approaches



## A few more common misconceptions...

Sugar makes an ADHD child's symptoms worse.

### **FALSE.**

- There is no known link between sugar intake and ADHD symptoms.
- Studies examining the link between sugar intake and ADHD find the link is mitigated by confounding factors (SES, ethnicity and race, parenting styles, etc).

ADHD isn't a real disorder – it's just bad parenting.

### **FALSE.**

- ADHD symptoms have been shown to be caused by deficits in the neural, cognitive, behavioral, and social functioning of children.
- However, parent training can be very successful in helping treat ADHD and manage family happiness.

If I give my child stimulant medications, they'll get hooked on drugs later in life.

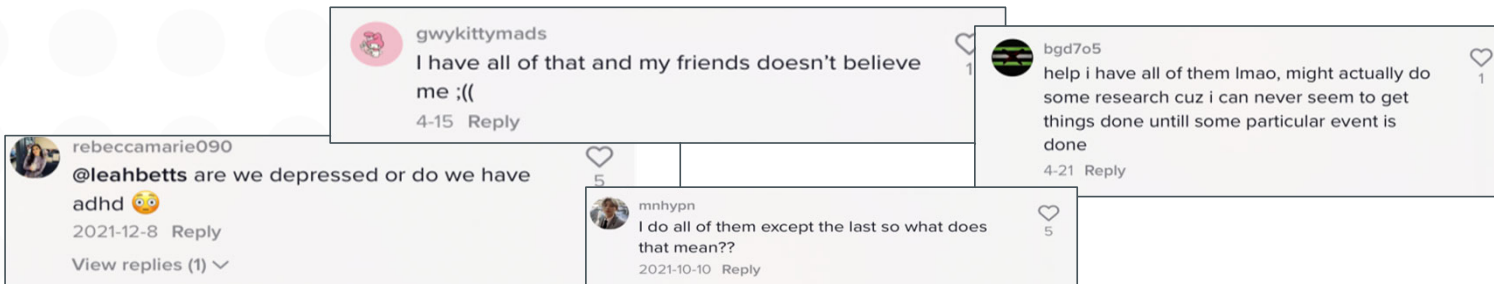
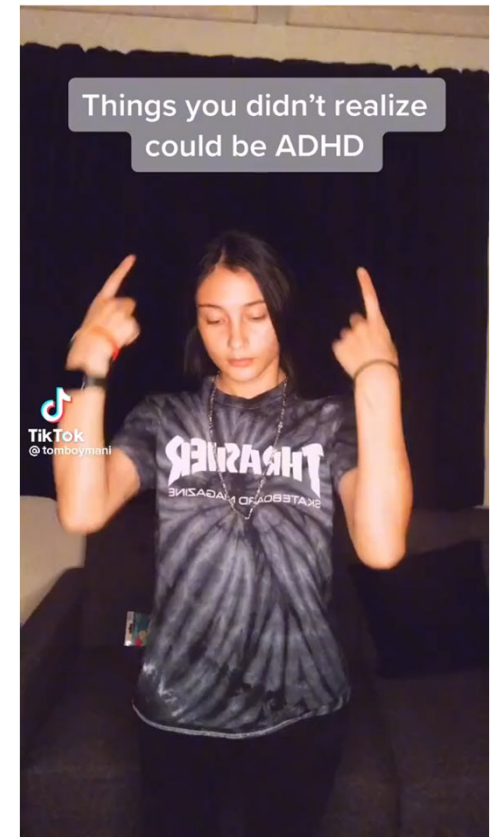
### **FALSE.**

- There is no evidence that stimulant medications contribute to drug use later in life.
- On the contrary, stimulant medications have been shown to decrease the risk of SUD later in life, and untreated ADHD puts you at higher risk for developing drug and alcohol use disorders.

# ADHD and Social Media

**Social media platforms such as TikTok, Instagram, and Facebook contain an abundance of misleading information about ADHD.**

- The hashtag “ADHD” has over 11.5 billion views on TikTok. While these videos could bring awareness to the struggles of ADHD, many spread misinformation.
- The video to the right shows a popular TikTok creator listing behaviors of ADHD. None are DSM criteria for symptoms, and few are even related to symptoms. While some behaviors listed could be linked to mood or behavioral comorbidities of ADHD, this misrepresentation of the disorder and trend of self-diagnosing is harmful.



# ADHD and Social Media

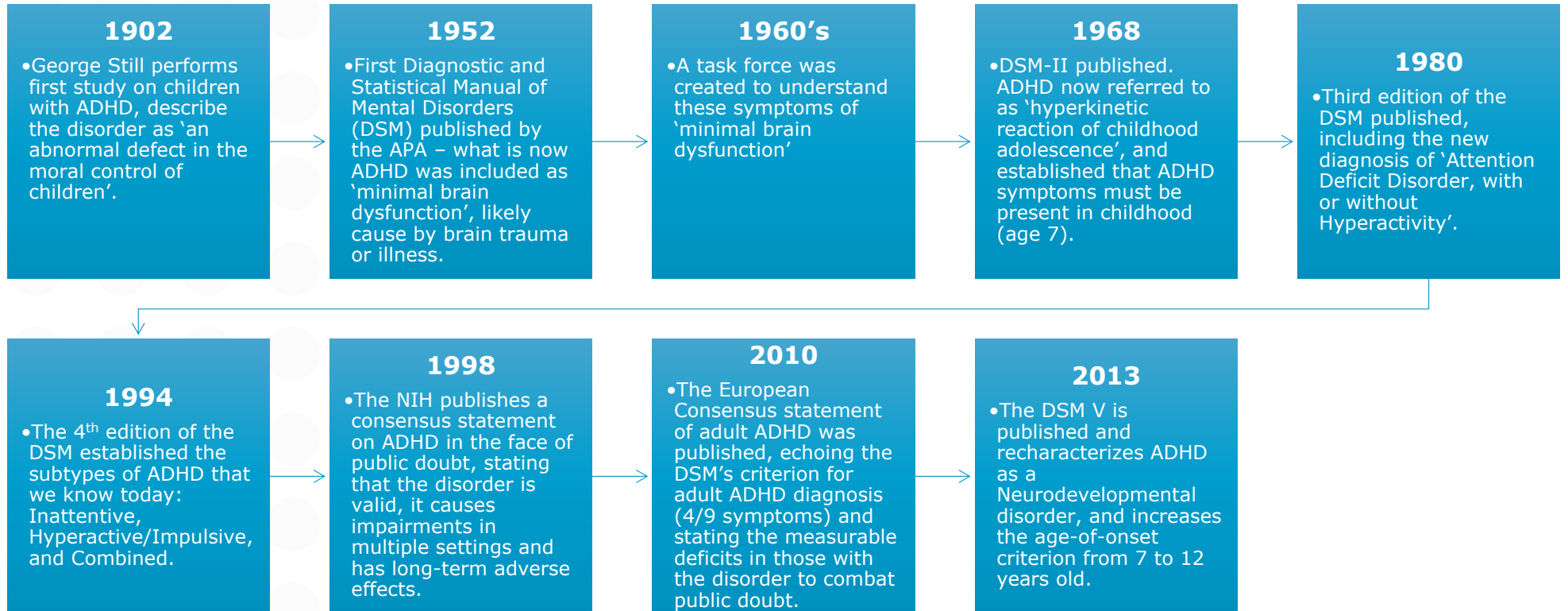
## Does social media cause ADHD?



No, *BUT* a study in 2017 shows that media multitasking and attentional problems are strongly related, with potential long-term effects in young adolescents.

- Social media has been shown to negatively effect mental and physical health and well-being, and teenagers are a very vulnerable demographic.
  - Social media is linked with depression and high risk of suicide.
  - Social media use can contribute to poor sleep – a precursor to some physical and mental health issues.
- Problematic social media use has been shown to amplify ADHD symptoms.
  - Problematic social media use is described as addiction-like behaviors, where social media takes priority over other activities, and conflicts with others arise because of social media use.
- Everyone is affected differently by outside influences, including social media.
  - For some, social media increases feelings of social connection, which is very important to development.

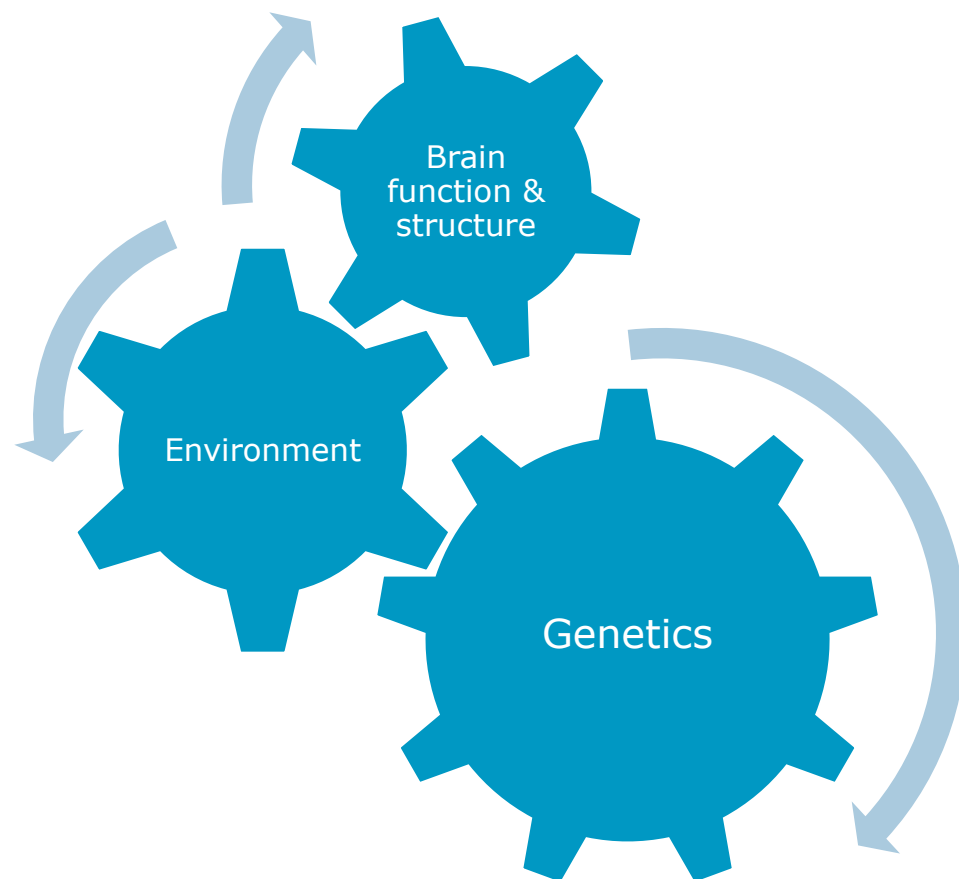
# Historical Review of ADHD



Leahy, L.G. (2017), Mahone, E.M., & Denckla M.B. (2017).

## Today's view of ADHD

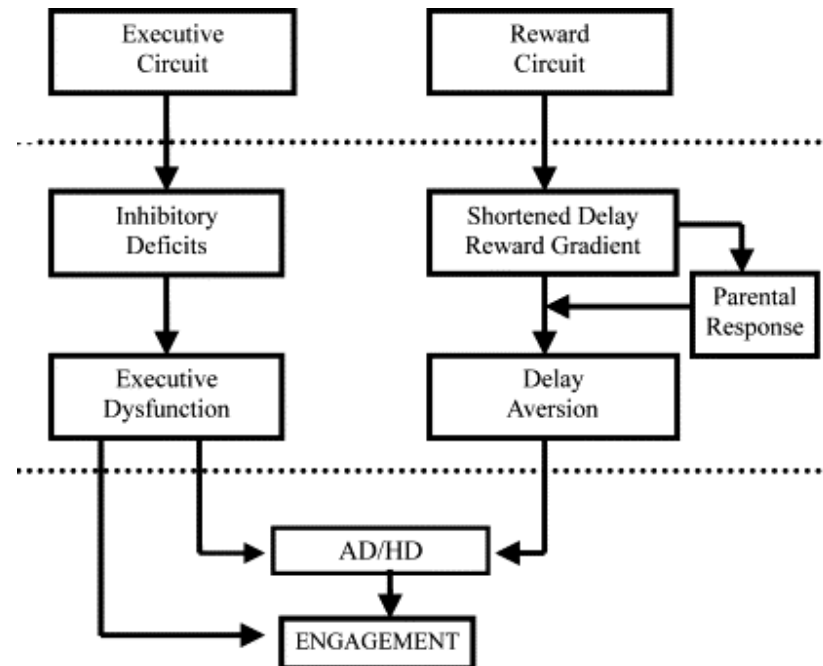
**Now, we have a better understanding of ADHD, but are still figuring things out.**



# Example Neurocognitive ADHD Model: Dual Pathways

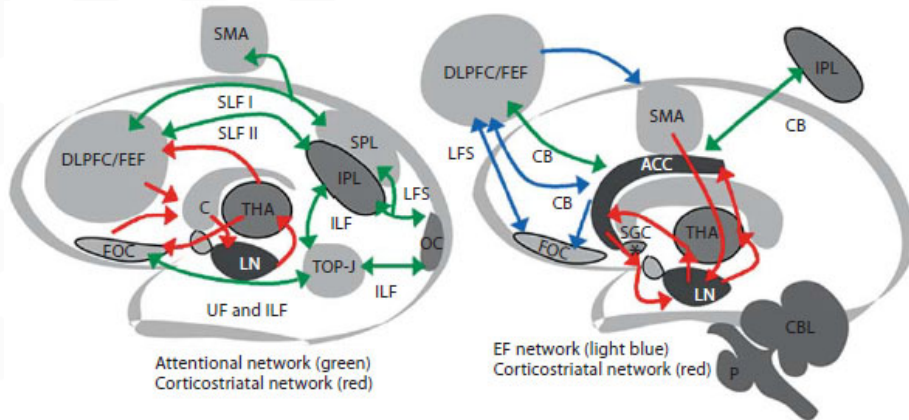
**Executive Circuit:** One putative pathway is associated with *executive dysfunction*. This refers to a variety of affected thought and action patterns, but primarily is characterized by issues with inhibitory control. For example, ADHD individuals might struggle to get started on projects.

**Reward Circuit:** Another pathway is related to *motivation* through dysfunctional delay aversion: ADHD individuals prefer small, immediate rewards over larger delayed rewards.



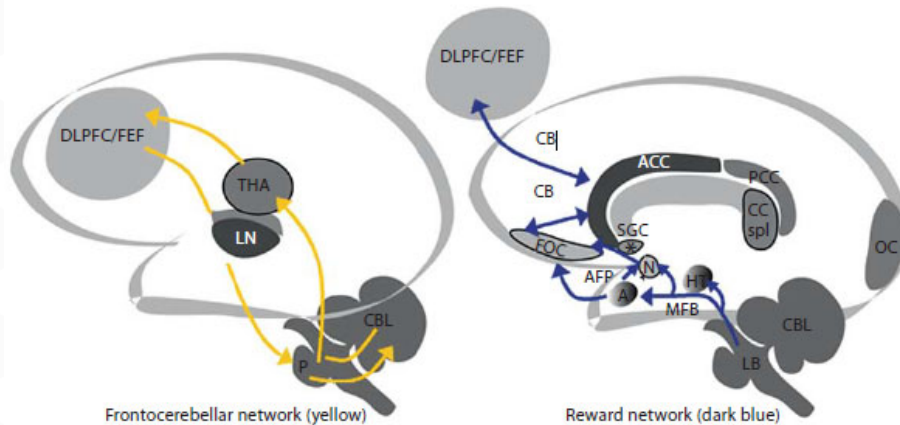
One of the dominant schemas explaining the circuitry involved in ADHD. Both pathways above use dopamine (DA).

# Heterogeneity of ADHD Brain Dysfunction – Current Views



“...some meta-analytic approaches suggest interplay of several key networks is associated with ADHD; this conclusion was not supported by the most comprehensive and unrestricted analyses.”

*Pereira-Sanchez and Castellanos 2021*



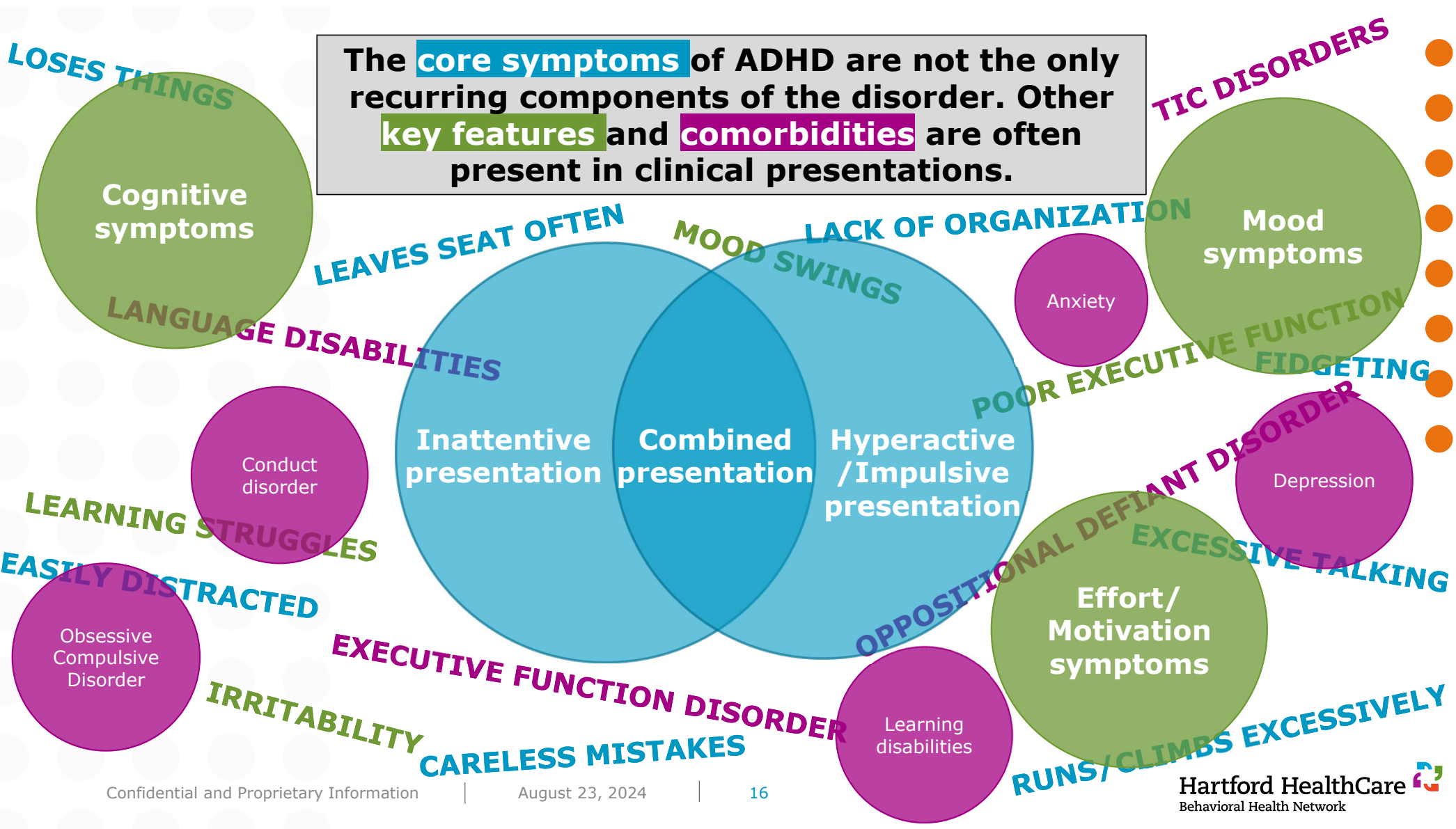
Makris et al. *Dev Neurosci* 2009

“...the literature specific to characterizing heterogeneity in ADHD based on MRI is maturing at a rapid pace. What is clear is that unique patterns in brain physiology exist in individuals with ADHD.”

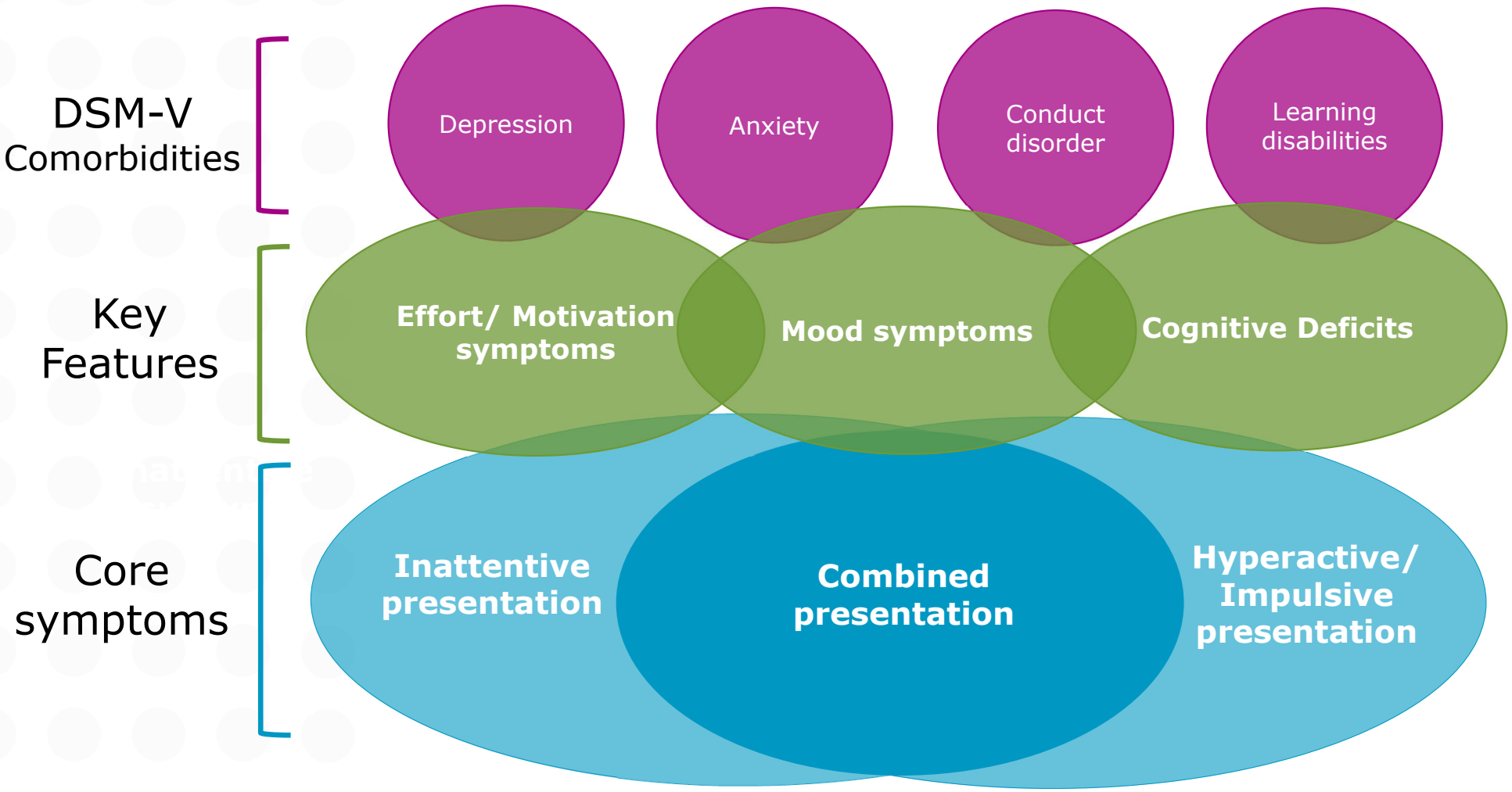
*Nigg, Karalunas, Feczko & Fair 2020*



The **core symptoms** of ADHD are not the only recurring components of the disorder. Other **key features** and **comorbidities** are often present in clinical presentations.

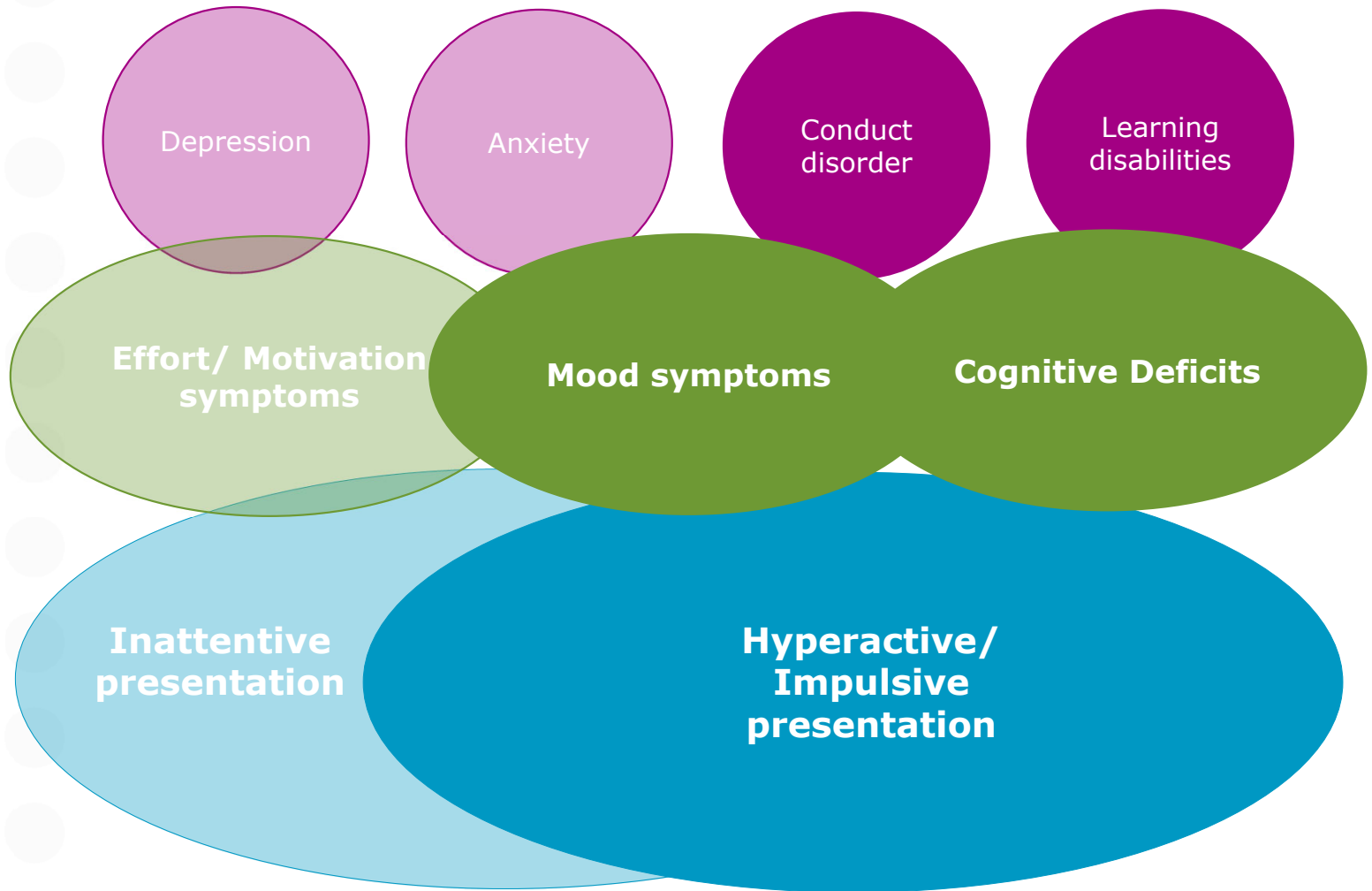






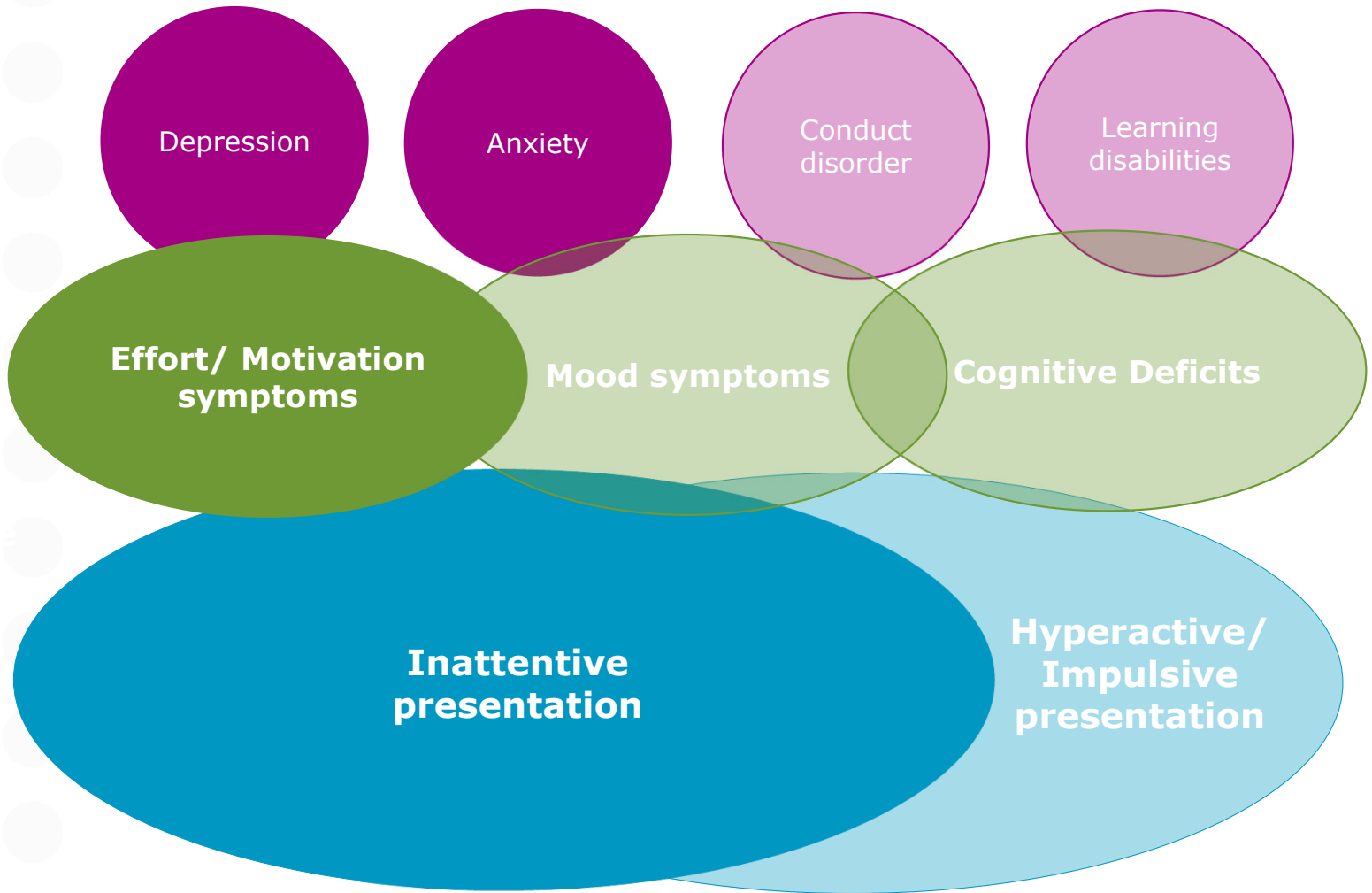


**Johnny**



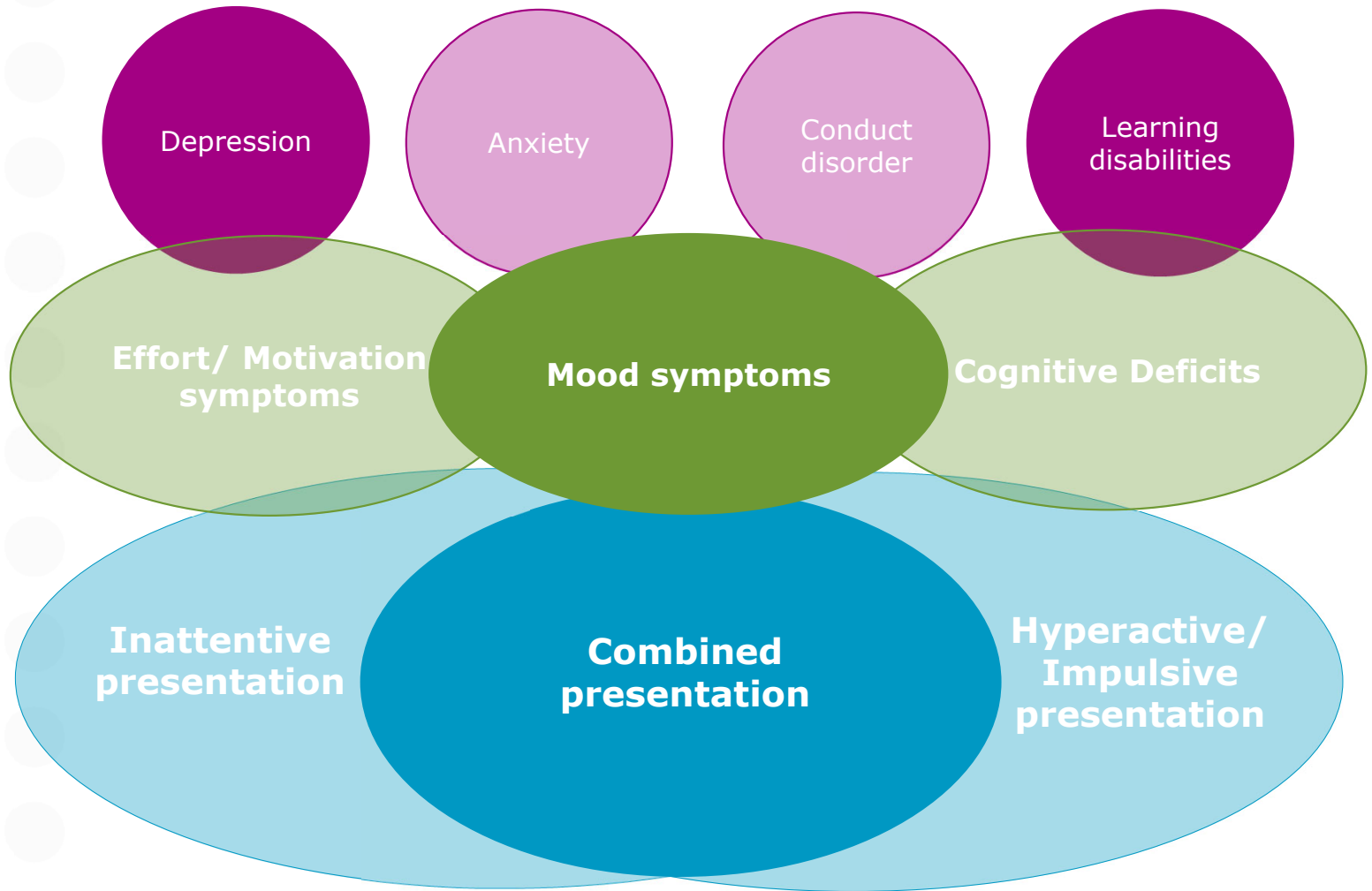


**Susie**





**Timmy**





**Ethnic/Racial Minority:** Children of African American and Latino backgrounds are less likely to have their ADHD diagnosed and to receive treatment for it.

**Health insurance:** The diagnosis process can be lengthy and expensive. Not having access to health insurance could prevent a diagnosis from happening – this disproportionately affects BIPOC and those with low SES.

## Barriers to Diagnosis

**School performance:** While many children with ADHD are impaired in their school performance, not all are. Children with ADHD who perform well in school often aren't diagnosed, despite being impaired by their ADHD in other settings.

**Classroom size:** AAP recommendations state that evidence drawn from school professionals should be integral to the diagnostic process. Teachers in overcrowded classrooms may not be able to offer comprehensive symptom evidence on a particular child.

Wolraich et al., 2019.

## Diagnosis – ADHD as a Comorbidity

Comorbid ADHD is related to problems with treatment adherence and deficits in treatment outcomes across a span of disorders. Presence of the primary disorder can delay/prevent a comorbid diagnosis of ADHD, but failure to address ADHD can be detrimental for treatment success.

- **Substance Use Disorder:** Comorbid ADHD with SUD causes substance abuse to transition much faster to dependence. SUD also lasts longer in adults with ADHD than without (*Wilens, 2004*).
- **Anxiety Disorder:** Anxious youth with comorbid ADHD have worse symptom severity, esp. attentional problems, school fears, and social competence. Also, more likely to present with sluggish cognitive tempo and poor response inhibition (*Halldorsdottir & Ollendick, 2014*).
- **Bipolar Disorder:** Comorbid ADHD is associated with earlier onset of bipolar disorder, more frequent affective episodes, suicide attempts, violence, and legal problems (*Barkley and Brown, 2008*).

A 2009 meta-analysis recommends diagnostic prioritization to first treat active alcohol/substance abuse, then severe mood disorders, then severe anxiety disorders, then ADHD. (*Goodman & Thase, 2009*).

ADHD in respondents with other disorders	%
Major depressive disorder	9.4
Dysthymia	22.6
Bipolar disorder	21.2
Any mood disorder	13.1
Generalized anxiety disorder	11.9
PTSD	13.4
Panic disorder	11.1
Agoraphobia	19.1
Specific phobia	9.4
Social phobia	14.0
Obsessive-compulsive disorder	6.5
Any anxiety disorder	9.5
Any substance use disorder	10.8

*Goodman & Thase, 2009*

# Diagnosis

There is no single test to diagnose ADHD.

**Despite ADHD being among the most well-researched disorders, definitive biomarkers for diagnosis are still evasive.**

- The closest research has gotten to date is using EEG, although it still cannot be used to diagnose. Theta-Beta frequency ratios can be used to confirm an ADHD diagnosis, but not to give an initial diagnosis nor to rule out ADHD.
- Neuropsychological testing is not sufficient to diagnose ADHD, though it is helpful in ruling out differential diagnoses.

AAP Clinical Practice Guidelines for Diagnosis

- 1) Evaluate when child age 4-18 presents with inattention, hyperactivity, impulsivity, academic underachievement, or behavior problems.
- 2) Child must meet DSM-5 criteria in more than one major setting (*see next slide*).
- 3) Evidence must come from parents/caregivers for: core symptoms, age of onset, symptom duration, & degree of impairment.
- 4) Evidence must come from school professional for: core symptoms, degree of impairment & associate conditions.
- 5) Assess for coexisting conditions using necessary diagnostic tests.

# DSM-V ADHD Symptoms

## What is the DSM-V?



The Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition (2013) is published by the American Psychological Association as a manual for diagnosing mental disorders. It is widely used by mental health professionals.

*Symptoms must have persisted for at least 6 months in multiple settings to a degree that is inconsistent with developmental level and that negatively impacts day-to-day life.*

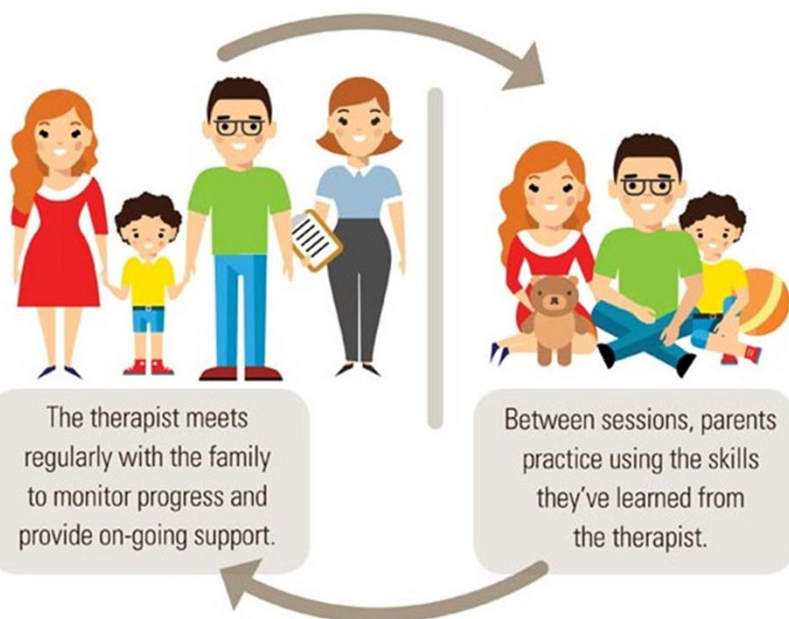
- **Inattentive** – making careless mistakes, difficulty sustaining attention, trouble listening, failure to follow through on work, difficulty organizing, reluctant to do work requiring sustained mental effort, losing things, easily distracted, forgetful in daily activities.
- **Hyperactive** – Fidgeting, leaving seat frequently, feeling restless, difficulty relaxing, feeling 'driven by a motor', excessive talking, blurting out answers, difficulty waiting turn, interrupting others.
- **Combined** – Criteria for both inattentive type *and* hyperactive type have been met.

***A diagnosis of ADHD can only be established after an extensive examination and by a trained mental health professional.***



# Best Practice Treatment - Behavioral Parent Training

Behavioral Parent Training is the **primary treatment** recommended by the AAP.



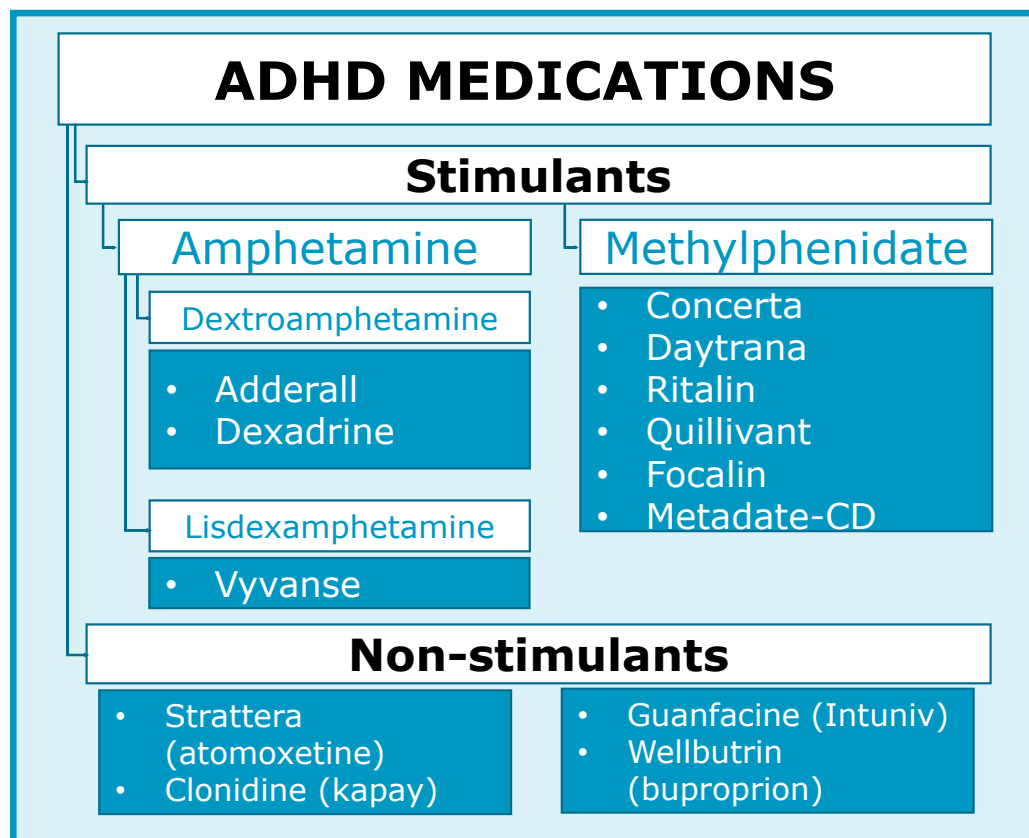
**After therapy ends, families continue to experience improved behavior and reduced stress.**

Behavioral Training  
An approach focused on learning skills to cope with ADHD symptoms at home, school, and in relationships.

# Best Practice Treatment - Medications

## Medication use predicts reduced risk for:

- Accidental injuries (9-32%)
- Motor vehicle accidents (38-58%)
- Criminality (32-41%)
- Substance Use Disorder (27-35%)
- Depression (20%)



## Treatment – Doesn't Work

### The Controversial Oligoantigenic Diet

This diet eliminates foods that caused mild antigenic response in kids with ADHD, who then saw significant ADHD symptom improvement. Critics point out that lack of exposure to certain foods can induce allergies, and that foods which exacerbate an individual's symptoms can change over time.



**Social Skills Training:** This training has a focus on reducing impulsive behaviors and improving interpersonal difficulties. *Many* studies have examined the efficacy of this approach with no success. Research shows little to no improvement in social skills by third party observers, and no relief to the impairment caused by ADHD.

**Diet:** ADHD diets have a wide range of focus, including the restriction of certain foods, elimination of additives or poly-unsaturated fatty acids, Omega-3 supplementation, etc. Most diets are not consistently effective, and when they are effective the effect size is small. While the role of diet in ADHD is not completely understood, this approach is riddled with misconceptions and can be costly to families and to a child's relationship with food.



## Promising Treatments *with medium/large effect sizes*

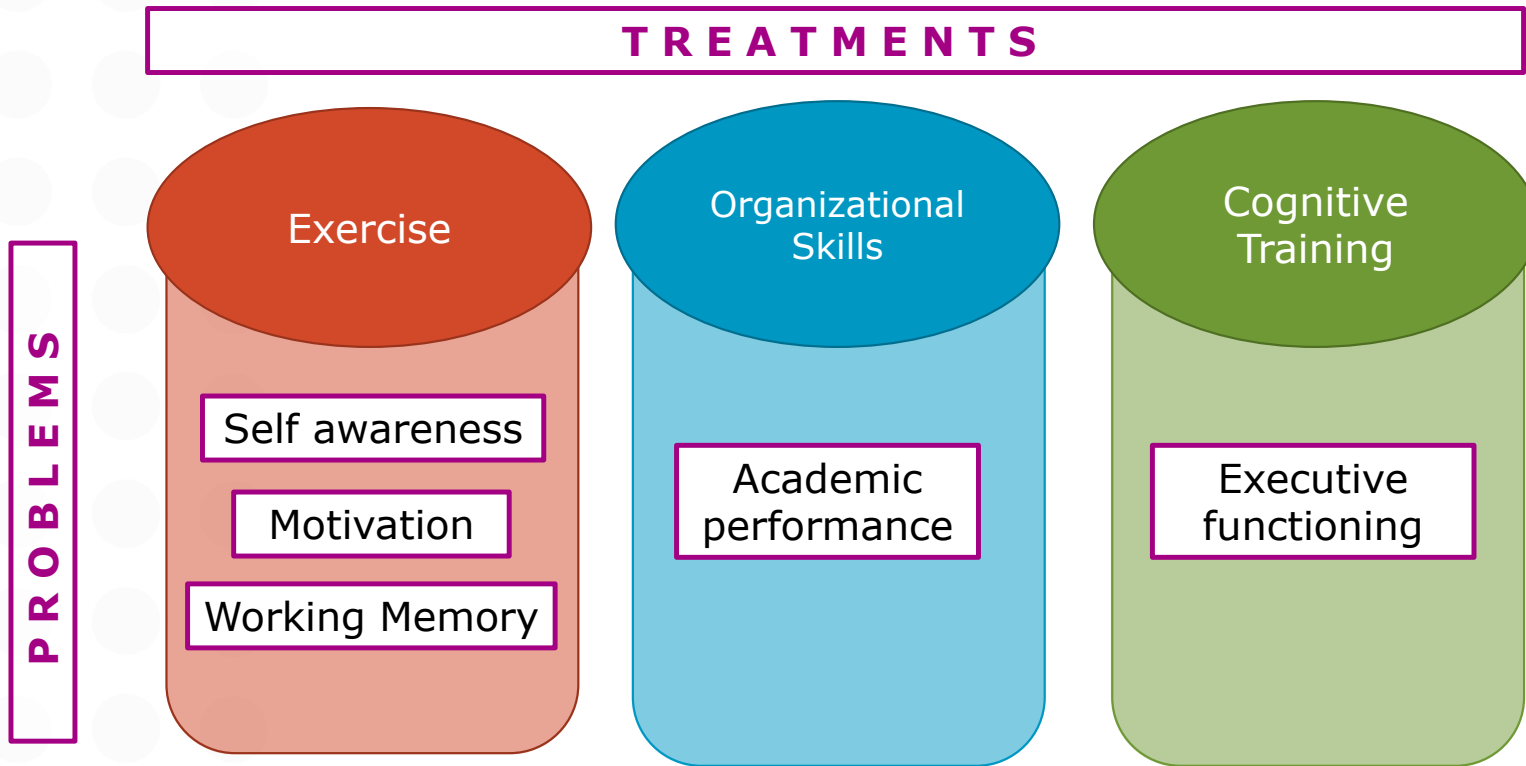
**What is an 'effect size'?**

These symptoms were all significantly affected by different treatment approaches for ADHD, and had a medium/large effect size.

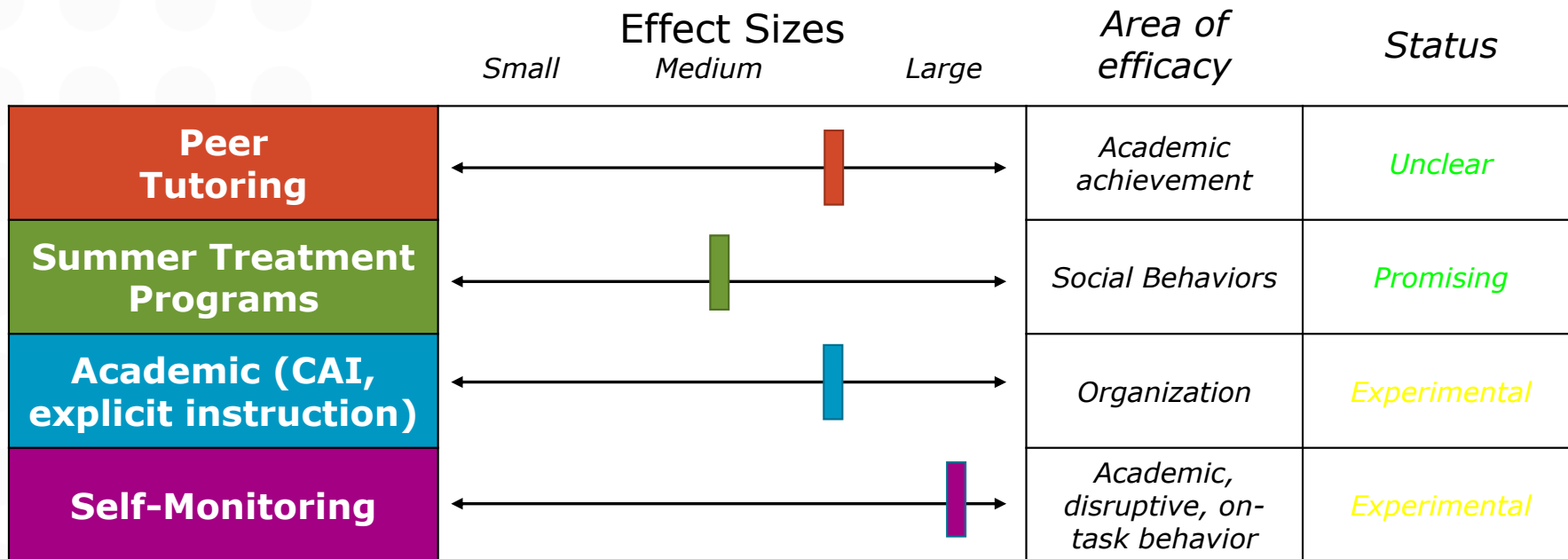
An effect size reflects the strength of the experimental effect – how meaningful is the relationship between the variables?

	Inattention	Impulsivity	Hyperactivity	Organization	Working Memory	Cognitive Flexibility
Exercise						
Cognitive Training						
Organizational skills						
Mindfulness/ Meditation						

# Promising Treatments ... *small effect sizes*



# Elementary School & Peer Based Treatments

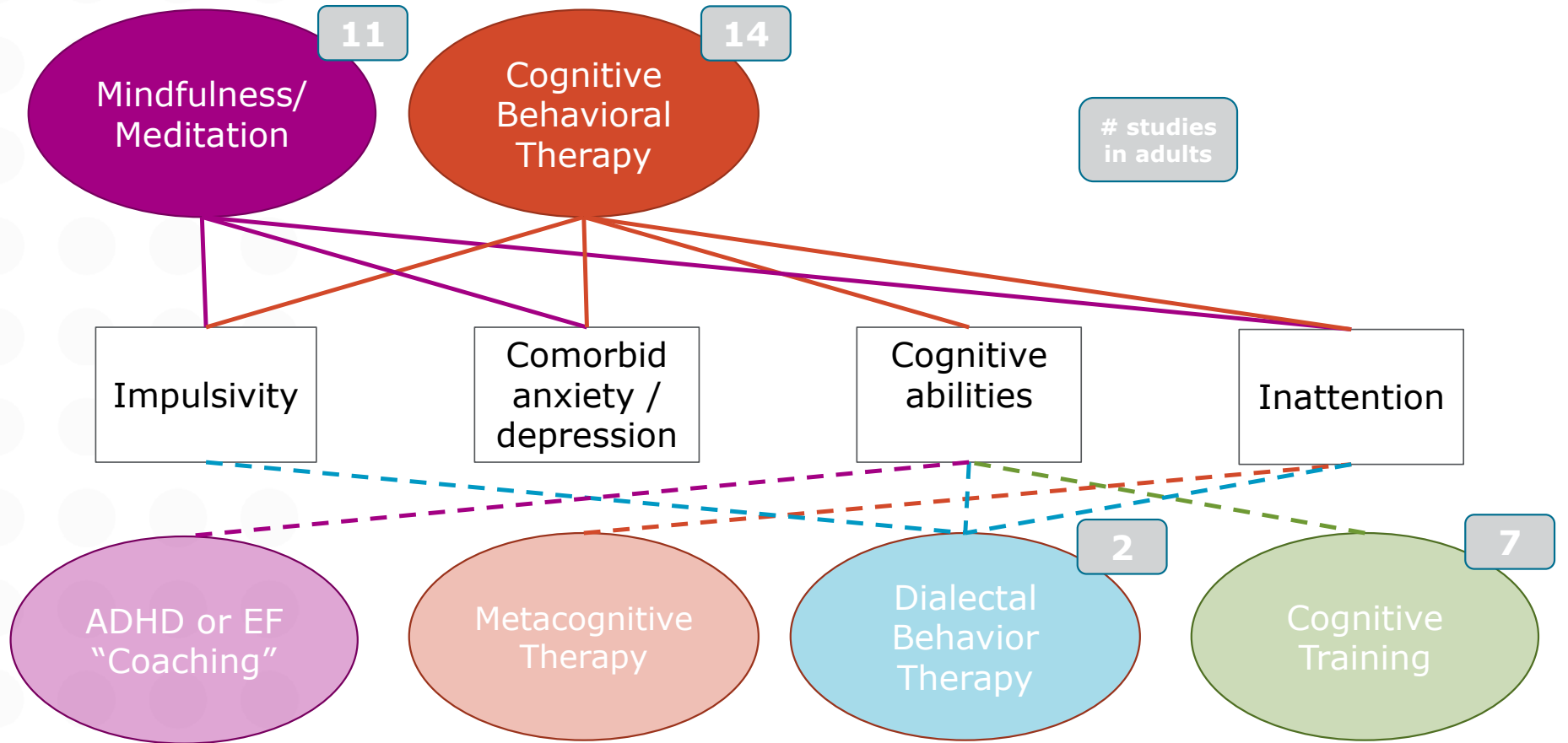


DuPaul et al. 2014, 2022

August 23, 2024

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# [Nimmo-Smith et al. 2020] Emerging Adult ADHD Evidence-Based Treatment



## Exploring New Treatments ...

# Experimental Treatments

I've heard about these!  
Why aren't these more  
widely used?

These treatments are still in the 'experimental' phase because there is a lack of standardization or clearly beneficial clinical outcomes.

If these techniques continue to prove effective as more research is done, they could achieve FDA approval and become recommended treatment options.



**Brain stimulation (rTMS, tDCS)** - This therapy targets particular regions of the brain that are shown to have abnormal activity in persons with ADHD. Using magnetic or electric stimulation approaches, these regions are activated or inhibited.

**Neurofeedback** - A type of biofeedback that encourages self-control of brain functions. *This has been examined for more than 40 years with varied results.* EEG-measured brain wave visualization provides immediate feedback to indicate when brain wave activity has met the study goals.





# Experimental Treatment – EEG Neurofeedback

**EEG-NF has been applied to ADHD for over 45 years with inconsistent findings.**

**Methodological issues.** Initially, many studies with promising results were unable to be replicated. In the last 2 decades, efforts have been made to address methodological shortcomings. Effect sizes of randomized control trials (RCTs) are only small-medium (inferior to RCT results of stimulant medications).

**Mixed results.** The majority of recent studies focused on increasing the fronto-central (Cz electrode) Theta-Beta ratio. NF outcomes are mixed – Only ~50% of ADHD patients treated with NF learn to successfully upregulate their target brain state. Need more studies with sham groups, larger sample sizes, and “responder” analyses.

**The attraction of long-lasting effects with few side effects continues to drive neurofeedback therapy investigation.**

**What about fMRI-NF and fNIRS-NF?**

There has been minimal exploration of these other NF technologies. With the research still in its infancy, nothing is known on optimal procedures.

# OUR RESEARCH

## at the Clinical Neuroscience and Development Lab

### ADHD Reward fMRI Study

Related to the idea that there might be multiple pathways to an ADHD diagnosis, we are examining reward behaviors in ADHD. Based on promising outcomes from our pilot study, we are investigating the identification of different cognitive profiles or “biotypes” of ADHD.

**This study is admitting teens with ADHD.**

#### **Informed Consent Call**

Via zoom, review study procedures with the family and answer any questions. Forms are signed to complete enrollment.

#### **Diagnostic Interviews**

Via zoom, separate interviews are conducted with the parent and the child to confirm ADHD diagnosis and get to know each participant.

#### **Visit 1: MRI & Cognitive Testing**

4 hours total. Participants complete questionnaires, neuropsychiatric testing, and fMRI scan.

#### **Visit 2: Reward Battery**

4 hours total. Participants complete a battery of various evidence-based neurocognitive computer tasks that measure different aspects of the brains reward system

#### **Key Participation Points:**

- **Ages 13-18**
- **No medications other than for ADHD (short-acting ADHD medications only)**
- **No comorbid psychotic disorders**
- **No brain abnormalities**
- **No metallic objects in body**

**Compensation: \$20/hr + BONUS Payments**

# OUR RESEARCH

## at the Clinical Neuroscience and Development Lab

### ADHD Executive Working Memory Clinical Trial

It is known that ADHD individuals struggle with executive functions, including *executive working memory*. We are exploring a new, drug-free treatment that involves virtually training the brain's executive working memory abilities. We hope to see changes in the superior frontal sulcus and dorsolateral prefrontal cortex alongside a reduction in ADHD symptoms. **This clinical trial is admitting teens both with and without ADHD.**

#### Informed Consent Call

Via zoom, review study procedures with the family and answer any questions. Forms are signed to complete enrollment.

#### Diagnostic Interview

Via zoom, separate interviews are conducted with the parent and the child to confirm ADHD diagnosis / lack of and get to know each participant.

#### 1<sup>st</sup> Visit

6 hours in-person are spent completing questionnaires, neuropsychiatric testing, and fMRI scan. Another 1.5 hours are spent on Zoom, virtually completing computer games.

#### 5-week Intervention \*ADHD ONLY\*

Participants complete 20 virtual brain training sessions. Each session lasts 30 minutes on zoom with a coach.

#### 2<sup>nd</sup> In-Person Visit

Participants complete the same procedures from their first visit – 6 hours in person, and another 1.5 hours at home for the virtual computer games.

#### 3 month follow-up \*ADHD ONLY\*

Participants complete surveys and another 1.5 hour session of virtual computer games. Families are debriefed regarding treatment group.

# Hartford HealthCare

## Behavioral Health Network



For more information about ADHD research opportunities, contact Julie Reid: 860-545-7788  
[Julie.reid@hhchealth.org](mailto:Julie.reid@hhchealth.org)

# Citations

## If you have ADHD, you...

- Ruiz-Goikoetxea, M., Cortese, S., Aznarez-Sanado, M., Magallón, S., Zallo, N. A., Luis, E. O., ... & Arrondo, G. (2018). Risk of unintentional injuries in children and adolescents with ADHD and the impact of ADHD medications: a systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 84, 63-71.
- Curry, A. E., Yerys, B. E., Metzger, K. B., Carey, M. E., & Power, T. J. (2019). Traffic crashes, violations, and suspensions among young drivers with ADHD. *Pediatrics*, 143(6).
- Young, S., & Cocallis, K. (2021). ADHD and offending. *Journal of neural transmission (Vienna, Austria : 1996)*, 128(7), 1009-1019. <https://doi.org/10.1007/s00702-021-02308-0>
- Lee, S. S., Humphreys, K. L., Flory, K., Liu, R., & Glass, K. (2011). Prospective association of childhood attention-deficit/hyperactivity disorder (ADHD) and substance use and abuse/dependence: a meta-analytic review. *Clinical psychology review*, 31(3), 328-341.
- Pelham III, W. E., Page, T. F., Altszuler, A. R., Gnagy, E. M., Molina, B. S., & Pelham Jr, W. E. (2020). The long-term financial outcome of children diagnosed with ADHD. *Journal of consulting and clinical psychology*, 88(2), 160.
- Gudjonsson, G. H., Sigurdsson, J. F., Eyjolfsson, G. A., Smari, J., & Young, S. (2009). The relationship between satisfaction with life, ADHD symptoms, and associated problems among university students. *Journal of attention disorders*, 12(6), 507-515. <https://doi.org/10.1177/1087054708323018>
- Giupponi, G., Giordano, G., Maniscalco, I., Erbuto, D., Berardelli, I., Conca, A., Lester, D., Girardi, P., & Pompili, M. (2018). Suicide risk in attention-deficit/hyperactivity disorder. *Psychiatria Danubina*, 30(1), 2-10. <https://doi.org/10.24869/psyd.2018.2>
- Doshi, J. A., Hodgkins, P., Kahle, J., Sikirica, V., Cangelosi, M. J., Setyawan, J., Erder, M. H., & Neumann, P. J. (2012). Economic impact of childhood and adult attention-deficit/hyperactivity disorder in the United States. *Journal of the American Academy of Child and Adolescent Psychiatry*, 51(10), 990-1002.e2. <https://doi.org/10.1016/j.jaac.2012.07.008>
- Schein, J., Adler, L. A., Childress, A., Cloutier, M., Gagnon-Sanschagrín, P., Davidson, M., ... & Lefebvre, P. (2022). Economic burden of attention-deficit/hyperactivity disorder among children and adolescents in the United States: a societal perspective. *Journal of Medical Economics*, 25(1), 193-205.

## Misconceptions – public

- Farsad-Naeimi, A., Asjodi, F., Omidian, M., Askari, M., Nouri, M., Beatriz Pizarro, A., & Daneshzad, E. (2020). Sugar consumption, sugar sweetened beverages and Attention Deficit Hyperactivity Disorder: A systematic review and meta-analysis. *Complementary Therapies in Medicine*, 53.
- Wolraich, M. L., Wilson, D. B., & White, J. W. (1995). The Effect of Sugar on Behavior or Cognition in Children. *Journal of the American Medical Association*, 1617-1621. doi:doi:10.1001/jama.1995.03530200053037
- Katusic, S. K., Barbaresi, W. J., Colligan, R. C., Weaver, A. L., Leibson, C. L., & Jacobsen, S. J. (2005). Psychostimulant treatment and risk for substance abuse among young adults with a history of attention-deficit/hyperactivity disorder: a population-based, birth cohort study. *Journal of child and adolescent psychopharmacology*, 15(5), 764-776. <https://doi.org/10.1089/cap.2005.15.764>

## Historical Review slide

- Leahy, L. G. (2017). *Attention-Deficit/Hyperactivity Disorder: A Historical Review (1775 to Present)*. *Journal of Psychosocial Nursing and Mental Health Services*, 55(9), 10–16. doi:10.3928/02793695-20170818-08
- Mahone, E. M., & Denckla, M. B. (2017). Attention-Deficit/Hyperactivity Disorder: A Historical Neuropsychological Perspective. *Journal of the International Neuropsychological Society : JINS*, 23(9-10), 916–929. <https://doi.org/10.1017/S1355617717000807>

## Dual Pathway Model

- Sonuga-Barke, E. J. (2003). The dual pathway model of AD/HD: an elaboration of neuro-developmental characteristics. *Neuroscience & biobehavioral reviews*, 27(7), 593-604.

## Core symptoms and features of ADHD

- Reale, L., Bartoli, B., Cartabia, M., Zanetti, M., Costantino, M. A., ... Bonati, M. (2017). *Comorbidity prevalence and treatment outcome in children and adolescents with ADHD*. *European Child & Adolescent Psychiatry*, 26(12), 1443–1457. doi:10.1007/s00787-017-1005-z
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.).
- Silver, L., MD. (2022, August 12). *When It's Not Just ADHD: Symptoms of Comorbid Conditions*. ADDitude. <https://www.additudemag.com/when-its-not-just-adhd>

## Diagnosis-A Multistep Process

- Wolraich, M. L., Hagan, J. F., Allan, C., Chan, E., Davison, D., Earls, M., ... & Zurhellen, W. (2019). Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics*, 144(4).

## Diagnosis – Biological Markers

- Miranda, P., Cox, C. D., Alexander, M., Danev, S., & Lakey, J. R. (2020). In quest of pathognomonic/endophenotypic markers of Attention Deficit Hyperactivity Disorder (ADHD): Potential of EEG-based frequency analysis and ERPs to better detect, prevent and manage ADHD. *Medical Devices: Evidence and Research*, 115-137.
- Stevens, M. C., Pearson, G. D., Calhoun, V. D., & Bessette, K. L. (2018). Functional Neuroimaging Evidence for Distinct Neurobiological Pathways in Attention-Deficit/Hyperactivity Disorder. *Biological psychiatry. Cognitive neuroscience and neuroimaging*, 3(8), 675–685. <https://doi.org/10.1016/j.bpsc.2017.09.005>
- Gloss, D., Varma, J. K., Pringsheim, T., & Nuwer, M. R. (2016). Practice advisory: The utility of EEG theta/beta power ratio in ADHD diagnosis: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. *Neurology*, 87(22), 2375–2379. <https://doi.org/10.1212/WNL.0000000000003265>
- Kiiski, H., Bennett, M., Rueda-Delgado, L. M., Farina, F. R., Knight, R., Boyle, R., ... & Whelan, R. (2020). EEG spectral power, but not theta/beta ratio, is a neuromarker for adult ADHD. *European Journal of Neuroscience*, 51(10), 2095-2109.
- Slater, J., Joobar, R., Koborsy, B. L., Mitchell, S., Sahlas, E., & Palmer, C. (2022). Can electroencephalography (EEG) identify ADHD subtypes? A systematic review. *Neuroscience & Biobehavioral Reviews*, 104752.

## Barriers to Diagnosis

- Wolraich, M. L., Hagan, J. F., Allan, C., Chan, E., Davison, D., Earls, M., ... & Zurhellen, W. (2019). Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics*, 144(4).

## Diagnosis – Comorbidities

- Barkley, R. A., & Brown, T. E. (2008). *Unrecognized Attention-Deficit/Hyperactivity Disorder in Adults Presenting with Other Psychiatric Disorders*. *CNS Spectrums*, 13(11), 977–984. doi:10.1017/s1092852900014036
- Goodman, D. W., & Thase, M. E. (2009). *Recognizing ADHD in Adults with Comorbid Mood Disorders: Implications for Identification and Management*. *Postgraduate Medicine*, 121(5), 31–41. doi:10.3810/pgm.2009.09.2049
- Halldorsdottir, T., & Ollendick, T. H. (2014). *Comorbid ADHD: Implications for the Treatment of Anxiety Disorders in Children and Adolescents*. *Cognitive and Behavioral Practice*, 21(3), 310–322. doi:10.1016/j.cbpra.2013.08.003

## Treatment – Best Practice

- Chang, Z., Ghirardi, L., Quinn, P. D., Asherson, P., D'Onofrio, B. M., & Larsson, H. (2019). Risks and Benefits of Attention-Deficit/Hyperactivity Disorder Medication on Behavioral and Neuropsychiatric Outcomes: A Qualitative Review of Pharmacoepidemiology Studies Using Linked Prescription Databases. *Biological psychiatry*, 86(5), 335–343. <https://doi.org/10.1016/j.biopsych.2019.04.009>
- *Parent Training in Behavior Management for ADHD*. (2022, August 9). Center for Disease Control. <https://www.cdc.gov/ncbddd/adhd/behavior-therapy.html>
- Wolraich, M. L., Chan, E., Froehlich, T., Lynch, R. L., Bax, A., Redwine, S. T., ... & Hagan, J. F. (2019). ADHD diagnosis and treatment guidelines: a historical perspective. *Pediatrics*, 144(4).

## Treatment – Doesn't Work

- Storebø, O. J., Elmose, A. M., Skoog, M., Joost, H. S., Simonsen, E., Pedersen, N., Tendal, B., Callesen, H. E., Faltinsen, E., Gluud, C. Social skills training for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years. *Cochrane Database of Systematic Reviews* 2019, Issue 6. Art. No.: CD008223. DOI: 10.1002/14651858.CD008223.pub3.
- Pelsser, L. M., Frankena, K., Toorman, J., & Rodrigues Pereira, R. (2017). Diet and ADHD, Reviewing the Evidence: A Systematic Review of Meta-Analyses of Double-Blind Placebo-Controlled Trials Evaluating the Efficacy of Diet Interventions on the Behavior of Children with ADHD. *PloS one*, 12(1), e0169277.
- Heilskov Rytter, M. J., Andersen, L. B. B., Houmann, T., Bilenberg, N., Hvolby, A., Mølgaard, C., ... & Lauritzen, L. (2015). Diet in the treatment of ADHD in children—A systematic review of the literature. *Nordic journal of psychiatry*, 69(1), 1-18.
- Dölp, A., Schneider-Momm, K., Heiser, P., Clement, C., Rauh, R., Clement, H. W., ... & Fleischhaker, C. (2020). Oligoantigenic diet improves children's adhd rating scale scores reliably in added video-rating. *Frontiers in Psychiatry*, 11, 730.

## Treatment – Promising

- Cortese, S., Ferrin, M., Brandeis, D., Buitelaar, J., Daley, D., Dittmann, R. W., Holtmann, M., Santosh, P., Stevenson, J., Stringaris, A., Zuddas, A., Sonuga-Barke, E. J., & European ADHD Guidelines Group (EAGG) (2015). Cognitive training for attention-deficit/hyperactivity disorder: meta-analysis of clinical and neuropsychological outcomes from randomized controlled trials. *Journal of the American Academy of Child and Adolescent Psychiatry*, 54(3), 164–174. <https://doi.org/10.1016/j.jaac.2014.12.010>
- Liang, X., Li, R., Wong, S. H. S., Sum, R. K. W., & Sit, C. H. P. (2021). The impact of exercise interventions concerning executive functions of children and adolescents with attention-deficit/hyperactive disorder: a systematic review and meta-analysis. *The international journal of behavioral nutrition and physical activity*, 18(1), 68. <https://doi.org/10.1186/s12966-021-01135-6>
- Bikic, A., Reichow, B., McCauley, S. A., Ibrahim, K., & Sukhodolsky, D. G. (2017). Meta-analysis of organizational skills interventions for children and adolescents with Attention-Deficit/Hyperactivity Disorder. *Clinical psychology review*, 52, 108–123. <https://doi.org/10.1016/j.cpr.2016.12.004>
- Xue, J., Zhang, Y., & Huang, Y. (2019). A meta-analytic investigation of the impact of mindfulness-based interventions on ADHD symptoms. *Medicine*, 98(23), e15957. <https://doi.org/10.1097/MD.00000000000015957>
- Cerrillo-Urbina, A. J., García-Hermoso, A., Sánchez-López, M., Pardo-Guijarro, M. J., Santos Gómez, J. L., & Martínez-Vizcaíno, V. (2015). The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and meta-analysis of randomized control trials. *Child: care, health and development*, 41(6), 779–788. <https://doi.org/10.1111/cch.12255>

## Treatment – Promising (continued)

- Che, X., Jong-Hwan, C., Shang, X. (2021). Comparative Efficacy and Acceptability of Nonpharmacotherapy in the Treatment of Inattention for ADHD: A Network Meta-Analysis. *Complexity*, 2021, 9435262. <https://doi.org/10.1155/2021/9435262>
- Liang, X., Li, R., Wong, S.H.S., Sum, R.K.W., Sit, C.H.P. (2021). The impact of exercise interventions concerning executive functions of children and adolescents with attention-deficit/hyperactive disorder: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity* 18(68).
- Cerrillo-Urbina, A.J., Garcia-Hermoso, E., Sanchez-Lopez, M., Pardo-Guijarro, M.J., Santos Gomez, J.L., Martinez-Vizcaino, V. (2015). The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and meta-analysis of randomized control trials. *Epub*, 41(6):779-88. doi: 10.1111/cch.12255.
- Bikic, A., Reichow, B., McCauley, S. A., Ibrahim, K., & Sukhodolsky, D. G. (2017). Meta-analysis of organizational skills interventions for children and adolescents with Attention-Deficit/Hyperactivity Disorder. *Clinical psychology review*, 52, 108-123.
- Che, X., Jong-Hwan, C., & Shang, X. (2021). Comparative efficacy and acceptability of nonpharmacotherapy in the treatment of inattention for ADHD: A network meta-analysis. *Complexity*, 2021.
- Xue, J., Zhang, Y., & Huang, Y. (2019). A meta-analytic investigation of the impact of mindfulness-based interventions on ADHD symptoms. *Medicine*, 98(23), e15957. <https://doi.org/10.1097/MD.00000000000015957>
- Karch, D., Albers, L., Renner, G., Lichtenauer, N., & von Kries, R. (2013). The efficacy of cognitive training programs in children and adolescents: a meta-analysis. *Deutsches Arzteblatt international*, 110(39), 643–652. <https://doi.org/10.3238/arztebl.2013.0643>

## Treatment: Experimental

- Miranda, P., Cox, C. D., Alexander, M., Danev, S., & Lakey, J. (2020). In Quest of Pathognomonic/Endophenotypic Markers of Attention Deficit Hyperactivity Disorder (ADHD): Potential of EEG-Based Frequency Analysis and ERPs to Better Detect, Prevent and Manage ADHD. *Medical devices (Auckland, N.Z.)*, 13, 115–137. <https://doi.org/10.2147/MDER.S241205>
- Stevens, M. C., Pearlson, G. D., Calhoun, V. D., & Bessette, K. L. (2018). Functional Neuroimaging Evidence for Distinct Neurobiological Pathways in Attention-Deficit/Hyperactivity Disorder. *Biological psychiatry. Cognitive neuroscience and neuroimaging*, 3(8), 675–685. <https://doi.org/10.1016/j.bpsc.2017.09.005>

## Experimental Treatment: Brain Stimulation

- Westwood SJ, Radua J, Rubia K. Noninvasive brain stimulation in children and adults with attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *J Psychiatry Neurosci*. 2021;46(1):E14-E33. Published 2021 Jan 4. doi:10.1503/jpn.190179
- Rubia K, Westwood S, Aggensteiner PM, Brandeis D. Neurotherapeutics for Attention Deficit/Hyperactivity Disorder (ADHD): A Review. *Cells*. 2021;10(8):2156. Published 2021 Aug 21. doi:10.3390/cells10082156

## Experimental Treatment: EEG Neurofeedback

- Rubia K, Westwood S, Aggensteiner PM, Brandeis D. Neurotherapeutics for Attention Deficit/Hyperactivity Disorder (ADHD): A Review. *Cells*. 2021;10(8):2156. Published 2021 Aug 21. doi:10.3390/cells10082156
- Lofthouse, N., Arnold, L. E., Hersch, S., Hurt, E., & DeBeus, R. (2012). A Review of Neurofeedback Treatment for Pediatric ADHD. *Journal of Attention Disorders*, 16(5), 351–372. <https://doi.org/10.1177/1087054711427530>