WHAT THE ADHD BRAIN WANTS---AND WHY

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Our understanding of the neurological bases of ADHD is in its infancy. This overview is a simplification of numerous theories that endeavor to explain an exceptionally complex condition.

All brains need to be aroused in order to function well. Optimal arousal enables brains to be alert, receptive and, hence, ready to attend and learn. Generally, non-ADHD brains are aroused by the shifting internal and external stimulation of daily life. Regardless of fluctuations in stimulation, those brains can power through, remaining alert and attentive, fueled by adequate neurotransmitters. These chemicals facilitate communication between neurons, and the resulting coordination of neurotransmitters allows brains to be aroused. When brains function well, they can work toward goals: the executive functions are choreographed to assess situations using current and past data and fine-tune responses without being overwhelmed by emotions or sensations.

ADHD brains do not adapt as easily. Lower levels of dopamine and norepinephrine in ADHD brains make finding and maintaining the necessary stimulation a challenge. Very often, the stimulation offered by mundane tasks can't compete with that of highly stimulating experiences. As a result, ADHD brains are always scanning the environment for 'hi-stim'. So, ADHD brains <u>are</u> highly motivated--to find that unique balance of stimulation that enables optimal arousal. Concerns about time or consequences are dwarfed by this urgent mission, which trumps all other goals. The hunt may distract ADHD brains from important stimuli that require their attention. Indeed, the owners of these brains are often ambushed by new situations and abruptly react without a thorough assessment. This compromises their ability to pro-actively select goal-oriented responses. These individuals are not making conscious choices to ignore relevant tasks, although it may appear that way; their brains are compelling them to do so.

For some ADHD brains, optimal arousal involves augmenting the existing stimulation—wanting things louder, faster, bigger, funnier, riskier—the more intense, the better. Boredom is a common complaint for the owners of these brains: it is a physiologically uncomfortable state in which brains are under-aroused and unable to

engage with their environment. In fact, in mundane, low-stimulation situations, ADHD brains may compel their owners to increase the intensity level with noise, laughter, chaos, or conflict, if there is no other route to high stimulation available. The more impulsive ADHD brains have their own logic: if some stimulation is good, more will be better. However, it is not that simple.

Most individuals with ADHD have difficulty modulating their stimulation level, and may suddenly find themselves in a state of over-arousal. The fun becomes too much fun, the laughter takes on a hint of hysteria, sights and sounds bombard them until they are disoriented and overwhelmed. Physiological overload may result in sudden tears, screaming, or an abrupt departure. Egged on by their brains, many individuals do not see the "crash" coming until they are emotionally or physically depleted. When their brains demand to shut down, their owners can no longer process information. They need immediate respite from the commotion, so that they can regroup without interacting, and safe from extraneous stimuli. Their sudden and total withdrawal is often a source of confusion and consternation to those around them.

Other ADHD brains can barely manage existing levels of stimulation. These brains already feel bombarded by the environment, and any excess stimulation quickly creates discomfort, frustration and irritation. Owners of hypersensitive brains tend to reduce stimulation by tuning out of group conversations and isolating themselves with a video game or movie. They may be reluctant to make plans and attend parties; they avoid department stores and loud concerts—staying where they can titrate the amount of stimulation they experience.

One of the hallmarks of ADHD is the brain's perpetual challenge to self-regulate. At any moment in time, the brain's stimulation needs vary according to internal and external demands; responses are based on the motivation and focus possible, given the neurotransmitter levels at the time. Whether ADHD brains err on the side of over-reaction or under-reaction, they rarely get the response just right. These alternate routes to the same goal explain how a high energy, outgoing, talkative, over-subscribed individual and a shy, low-energy, passive, and withdrawn individual can appear to function so differently, but both still have ADHD. These disparate presentations illustrate the inconsistent sensory perceptions that provoke some to question the phenomenon of AD/HD. Indeed, the behaviors within a given individual are consistently inconsistent.

The Dopamine Reward Center

Learning from experience is the basis for good decision-making, and the motivation to learn is reinforced by pleasurable rewards for the brain. The nucleus accumbens, located in the midbrain, has a central role in this dopamine reward circuit. Generally, in anticipation of a completed task, dopamine increases, as does the desire for reward. At the same time, a decrease in serotonin lowers satiety and inhibition. All brains have the incentive to repeat behaviors associated with re-experiencing that reward. Every behavioral reward that has been studied has been shown to amplify dopamine production, including food, sex, competition, exercise, and music. However, nicotine, caffeine, alcohol, opiates, pornography, gambling, risk-taking, reckless driving, and compulsive buying increase dopamine even more. In fact, all substances or behaviors that trigger dependencies increase the release of dopamine and reduce the impulse controlling effects of serotonin.

Dopamine-increasing behaviors are actually more gratifying to ADHD brains than to non-ADHD brains. Key aspects of the reward system are underactive in ADHD brains. The result is a biochemical inability to derive a reinforcing reward from ordinary activities. ADHD brains struggle to sustain the motivation to learn when the reward is mild or linked to long-term gratification. As a result, stimuli need to be more salient—larger, faster, more intense—to gain the brain's undivided attention; the greatest arousal follows a dopamine spike. High-risk activities that demand hyperfocus, like driving fast, downhill skiing, motorcycle riding, and waterskiing focus ADHD brains, as do high-risk jobs, like emergency medical technicians, firemen, and ER doctors.

Dopamine-deficient ADHD brains experience a surge of motivation after a high stimulation behavior triggers an increase in dopamine. But in the aftermath of that surge and reward, the return to baseline levels results in an immediate drop in motivation. ADHD brains, distracted from low-reward tasks, seek stimulation that increases dopamine more quickly and intensely. Larger, more immediate, and/or repeated rewards are needed to sustain motivation. Ultimately, the pursuit of those pleasurable rewards can become a potent form of self-medication. It helps explain the intensity of the draw of video games and sugary foods to children with ADHD, and emphasizes the addictive potential of a dopamine-deficient reward system. Again, individuals with ADHD are not consciously making those choices; their brains are.

Many of the impulsive behaviors that stimulate the reward center reflect the impaired behavior inhibition and lack of planning typical of ADHD. Food is a necessary and ubiquitous substance that activates the dopamine reward center; as such, it can be a self-regulation challenge for those with ADHD. The low levels of dopamine in ADHD brains interfere with focused self-regulation, increasing the likelihood that ADHD individuals will be inattentive to the many factors that modify eating behaviors.

ADHD brains exhibit decreased glucose metabolism compared to non-ADHD brains, resulting in less energy available to the attentional center in the prefrontal cortex. ADHD brains send out distress messages demanding more glucose and, suddenly, those with ADHD may crave carbohydrates, which quickly convert into glucose. Many chide themselves for indulging in pasta, bread, and cookies, when their brains are actually demanding those foods instead of a salad. Chocolate is especially appealing to the ADHD brain because it increases glucose and has the added stimulation from caffeine and sugar. It is no wonder that those with ADHD struggle with eating disorders; each time they self-medicate with food, their brain enjoys a surge of dopamine, an increase in glucose-based energy that improves attention, and a serotonin-based calming of restlessness. With such insidious and yet pleasurable rewards, the addictive potential surely increases.

The reticular activating system in the brainstem (RAS) is responsible for arousal, as well as for the sleep/wake cycle. Consequently, when the RAS is dysregulated, alertness, sleep–wake, and circadian cycles suffer. Hence, it is not surprising that ADHD very often co-occurs with circadian-based disorders, and that the symptoms of sleep deprivation, such as trouble concentrating, inattentiveness, and decreased working memory, overlap with those of ADHD. The production of the hormone melatonin is triggered by darkness, and all brains get drowsy as melatonin increases. However, engaging in well-lit activities late into the evening delays melatonin production and hence, sleepiness is delayed.

In ADHD brains, the RAS is dysregulated; circadian cycles tend to skew towards higher activity levels in the evening, resulting in later bedtimes and waking times. Many individuals with ADHD mismanage time and finally have personal time at the end of the evening. This is when they watch TV, engage with their social media, or play games on the computer. It has also been shown that the blue LED light from computer and other such screens increases brain alertness while suppressing the

normal elevation of melatonin that signals the circadian clock. As a result, ADHD brains are often flooded with both internal and external stimulation until after midnight, delaying sleep and making it difficult to be an early riser.

Understanding what ADHD brains want makes it less likely that the owners of these brains will judge their difficulties in self-regulation so harshly. ADHD behaviors are often mislabeled and misjudged by society, and there is some comfort in knowing that there are neurological explanations for responses that sometimes seem to defy logic. When the workings of the ADHD brains are better understood, the behavior of their owners becomes more comprehensible and predictable. Responses can be anticipated, and the world may feel a bit less out of control. Ideally, appreciating the extent to which ADHD brains are driven by neurology and genetics makes it much easier not to blame the owners.