Arousal and Autistic Spectrum Disorder (ASD)

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Abstract:
Arousal is a physiological and psychological state of being awake or reactive to stimuli. It involves the activation of the reticular activating system in the brain stem, the autonomic nervous system and the endocrine system, leading to increased heart rate and blood pressure and a condition of sensory alertness, mobility and readiness to respond. There are many different neural systems involved in what is collectively known as the arousal system. Four major systems originating in the brainstem, with connections extending throughout the cortex, are based on the brain's neurotransmitters, acetylcholine, norepinephrine, dopamine, and serotonin. When these systems are in action, the receiving neural areas become sensitive and responsive to incoming signals.

Arousal is not a new construct and was originally proposed as an explanatory theory for autism spectrum disorders. Two implications of this theory are that children and adults with an autism spectrum disorder (ASD) would be more reactive to sensory stimuli than the normal population, and they may be slower to habituate to stimuli. There is some laboratory evidence of differences in physiological responses of individuals with ASD compared to non-autistic controls.

Key words: arousal, performance, ASD

Rezumat:
Activarea/trezirea/excitarea este starea fiziologică și psihologică de a fi treaz sau reactiv la stimuli. Aceasta implică activarea sistemului reticular activator, sistemului nervos vegetativ și sistemului endocrin, care să conducă la creșterea ritmului cardiac și tensiunii

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arteriale, la o stare de vigilență senzorială și la mobilitatea și disponibilitatea de a răspunde.

Există numeroase și diferite sisteme neuronale implicate în ceea ce este colectiv cunoscut sub numele de sistemul de activare/trezire/excitare. Patru sisteme majore, originare din trunchiul cerebral, cu conexiuni extinse în întregul cortexul, se bazează pe neurotransmițătorii creierului: noradrenalina, acetilcolina, dopamina și serotonina.

Atunci când aceste sisteme sunt în acțiune, zonele neuronale receptoroare devin sensibile și receptive la semnalele primate.

Activarea nu este un concept nou și a fost propus inițial ca o teorie explicativă pentru tulburarea de spectrul autist. Două implicații ale acestei teorii ar fi următoarele: copiii și adulții cu o tulburare din spectrul autismului ar fi mai reactivi la stimulii senzoriai decât populația normală și ei s-ar adapta mai lent la stimuli.

**Cuvinte cheie:** activare, performanță, TSA

## INTRODUCTION

Arousal is a physiological and psychological state of being awake or reactive to stimuli. It involves the activation of the reticular activating system in the brain stem, the autonomic nervous system and the endocrine system, leading to increased heart rate and blood pressure and a condition of sensory alertness, mobility and readiness to respond (Randy J. Larsen, David M. Buss, McGraw Hill, 2008).

There are many different neural systems involved in what is collectively known as the arousal system. Four major systems originating in the brainstem, with connections extending throughout the cortex, are based on the brain's neurotransmitters, acetylcholine, norepinephrine, dopamine, and serotonin. When these systems are in action, the receiving neural areas become sensitive and responsive to incoming signals.

Arousal is important in regulating consciousness, attention, and information processing. It is crucial for motivating certain behaviours, such as mobility, the pursuit of nutrition, the fight-or-flight response and sexual activity. It is also very important in emotion, and has been included as a part of many influential theories such as the James-Lange theory of emotion.
According to Hans Eysenck, differences in baseline arousal level lead people to be either extraverts or introverts. Later research suggests it is most likely that extroverts and introverts have different arousability. Their baseline arousal level is the same, but the response to stimulation is different (Randy J. Larsen, David M. Buss, McGraw Hill, 2008).

An important discovery related to "arousal" is the Yerkes-Dodson Law (1908). According to it between "arousal" and performance is a function of dependence, represented graphically by a U-shaped curve back (figure 1).

![Figure 1. Yerkes-Dodson Law](image)

Following the experiments they showed that low or high arousal leads to a minimum performance and the average excitation results in best performance.

They showed that different activities require different thresholds of excitation. Obtaining an optimal level of efficiency of work involves the control of the excitation factors in the environment (environmental arousal), such as noise, temperature, comfort and revival of this state directly related to technical work.

**Arousal** is the central concept of reversal theory (Reversal theory - M.Apter, 1989). According to it, the same level of "arousal" (intense physiological activity) may be perceived badly or pleasant depending on the condition telic (goal-oriented, seriously) or
paratelic status (orientation towards pleasure, instant gratification, for "here and now") in which the individual is (figure 2).

**Figure 2.** Reversal theory

Most people spend time in a balanced state of activation (figure 3).

**Figure 3.** State of activation
Abnormally increased behavioural arousal: this is a state caused by withdrawal from alcohol or barbiturates, acute encephalitis, head trauma resulting in coma, partial seizures in epilepsy, metabolic disorders of electrolyte imbalance, intra-cranial space-occupying lesions, Alzheimer's disease, rabies, hemispheric lesions in stroke and multiple sclerosis (Mirr, Micheline Pheifer, 2001). Anatomically this is a disorder of the limbic system, hypothalamus, temporal lobes, amygdala and frontal lobes. It is not to be confused with mania.

**AROUSAL AND AUTISTIC SPECTRUM DISORDER (ASD)**

Arousal is not a new construct and was originally proposed as an explanatory theory for autistic spectrum disorders (Hutt, Hutt, Lee and Ounsted, 1964).

Two implications of this theory are that children and adults with an autistic spectrum disorder (ASD) would be more reactive to sensory stimuli than the normal population, and they may be slower to habituate to stimuli. There is some laboratory evidence of differences in physiological responses of individuals with ASD compared to non-autistic controls (Althaus, van Roon, Mulder, Mulder, Aarnoudse and Minderaa, 2004).

There have been studies comparing autistic children to non-autistic controls, one studying the baseline heart rates of each (Goodwin, et al., 2006), and another comparing their baseline skin conductance responses (Hirstein, et al., 2001).

These differences require replication using larger samples, although there is an intriguing possibility that there may be considerable variation in physiological reactivity of both autistic children and adults.

**Hyper- or hypo-arousal?**

Hyper-arousal is not universally accepted by all researchers. A recent review of sensory difficulties in autism concluded that the experimental evidence or hyper-arousal was at best mixed (Rogers and Ozonoff, 2005).

There are a number of problems with this view. First, ASD is a heterogeneous condition and the assumption that hyper-arousal should be a general explanatory theory of autism was too broad. Second, sensitivity to arousing stimuli may be intermittently
presenting in individuals with ASD. Third, the stimuli employed in habituation paradigms cannot easily mimic real life non-laboratory-based events. Animal research on arousal has attempted to link deficiencies to conditions such as attention-deficit hyperactivity disorder, Alzheimer's disease, and autism (Garey, Goodwillie, Frohlich, Morgan, Gustafsson, Smithies, Korach, Ogawa and Pfaff, 2003).

Historically, hypo-arousal in people with an ASD has also been proposed as a factor to specific stimuli (Rimland, 1964), although with limited laboratory evidence. Repetitive movements may serve a de-arousing function (Kinsbourne, 1980). Unusual sensory experiences have been reported in autobiographical accounts of people with an ASD (Shore, 2003).

Sensory over-activity has been explained as a possible response to hyper-arousal (Liss, Saulnier, Fein and Kinsbourne, 2006). An understanding of arousal and sensory experiences may have great explanatory significance for some forms of challenging behaviours.

**Stress and arousal**

Stress and anxiety have been proposed as factors in challenging behaviours of people with ASD (Howlin, 1998). There is a transactional model of stress that emphasizes the interaction between an individual and his or her environment. In this model, stress occurs when the demands of stressors outweigh coping responses (Lazarus and Folkman, 1984).

There is a clear interaction between environmental and physiological events. Implicit in this model is the cognitive appraisal of threat. Some individuals with an ASD have difficulties in regulating their emotional responses and even communicating this to carers (Frith, 2003). To help account for challenging behaviours, such as aggression and self-injury, arousal may mediate stress. There is a strong association between arousal and sensory experiences of people with ASD.

**Arousal curve and information processing**

The majority of individuals spend time in a state of arousal equilibrium. In the case of people with an ASD, two distinct arousal groupings have an effect on behaviour.
A group of individuals will be hyper-aroused and highly reactive to environmental sensory stimuli (Liss, Saulnier, Fein and Kinsbourne, 2006). At the opposite end of the distribution, a proportion of people are hypo-aroused.

A number of people with ASD, who present with challenging behaviours, may experience either constant or intermittent states of hyper-arousal.

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