

## **EVALUATIVE STUDY ON CONSEQUENCES OF COGNITIVE AND SENSORY OVERLOAD : A SOCIO – PSYCHOLOGICAL PERSPECTIVE**

**Prof Dr.C.Karthikeyan\***

---

**Abstract :** We are becoming negligent or neglect per se on heavy cognitive load, due to unawareness of unconsciously on the fast move towards our goals, without realising that we are closing in a mental hygiene problem, which if unattended can lead to problems. Sensory overload and heavy cognitive load can have negative effects on task completion, and it is important to note that the experience of cognitive load is not the same in everyone. The elderly, students, and children experience different, and more often higher, amounts of cognitive load. High cognitive load in the elderly has been shown to affect their center of balance. With increased distractions and cell phone use students are more prone to experiencing high cognitive load which can reduce academic success

**Key Words; Cognitive, Sensory, Overload, Stress, Exhaustion, Elderly, Adolescent Children, Extraneous**

---

**\* Director-Adithya School of Business, Adithya Institute of Technology, Coimbatore, Affiliated to Anna University, Chennai, Tamilnadu**

**Introduction; Cognitive load;** In cognitive psychology, **cognitive load** refers to the total amount of mental effort being used in the working memory. For example; When students become ‘overloaded’ with information, even the most carefully planned and useful activities can lose their effectiveness; in addition, students may become more easily frustrated. Understanding what happens to students in this ‘loaded state’ and what can cause this state is useful for teachers, both in their planning and in dealing with it when it happens in class. **John Sweller** (1980) argued that instructional design can be used to reduce cognitive load in learners. Cognitive load theory differentiates cognitive load into three types: **intrinsic, extraneous, and germane**. **Intrinsic cognitive** load is the effort associated with a specific topic. **Extraneous cognitive load** refers to the way information or tasks are presented to a learner. And, **germane cognitive load** refers to the work put into creating a permanent store of knowledge, or a schema.

**Objectives; (i) To Explore the Reasons for Cognitive Overload**

**(ii) To Explore the reasons for Sensory Overload**

**(iii) To evaluate the impact of Sensory and Cognitive Overload**

**(iv) To examine the impact on Mental Health of Children, Adults and Aged**

**Scope of the study;** Useful for making policies on Education System and reduction of overload in children and working people for better health

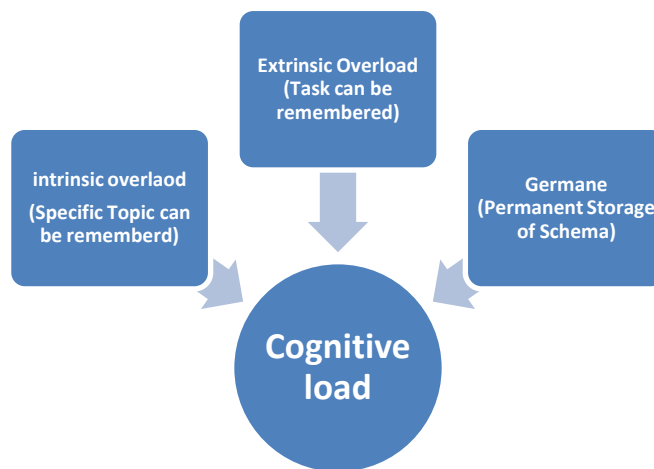
**Methodology;** Secondary Data from Review of Literature and valid sources of Non-Clinical settings.

**Data;** Secondary Data

**Research Design;** Qualitative

How it happens? Researchers **Paas and Van Merriënboer** found **Heavy cognitive load** can have negative effects on task completion, and it is important to note that the experience of cognitive load is not the same in everyone. The elderly, students, and children experience different, and more often higher, amounts of cognitive load. High cognitive load in the elderly

has been shown to affect their center of balance. With increased distractions and cell phone use students are more prone to experiencing high cognitive load which can reduce academic success. Another way to understand is like; **Cognitive capacity** is the total amount of information the brain is capable of retaining at any particular moment. This amount is finite, so we can say our total capacity is only ever 100%. How much of one's cognitive capacity is being used towards a particular task at any given time is called the **cognitive load**.



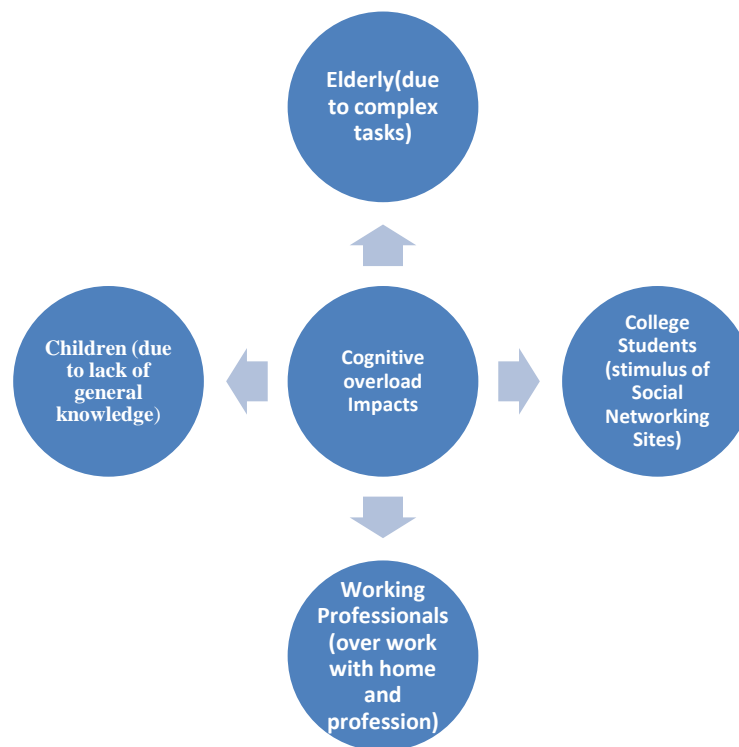
**Figure I; Cognitive load generates with three different kinds of overloading almost in every human being. Designed by Prof Dr.C.Karthikeyan**

**Theory;** The history of cognitive load theory can be traced to the beginning of Cognitive Science in the 1950s and the work of G.A. Miller. In his classic paper, Miller was perhaps the first to suggest our working memory capacity has inherent limits. His experimental results suggested that humans are generally able to hold only seven plus or minus two units of information in short-term memory. The empirical results from these studies led to the demonstration of several learning effects: the completion-problem effect; modality effect; split-attention effect; worked-example effect; and expertise reversal effect. A number of factors contribute to the cognitive load in people with lower socioeconomic status that are not present in middle and upper-class people. Identifying the processing capacity of individuals could be extremely useful in further adapting instruction (or predicting the behavior) of individuals. Accordingly, further research would clearly be desirable. First, it is essential to compute the memory load imposed by detailed analysis of the processes to be used. Second, it is essential to

ensure that individual subjects are actually using those processes. The latter requires intensive pre-training.

### Effects of heavy cognitive load

A heavy cognitive load typically creates error or some kind of interference in the task at hand. A heavy cognitive load can also increase stereotyping. Stereotyping is an extension of the Fundamental Attribution Error which also increases in frequency with heavier cognitive load. The notions of cognitive load and arousal contribute to the "Overload Hypothesis" explanation of social facilitation: in the presence of an audience, subjects tend to perform worse in subjectively complex tasks whereas they tend to excel in subjectively easy tasks. Depression or general unhappiness, Anxiety and agitation, Moodiness, irritability, or anger, Feeling overwhelmed, Loneliness and isolation, Other mental or emotional health problems.

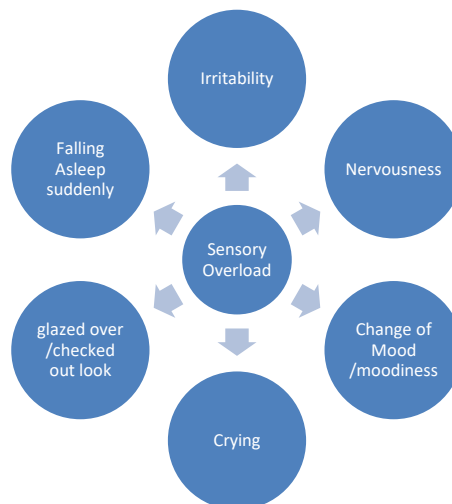


**Figure; II; Impact of Cognitive Over load to all categories of people: Designed by Prof Dr.C.Karthikeyan**

**Elderly;** Research study examined the relationship between body sway and cognitive function and their relationship during multitasking and found disturbances in balance led to a decrease in performance on the cognitive task. Heavy cognitive load can disturb balance in elderly people.

Conversely, an increasing demand for balance can increase cognitive load. **College Students;** With the use of Facebook and other social forms of communication, adding multiple tasks is hurting students performance in the classroom. Both students who were heavy Facebook users and students who sat nearby those who were heavy Facebook users performed poorly and resulted in lower GPA.

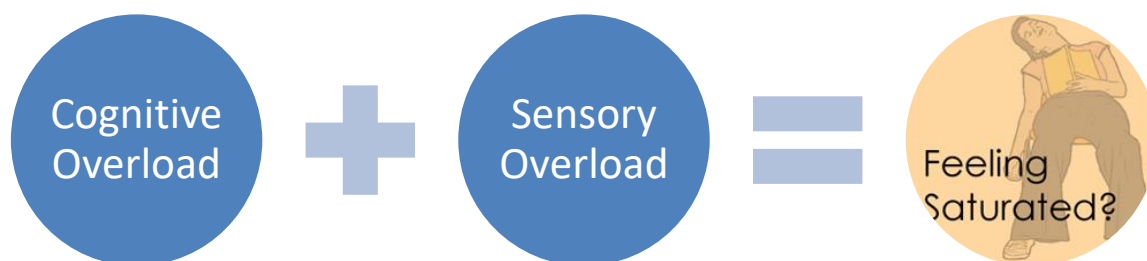
**Children;** Children lack general knowledge, and this is what creates increased cognitive load in children. Children in impoverished families often experience even higher cognitive load in learning environments than those in middle-class families. **Sensory overload** occurs when one or more of the body's senses experiences over-stimulation from the environment. There are many environmental elements that impact an individual. Examples of these elements are urbanization, crowding, noise, mass media, technology, and the explosive growth of information.<sup>[1]</sup> Sensory overload is commonly associated with sensory processing disorder. Like its opposite sensory deprivation, it has been used as a means of torture. Sensory overload can happen, and does happen to all of us, not just children with sensory processing challenges. (The exception to this rule is the case of a child who under-registers all forms of sensory input, who may never "feel" sensory overload.) **Definition;** When the brain and nervous system is bombarded with too much sensory input from one or more sensory systems and is unable to process and sort out the incoming sensory messages. **A Few Possible Signs of Sensory Overload:**



**Figure:III; Signs and Symptoms of Overload;Designed by Prof Dr.C.Karthikeyan**

**Other Sensory Overload symptoms in daily life can be;** Irritability, "Shuts down", or refuses to participate in activities and/or interact with others, Avoids touching or being touched, Gets overexcited, Covers eyes around bright lights, Makes poor eye contact, Covers ears to close, out sounds or voices, Complains about noises that do not affect others, Having difficulty focusing on an activity, Constantly changing activities, never completing a task, Irritation caused by shoes, socks, tags, or different textures, Over-sensitivity to touch, movement, sights, and/or sounds, Has trouble with social interactions, Extremely high or extremely low activity levels, Muscle tension, Fidgeting and restlessness, Angry outbursts, Sleeplessness/fatigue, Difficulty concentrating.

**Prevalence;** Sensory overload does not mean something is wrong with the child. Sensory overload is not the same as a sensory meltdown. Although sensory overload is a precursor and trigger for a sensory meltdown. Sensory overload is common for a neuro-typical brain, but can occur at a much greater extent and frequency for a child with sensory processing challenges. One can recover and return to ready state and regulated without full dysregulation and fight or flight taking over. This is where sensory tools and strategies come in to play as well as watching for the sensory signals your child gives you. Our society and environment has very little regard for our sensory systems and needs, we must adapt, and avoid the best we can, and be acutely aware of our surroundings to protect our sensory systems. Figure 4 describes what happens when both Sensory and Cognitive Overload happens which is very true in the present scenario of daily life;



**Figure:IV: Final Outcome when both overloading happens. Designed by Prof Dr.C.Karthikeyan**

**The Next Stage; Sensory "meltdown"** is one of the most frequently used terms for children with sensory differences. It is also likely the greatest challenge a parent faces with any child....and a whole new ballgame when a child struggles with sensory processing and self-regulation. A **standard meltdown** may be referring to a child who is kicking and screaming and biting or spitting...or a child who simply can't stop crying....or a child reacting to a situation in a disruptive and aggressive manner. On the other hand...when you throw sensory processing challenges and difficulty with self-regulation in to the mix...you have a completely different scenario. The sensory meltdown is often misunderstood for attention seeking or spoiled behavior or simply the child trying to get what they want out of the situation. This may be true in a few cases, but it is often much more deep rooted than that.

**Reasons for Sensory Meltdown;** Sensory overload, Dysregulation and the inability to maintain self-regulation and a ready state, "Fight or flight" response to sensory overload, yet mistaken for a standard, behavior driven meltdown, the inability to cope with a new or challenging situation, Inability to communicate wants and needs, difficulty with transitions, lack of sleep or over tired, lack of proper nutrition or too much of the wrong food, change in routine. The next level of impact silently starts are very subtle but serious in nature if overlooked.

**Precursors; Attention Deficit Hyperactivity Disorder (ADHD);** Attention-deficit/hyperactivity disorder (ADHD) is a brain disorder marked by an ongoing pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development.

- **Inattention** means a person wanders off task, lacks persistence, has difficulty sustaining focus, and is disorganized; and these problems are not due to defiance or lack of comprehension.
- **Hyperactivity** means a person seems to move about constantly, including in situations in which it is not appropriate; or excessively fidgets, taps, or talks. In adults, it may be extreme restlessness or wearing others out with constant activity.
- **Impulsivity** means a person makes hasty actions that occur in the moment without first thinking about them and that may have high potential for harm; or a desire for immediate rewards or inability to delay gratification. An impulsive person may be socially intrusive and

excessively interrupt others or make important decisions without considering the long-term consequences.

- 

### **Signs and Symptoms**

Inattention and hyperactivity/impulsivity are the key behaviors of ADHD. Some people with ADHD only have problems with one of the behaviors, while others have both inattention and hyperactivity-impulsivity. Most children have the combined type of ADHD. In preschool, the most common ADHD symptom is hyperactivity. It is normal to have some inattention, unfocused motor activity and impulsivity, but for people with ADHD, these behaviors: are more severe, occur more often, interfere with or reduce the quality of how they function socially, at school, or in a job. Inattention; People with symptoms of inattention may often: Overlook or miss details, make careless mistakes in schoolwork, at work, or during other activities, have problems sustaining attention in tasks or play, including conversations, lectures, or lengthy reading, not seem to listen when spoken to directly, not follow through on instructions and fail to finish schoolwork, chores, or duties in the workplace or start tasks but quickly lose focus and get easily sidetracked, have problems organizing tasks and activities, such as what to do in sequence, keeping materials and belongings in order, having messy work and poor time management, and failing to meet deadlines. Avoid or dislike tasks that require sustained mental effort, such as schoolwork or homework, or for teens and older adults, preparing reports, completing forms or reviewing lengthy papers. Lose things necessary for tasks or activities, such as school supplies, pencils, books, tools, wallets, keys, paperwork, eyeglasses, and cell phones. Be easily distracted by unrelated thoughts or stimuli. Be forgetful in daily activities, such as chores, errands, returning calls, and keeping appointments

### **Hyperactivity-Impulsivity**

People with symptoms of hyperactivity-impulsivity may often: Fidget and squirm in their seats, Leave their seats in situations when staying seated is expected, such as in the classroom or in the office, Run or dash around or climb in situations where it is inappropriate or, in teens and adults, often feel restless, Be unable to play or engage in hobbies quietly, Be constantly in motion or “on the go,” or act as if “driven by a motor”, Talk nonstop, Blurt out an answer before a question has been completed, finish other people’s sentences, or speak without waiting for a turn in



conversation, Have trouble waiting his or her turn, Interrupt or intrude on others, for example in conversations, games, or activities. **Diagnosis of ADHD requires** a comprehensive evaluation by a licensed clinician, such as a pediatrician, psychologist, or psychiatrist with expertise in ADHD. For a person to receive a diagnosis of ADHD, the symptoms of inattention and/or hyperactivity-impulsivity must be chronic or long-lasting, impair the person's functioning, and cause the person to fall behind normal development for his or her age. The doctor will also ensure that any ADHD symptoms are not due to another medical or psychiatric condition. Most children with ADHD receive a diagnosis during the elementary school years. For an adolescent or adult to receive a diagnosis of ADHD, the symptoms need to have been present prior to age 12. ADHD symptoms can appear as early as between the ages of 3 and 6 and can continue through adolescence and adulthood. Symptoms of ADHD can be mistaken for emotional or disciplinary problems or missed entirely in quiet, well-behaved children, leading to a delay in diagnosis. Adults with undiagnosed ADHD may have a history of poor academic performance, problems at work, or difficult or failed relationships. ADHD symptoms can change over time as a person ages. In young children with ADHD, hyperactivity-impulsivity is the most predominant symptom. As a child reaches elementary school, the symptom of inattention may become more prominent and cause the child to struggle academically. In adolescence, hyperactivity seems to lessen and may show more often as feelings of restlessness or fidgeting, but inattention and impulsivity may remain. Many adolescents with ADHD also struggle with relationships and antisocial behaviors. Inattention, restlessness, and impulsivity tend to persist into adulthood.

### **Risk Factors**

Scientists are not sure what causes ADHD. Like many other illnesses, a number of factors can contribute to ADHD, such as: Genes. Cigarette smoking, alcohol use, or drug use during pregnancy. Exposure to environmental toxins during pregnancy. Exposure to environmental toxins, such as high levels of lead, at a young age. Low birth weight. Brain injuries. ADHD is more common in males than females, and females with ADHD are more likely to have problems primarily with inattention. Other conditions, such as learning disabilities, anxiety disorder, conduct disorder, depression, and substance abuse, are common in people with ADHD.

## Treatment and Therapies

While there is no cure for ADHD, currently available treatments can help reduce symptoms and improve functioning. Treatments include medication, psychotherapy, education or training, or a combination of treatments. **Medication** For many people, ADHD medications reduce hyperactivity and impulsivity and improve their ability to focus, work, and learn. Medication also may improve physical coordination. Sometimes several different medications or dosages must be tried before finding the right one that works for a particular person. Anyone taking medications must be monitored closely and carefully by their prescribing doctor. **Stimulants.** The most common type of medication used for treating ADHD is called a “stimulant.” Although it may seem unusual to treat ADHD with a medication that is considered a stimulant, it works because it increases the brain chemicals dopamine and norepinephrine, which play essential roles in thinking and attention. Under medical supervision, stimulant medications are considered safe. However, there are risks and side effects, especially when misused or taken in excess of the prescribed dose. For example, stimulants can raise blood pressure and heart rate and increase anxiety. Therefore, a person with other health problems, including high blood pressure, seizures, heart disease, glaucoma, liver or kidney disease, or an anxiety disorder should tell their doctor before taking a stimulant. Talk with a doctor if you see any of these side effects while taking stimulants: decreased appetite, sleep problems (sudden, repetitive movements or sounds); personality changes, increased anxiety and irritability, stomachaches, headaches. **Non-stimulants.** A few other ADHD medications are non-stimulants. These medications take longer to start working than stimulants, but can also improve focus, attention, and impulsivity in a person with ADHD. Doctors may prescribe a non-stimulant: when a person has bothersome side effects from stimulants; when a stimulant was not effective; or in combination with a stimulant to increase effectiveness. Although not approved by the U.S. Food and Drug Administration (FDA) specifically for the treatment of ADHD, some antidepressants are sometimes used alone or in combination with a stimulant to treat ADHD. Antidepressants may help all of the symptoms of ADHD and can be prescribed if a patient has bothersome side effects from stimulants. Antidepressants can be helpful in combination with stimulants if a patient also has another condition, such as an anxiety disorder, depression, or another mood disorder.

**Tips to Help Kids and Adults with ADHD Stay Organized;****For Kids:** Parents and teachers can help kids with ADHD stay organized and follow directions with tools such as: Keeping a routine and a schedule. Keep the same routine every day, from wake-up time to bedtime. Include times for homework, outdoor play, and indoor activities. Keep the schedule on the refrigerator or on a bulletin board in the kitchen. Write changes on the schedule as far in advance as possible. Organizing everyday items. Have a place for everything, and keep everything in its place. This includes clothing, backpacks, and toys. Using homework and notebook organizers. Use organizers for school material and supplies. Stress to your child the importance of writing down assignments and bringing home the necessary books. Being clear and consistent. Children with ADHD need consistent rules they can understand and follow. Giving praise or rewards when rules are followed. Children with ADHD often receive and expect criticism. Look for good behavior, and praise it. **For Adults:** A professional counselor or therapist can help an adult with ADHD learn how to organize his or her life with tools such as: Keeping routines, Making lists for different tasks and activities, Using a calendar for scheduling events, Using reminder notes, Assigning a special place for keys, bills, and paperwork, Breaking down large tasks into more manageable, smaller steps so that completing each part of the task provides a sense of accomplishment.

**Chronic fatigue syndrome (CFS) ;** Chronic fatigue syndrome (CFS) is a complicated disorder characterized by extreme fatigue that can't be explained by any underlying medical condition. The fatigue may worsen with physical or mental activity, but doesn't improve with rest. Chronic fatigue syndrome has also been called myalgic encephalomyelitis (ME) and, more recently, systemic exertion intolerance disease (SEID). Although CFS/ME and SEID share the same major symptom of chronic fatigue, there is variation between the definitions of these disorders. The symptom of chronic fatigue also may arise from more than one underlying condition. The cause of chronic fatigue syndrome is unknown, although there are many theories — ranging from viral infections to psychological stress. Some experts believe chronic fatigue syndrome might be triggered by a combination of factors. There's no single test to confirm a diagnosis of chronic fatigue syndrome. You may need a variety of medical tests to rule out other health problems that have similar symptoms. Treatment for chronic fatigue syndrome focuses on symptom relief.

**What are the symptoms;** Chronic fatigue syndrome has eight official signs and symptoms, plus the central symptom that gives the condition its name: Fatigue, Loss of memory or concentration, Sore throat, Enlarged lymph nodes in your neck or armpits, Unexplained muscle pain, Pain that moves from one joint to another without swelling or redness, Headache of a new type, pattern or severity, Unrefreshing sleep, Extreme exhaustion lasting more than 24 hours after physical or mental exercise. **Causes;** Scientists don't know exactly what causes chronic fatigue syndrome. It may be a combination of factors that affect people who were born with a predisposition for the disorder. Some of the factors that have been studied include: **Viral infections.** Because some people develop chronic fatigue syndrome after having a viral infection, researchers question whether some viruses might trigger the disorder. Suspicious viruses include Epstein-Barr virus, human herpes virus 6 and mouse leukemia viruses. No conclusive link has yet been found. **Immune system problems.** The immune systems of people who have chronic fatigue syndrome appear to be impaired slightly, but it's unclear if this impairment is enough to actually cause the disorder. **Hormonal imbalances.** People who have chronic fatigue syndrome also sometimes experience abnormal blood levels of hormones produced in the hypothalamus, pituitary glands or adrenal glands. But the significance of these abnormalities is still unknown. **Risk Factors;** Factors that may increase your risk of chronic fatigue syndrome include: **Age.** Chronic fatigue syndrome can occur at any age, but it most commonly affects people in their 40s and 50s. **Sex.** Women are diagnosed with chronic fatigue syndrome much more often than men, but it may be that women are simply more likely to report their symptoms to a doctor. **Stress.** Difficulty managing stress may contribute to the development of chronic fatigue syndrome. **Complications;** Possible complications of chronic fatigue syndrome include: Depression, Social isolation, Lifestyle restrictions, Increased work absences

**Posttraumatic stress disorder (PTSD) ;** Post-traumatic stress disorder (PTSD) is a mental health condition that's triggered by a terrifying event — either experiencing it or witnessing it. Symptoms may include flashbacks, nightmares and severe anxiety, as well as uncontrollable thoughts about the event. Many people who go through traumatic events have difficulty adjusting and coping for a while, but they don't have PTSD — with time and good self-care, they usually get better. But if the symptoms get worse or last for months or even years and interfere with your functioning, you may have PTSD. Getting effective treatment after PTSD symptoms develop

can be critical to reduce symptoms and improve function. Symptoms; **Post-traumatic stress disorder symptoms** may start within three months of a traumatic event, but sometimes symptoms may not appear until years after the event. These symptoms cause significant problems in social or work situations and in relationships. PTSD symptoms are generally grouped into four types: intrusive memories, avoidance, negative changes in thinking and mood, or changes in emotional reactions. Intrusive memories; Symptoms of intrusive memories may include: Recurrent, unwanted distressing memories of the traumatic event, Reliving the traumatic event as if it were happening again (flashbacks), Upsetting dreams about the traumatic event, Severe emotional distress or physical reactions to something that reminds you of the event **Avoidance; Symptoms of avoidance may include:** Trying to avoid thinking or talking about the traumatic event, Avoiding places, activities or people that remind you of the traumatic event, Negative changes in thinking and mood, Symptoms of negative changes in thinking and mood may include: Negative feelings about yourself or other people. Inability to experience positive emotions, Feeling emotionally numb, Lack of interest in activities you once enjoyed, Hopelessness about the future, Memory problems, including not remembering important aspects of the traumatic event, Difficulty maintaining close relationships, Changes in emotional reactions. Symptoms of changes in emotional reactions (also called arousal symptoms) may include: Irritability, angry outbursts or aggressive behavior, Always being on guard for danger, Overwhelming guilt or shame, Self-destructive behavior, such as drinking too much or driving too fast, Trouble concentrating, Trouble sleeping, Being easily startled or frightened. Intensity of symptoms; PTSD symptoms can vary in intensity over time. You may have more PTSD symptoms when you're stressed in general, or when you run into reminders of what you went through. For example, you may hear a car backfire and relive combat experiences. Or you may see a report on the news about a sexual assault and feel overcome by memories of your own assault. **Causes;** You can develop post-traumatic stress disorder when you go through, see or learn about an event involving actual or threatened death, serious injury or sexual violation. Doctors aren't sure why some people get PTSD. As with most mental health problems, PTSD is probably caused by a complex mix of: Inherited mental health risks, such as an increased risk of anxiety and depression, Life experiences, including the amount and severity of trauma you've gone through since early childhood, Inherited aspects of your personality — often called your temperament, the way your brain regulates the chemicals and hormones your body releases in

response to stress. **Risk Factors;** People of all ages can have post-traumatic stress disorder. However, some factors may make you more likely to develop PTSD after a traumatic event, such as: Experiencing intense or long-lasting trauma, Having experienced other trauma earlier in life, including childhood abuse or neglect, Having a job that increases your risk of being exposed to traumatic events, such as military personnel and first responders, Having other mental health problems, such as anxiety or depression, Lacking a good support system of family and friends, Having biological (blood) relatives with mental health problems, including PTSD or depression, The most common events leading to the development of PTSD include: Combat exposure, Childhood neglect and physical abuse, Sexual assault, Physical attack, Being threatened with a weapon, Many other traumatic events also can lead to PTSD, such as fire, natural disaster, mugging, robbery, car accident, plane crash, torture, kidnapping, life-threatening medical diagnosis, terrorist attack, and other extreme or life-threatening events. Complications; Post-traumatic stress disorder can disrupt your whole life: your job, your relationships, your health and your enjoyment of everyday activities, Having PTSD also may increase your risk of other mental health problems, such as: Depression and anxiety , Issues with drugs or alcohol use, Eating disorders, Suicidal thoughts and actions

### **Risk factors**

**Autism spectrum** disorder affects children of all races and nationalities, but certain factors increase a child's risk. They include: **Your child's sex.** Boys are about four times more likely to develop ASD than girls are. **Family history.** Families who have one child with ASD have an increased risk of having another child with the disorder. It's also not uncommon for parents or relatives of a child with ASD to have minor problems with social or communication skills themselves or to engage in certain behaviors typical of ASD. **Other disorders.** Children with certain medical conditions have a higher than normal risk of ASD or ASD-like symptoms. Examples of these conditions include fragile X syndrome, an inherited disorder that causes intellectual problems; tuberous sclerosis, a condition in which benign tumors develop in the brain; the neurological disorder Tourette syndrome; and Rett syndrome, a genetic condition occurring almost exclusively in girls, which causes slowing of head growth, intellectual disability and loss of purposeful hand use. **Extremely preterm babies.** Babies born before 26 weeks of pregnancy may have a greater risk of ASD. **Parents' ages.** There may also be a

connection between children born to older parents and ASD, but more research is necessary to establish this link.

**Synesthesia; Synesthesia** (also spelled **synæsthesia** or **synaesthesia**; from the is a neurological phenomenon in which stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway. People who report a lifelong history of such experiences are known as synesthetes. In one common form of synesthesia, known as grapheme-color synesthesia or color-graphemic synesthesia, letters or numbers are perceived as inherently colored. In spatial-sequence, or number form synesthesia, numbers, months of the year, and/or days of the week elicit precise locations in space (for example, 1980 may be "farther away" than 1990), or may appear as a three-dimensional map (clockwise or counterclockwise). Synesthetic associations can occur in any combination and any number of senses or cognitive pathways. Little is known about how synesthesia develops. It has been suggested that synesthesia develops during childhood when children are intensively engaged with abstract concepts for the first time. This hypothesis – referred to as *semantic vacuum hypothesis* – explains why the most common forms of synesthesia are grapheme-color, spatial sequence and number form. These are usually the first abstract concepts that educational systems require children to learn.

**Signs and Symptoms;** Some synesthetes often report that they were unaware their experiences were unusual until they realized other people did not have them, while others report feeling as if they had been keeping a secret their entire lives. The automatic and ineffable nature of a synesthetic experience means that the pairing may not seem out of the ordinary. This involuntary and consistent nature helps define synesthesia as a real experience. Most synesthetes report that their experiences are pleasant or neutral, although, in rare cases, synesthetes report that their experiences can lead to a degree of sensory overload. Though often stereotyped in the popular media as a medical condition or neurological aberration, many synesthetes themselves do not perceive their synesthetic experiences as a handicap. To the contrary, some report it as a gift—an additional "hidden" sense—something they would not want to miss. Most synesthetes become aware of their distinctive mode of perception in their childhood. Some have learned how to apply their ability in daily life and work. Synesthetes have used their abilities in memorization of



names and telephone numbers, mental arithmetic, and more complex creative activities like producing visual art, music, and theater.

**Sensory processing disorder;** Sensory processing disorder (SPD; also known as sensory integration dysfunction) is a controversial condition that exists when multisensory integration is not adequately processed in order to provide appropriate responses to the demands of the environment. Sensory modulation refers to a complex central nervous system process by which neural messages that convey information about the intensity, frequency, duration, complexity, and novelty of sensory stimuli are adjusted. Those with SMD present difficulties processing the degree of intensity, duration, frequency, etc., of information and may exhibit behaviors with a fearful or anxious pattern, negative or stubborn behaviors, self-absorbed behaviors that are difficult to engage, or creative or actively seeking sensation. SMD consists of three subtypes: Sensory over-responsivity, Sensory under-responsivity, Sensory craving/seeking.

**Warning Signs in a Toddler;** Is a messy eater, preferring to eat with fingers rather than a fork or spoon, Is unable to ride a tricycle or play ball, Is delayed at becoming toilet trained, Avoids playing with construction toys and puzzles, Doesn't talk as well as kids the same age and might not say single words until age 3. **Warning Signs in Preschool or Early Elementary School;** Often bumps into people and things, Has trouble learning to jump and skip, Is slow to develop left- or right-hand dominance, Often drops objects or has difficulty holding them, Has trouble grasping pencils and writing or drawing, Has difficulty working buttons, snaps and zippers, Speaks slowly or doesn't enunciate words, Has trouble speaking at the right speed, volume and pitch, Struggles to play and interact with other kids. **Warning Signs in Grade School or Middle School;** Tries to avoid sports or gym class, Takes a long time to write, due to difficulty gripping pencil and forming letters, Has trouble moving objects from one place to another, such as pieces on a game board, Struggles with games and activities that require hand-eye coordination, Has trouble following instructions and remembering them, Finds it difficult to stand for a long time as a result of weak muscle tone. **Warning Signs in High School,** Has trouble with sports that involve jumping and cycling, Tends to fall and trip; bumps into things and people, May talk continuously and repeat things, May forget and lose things, Has trouble picking up on nonverbal



signals from others, With treatment and support, children with dyspraxia may improve their muscle tone and coordination over time.

**What skills are affected by dyspraxia?** ;Dyspraxia can affect a variety of skills. Here are some common ones. Keep in mind that there are ways to help your child improve in each of these areas: **Communication:** Kids with dyspraxia may struggle with different aspects of speech. They can have trouble pronouncing words or expressing their ideas. They may also have trouble adjusting the pitch and volume of their voice. As a result, making friends and being social can be much harder. **Emotional/behavioral skills:** Children with dyspraxia may behave immaturely. They may easily become overwhelmed in group settings. This can create problems with making friends, and kids can become anxious about socializing with others, especially as they get older. Their difficulties with sports may also affect their self-esteem and social abilities. Learn more about how dyspraxia can affect your child’s social life. **Academics:** Kids with dyspraxia often have difficulty writing quickly. This can create a number of classroom challenges, such as trouble taking notes and finishing tests. Children who have speech difficulties also may have difficulty with reading and spelling. **Overall life skills:** Dyspraxia can make it hard to master everyday tasks needed for independence. In elementary school, kids still may need help buttoning a shirt or brushing their teeth. As teens, they could have trouble learning to drive a car or fry an egg. **Dyslexia:** Kids with dyslexia might have trouble learning to read. Dyslexia can also make it hard to write, spell and say the words you want to say. **Dyscalculia:** This causes kids to have difficulties with math. Kids with dyscalculia may have trouble remembering basic math facts such as  $2 + 2 = 4$ , doing calculations and estimating quantities and times (such as how long a minute is). Dyspraxia can cause trouble with math, too. Find out how this is different from dyscalculia-related math difficulties. **Dysgraphia:** Dysgraphia causes trouble with writing. Dysgraphia and dyspraxia are very different, but they often have overlapping symptoms—like messy handwriting. Learn more about the difference between dysgraphia and dyspraxia. **ADHD:** ADHD can make it difficult for your child to keep still, concentrate, consider consequences and control impulses. About half of children with dyspraxia also have attention issues. Fortunately, there are many people who can help your child with dyspraxia. Some of these people may work in your child’s school and some you might find in your community or online.

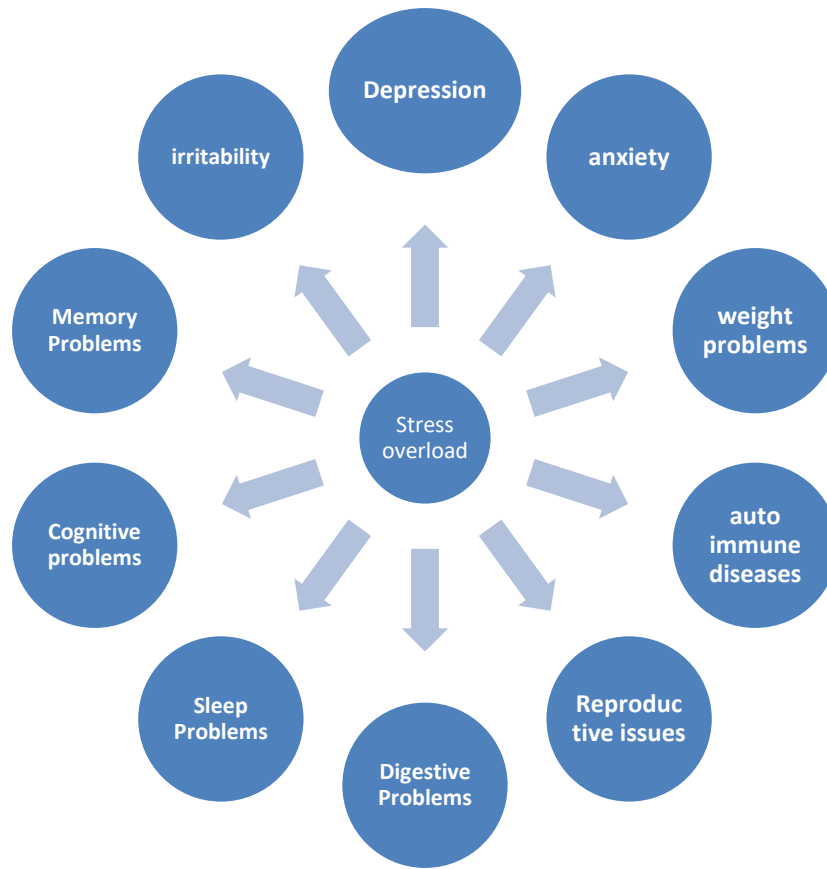
Your child's teacher or doctor can help you find specialists who are trained in the following:

**Occupational therapy:** An occupational therapist can help your child develop everyday skills needed to thrive in and out of school. This includes such things as learning to use a knife or write legibly. **Speech therapy:** A speech-language pathologist can pinpoint your child's speech issues and then suggest specific exercises that can help your child communicate more clearly. **Perceptual motor training:** This kind of training is typically done by occupational or physical therapists. It's designed to improve children's language, visual, movement and hearing and listening skills. It involves giving kids tasks to do that are challenging, but not so difficult that they become frustrated. Kids are given a series of exercises that will help them better learn how to integrate motor, sensory and language information. **Substance-induced cognitive impairment** ;Cognition is a group of mental processes that includes attention, memory, the ability to understand and use language, learning, reasoning, problem solving, and decision making. We use our cognitive functions constantly in daily life. From the moment we are born, our cognitive abilities guide us through the learning process, communication with others, interpreting sensory input, and the crucial thought processes that form our personalities and help us to make decisions. Cognitive rehabilitation techniques and exercises may also help detoxified patients more rapidly restore drug induced deficits in their mental functioning. Many of these methods are easily applicable to current computer technologies. They consist of exercises for memory, problem solving, reasoning, impulse control, reading comprehension, and other tasks of gradual increasing complexity that can be delivered via computer assisted cognitive rehab formats.

**The ultimate stage** ; stress overload; Your heart pounds faster, muscles tighten, blood pressure rises, breath quickens, and your senses become sharper. These physical changes increase your strength and stamina, speed your reaction time, and enhance your focus. This is known as the "fight or flight" or mobilization stress response and is your body's way of protecting you. When stress is within your comfort zone, it can help you to stay focused, energetic, and alert. In emergency situations, stress can save your life—giving you extra strength to defend yourself, for example, or spurring you to slam on the brakes to avoid an accident. Stress can also help you rise to meet challenges. Stress is what keeps you on your toes during a presentation at work, sharpens your concentration when you're attempting the game-winning free throw, or drives you to study

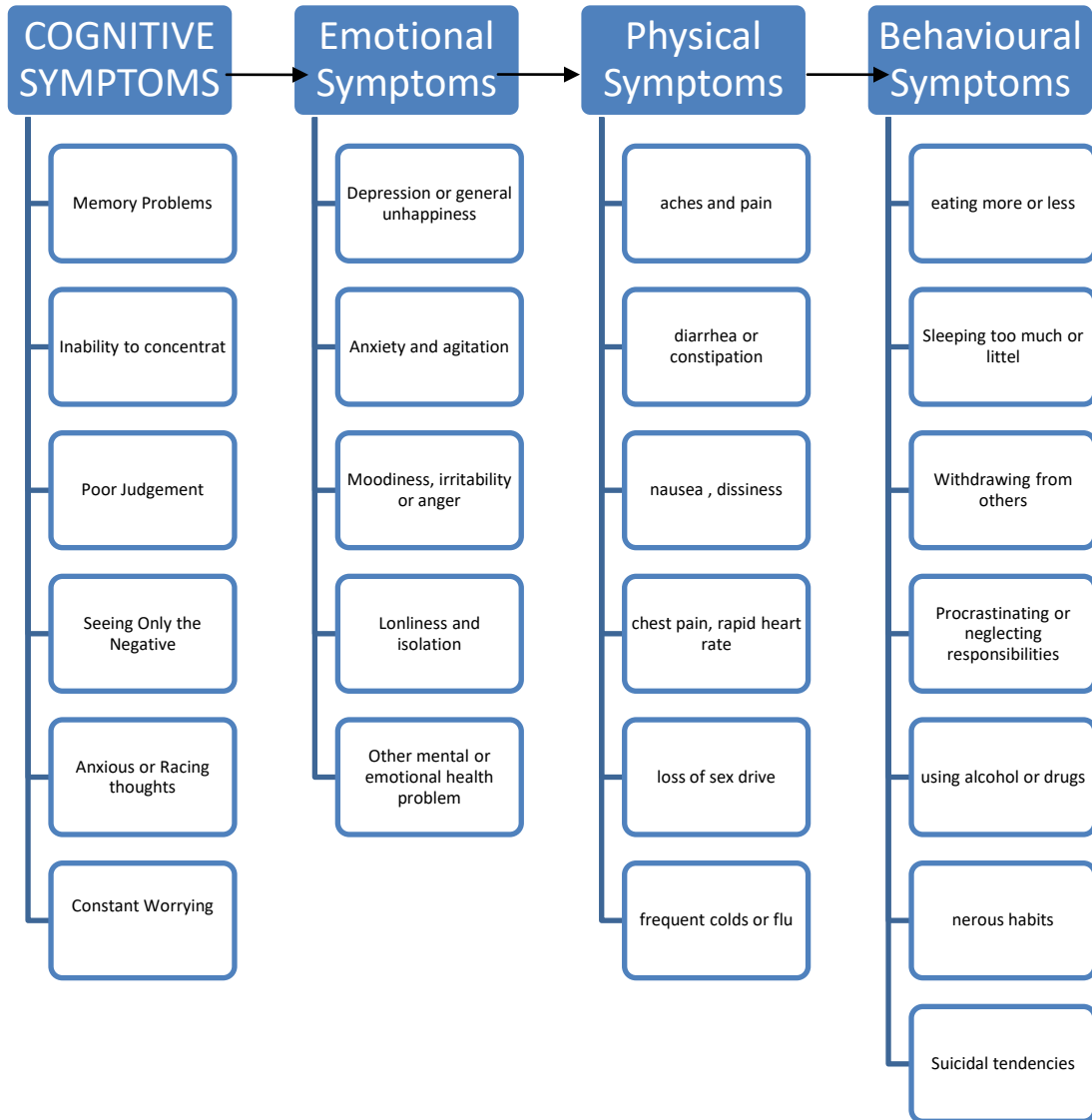
for an exam when you'd rather be watching TV. But beyond your comfort zone, stress stops being helpful and can start causing major damage to your mind and body. When you need (or *think* you need) to defend yourself or run away from danger, your body prepares for **mobilization**. The nervous system rouses for emergency action—preparing you to either fight or flee from the danger at hand. If mobilization fails, the body freezes instead, a response known as **immobilization**. In extreme, life-threatening situations, you may even lose consciousness, enabling you to survive high levels of physical pain. This can leave you traumatized or unable to move on. **The effects of chronic stress;** The body's nervous system often does a poor job of distinguishing between daily stressors and life-threatening events. If you're stressed over an argument with a friend, a traffic jam on your commute, or a mountain of bills, for example, your body can still react as if you're facing a life-or-death situation. When you repeatedly experience the mobilization or fight-or-flight stress response in your daily life, it can lead to serious health problems. Chronic stress disrupts nearly every system in your body. It can shut down your immune system, upset your digestive and reproductive systems, raise blood pressure, increase the risk of heart attack and stroke, speed up the aging process and leave you vulnerable to many mental and physical health problems.

**Causes of stress;** The situations and pressures that cause stress are known as stressors. We usually think of stressors as being negative, such as an exhausting work schedule or a rocky relationship. However, anything that puts high demands on you can be stressful. This includes positive events such as getting married, buying a house, going to college, or receiving a promotion. Of course, not all stress is caused by external factors. Stress can also be internal or self-generated, when you worry excessively about something that may or may not happen, or have irrational, pessimistic thoughts about life. Common external causes of stress; Major life changes, Work or school, Relationship difficulties, Financial problems, Being too busy, Children and family. Common internal causes of stress, Chronic worry, Pessimism, Rigid thinking, lack of flexibility, Negative self-talk, Unrealistic expectations/Perfectionism, All-or-nothing attitude. Health problems caused or exacerbated by stress include: Depression and anxiety, Weight problems, Auto immune diseases, Skin conditions, such as eczema, Reproductive issues, Pain of any kind, Heart disease, Digestive problems, Sleep problems, Cognitive and memory problems and this is a vicious cycle as shown below;



**Figure:V: Hub and Spoke Vicious Cycle of Health Problems caused by Stress Overload:  
Designed by Prof Dr.C.Karthikeyan**

The following table lists some of the common warning signs and symptoms of chronic stress. The more signs and symptoms you notice in yourself, the closer you may be to stress overload.



**Figure :VI: Complementing Impact on Health due to Stress Overlaod ; Stress Over load Matrix: Designed by Prof Dr.C.Karthikeyan**

**Conclusion:** Research shows that children with sensory processing disorder and sensory processing differences have a greater tendency to switch from the PNS (parasympathetic nervous system) to the SNS (sympathetic nervous system) based on an adverse stimuli or an environment with new or a great amount of sensory stimuli. **Parasympathetic nervous system:** This is

where our nervous remains most of the time and when we are at “ready state” for learning, social interaction, and alert and awake. **Sympathetic nervous system:** The state of “fight or flight”. This part of our nervous system is intended for safety and the ability to react to a perceived dangerous situation. **Why do we See our Children in “Fight or Flight” so Often?** Children with sensory defensiveness or who over-register sensory input perceive their environment as dangerous and painful based on how they process sensory information. Therefore their nervous system switches to the SNS and displays a “fight or flight” response. A child who has a difficult time processing and modulating sensory input can also have the tendency to switch to “fight or flight”. And almost all children with sensory differences have a difficult time with self-regulation, in turn, a greater risk for “fight or flight” episodes. **What Does “Fight or Flight” Look Like?** There are many different manifestations of “fight or flight” but some common responses may be: Hitting, kicking, biting, spitting, pushing (especially while standing in line or in new challenging/overwhelming situations or activities). Trying to run or escape from the situation. Trying to hide under something like a desk, table, or chair. Burying themselves in a teacher’s arms, avoiding all eye contact, or trying to curl up in a ball on the floor or at their desk. Covering ears or eyes, Crying or screaming, Hiding in the closet, under couch cushions, or under covers in bed, Shutting down completely and not speaking or responding, Even falling asleep unexpectedly. **Recommendations to control ;** Do NOT treat it from a behavioral stand point; your efforts will be fruitless. The brain is not responding in a cortical manner (thinking, judgment, and reasoning), it has shifted to brain stem level during a “fight or flight” episode. **I think this is the most important concept to grasp.** Remove the child from the adverse stimuli and decrease sensory stimuli to a minimum. Provide a sensory retreat for the child, such as a play tent loaded with pillows with other calming sensory tools (soft music, vibration, chewy/oral sensory tool, weighted blanket, noise cancelling headphones, calming fidget toy). Allow for the child to come out of the sensory retreat on their own terms. Their nervous system will know when it is ready. Do not try to talk the child through it, calm, bargain, or rationalize. This in itself can be overwhelming and the child’s brain is not ready for that type of interaction yet. **How to Help Sensory Overload From Turning in to a Sensory Meltdown:** Take note of your child's environment at all times. Keep it calm and keep it simple. Avoid the triggers when at all possible. Watch for signs and sensory signals of possible overload and respond right then and



there. Don't push through. Slow down. Make time for the transitions in the day. Enjoy the moment and simple things in life. A schedule packed from morning to night is not healthy for anyone. Let your kid be a kid. Let them lead the way and explore their little world. Build a pillow fort and play in the mud. Play with a cardboard box. Stay organized. Maintain a predictable and reasonable schedule. Be sure to incorporate calming and organizing sensory activities throughout the day. Offer regular and frequent sensory retreat breaks throughout the day. Take deep breaths often with your child throughout the day. Keep it Real. Keep it Simple.


## Conclusion

1. Andersson, Gerhard; Hagman, Jenni; Talianzadeh, Roya; Svedberg, Alf; Larsen, Hans Christian (May 2002). "Effect of cognitive load on postural control". *Brain Research Bulletin*. **58** (1): 135–139. doi:10.1016/s0361-9230(02)00770-0. PMID 12121823.
2. Frein, Scott T.; Jones, Samantha L.; Gerow, Jennifer E. (November 2013). "When it comes to Facebook there may be more to bad memory than just multitasking". *Computers in Human Behavior*. **29** (6): 2179–2182. doi:10.1016/j.chb.2013.04.031.
3. Skulmowski, Alexander; Pradel, Simon; Kühnert, Tom; Brunnett, Guido; Rey, Günter Daniel (2016). "Embodied learning using a tangible user interface: The effects of haptic perception and selective pointing on a spatial learning task". *Computers & Education*. 92–93: 64–75. doi:10.1016/j.compedu.2015.10.011.
4. Sweller, J.; Van Merriënboer, J. & Paas, F. (1998). "Cognitive architecture and instructional design". *Educational Psychology Review*. **10** (3): 251–296. doi:10.1023/A:1022193728205.
5. Miller, G.A. (1956). "The magical number seven, plus or minus two: some limits on our capacity to process information". *Psychological Review*. **63** (2): 81–97. doi:10.1037/h0043158. PMID 13310704.
6. Chase, W.G.; Simon, H.A. (1973). "Perception in chess". *Cognitive Psychology*. **4** (1): 55–81. doi:10.1016/0010-0285(73)90004-2.
7. Paas, F. (1992). "Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach". *Journal of Educational Psychology*. **84** (4): 429–434. doi:10.1037/0022-0663.84.4.429.

8. Moreno, R. & Mayer, R. (1999). "Cognitive principles of multimedia learning: The role of modality and contiguity". *Journal of Educational Psychology*. **91** (2): 358–368. doi:10.1037/0022-0663.91.2.358.
9. Mousavi, S.; Low, R. & Sweller, J. (1995). "Reducing cognitive load by mixing auditory and visual presentation modes". *Journal of Educational Psychology*. **87** (2): 319–334. doi:10.1037/0022-0663.87.2.319.
10. Chandler, P. & Sweller, J. (1992). "The split-attention effect as a factor in the design of instruction". *British Journal of Educational Psychology*. **62** (2): 233–246. doi:10.1111/j.2044-8279.1992.tb01017.x.
11. Cooper, G. & Sweller, J. (1987). "Effects of schema acquisition and rule automation on mathematical problem-solving transfer". *Journal of Educational Psychology*. **79** (4): 347–362. doi:10.1037/0022-0663.79.4.347.
12. Sweller, J. & Cooper, G.A. (1985). "The use of worked examples as a substitute for problem solving in learning algebra". *Cognition and Instruction*. **2** (1): 59–89. doi:10.1207/s1532690xci0201\_3.
13. Kalyuga, S.; Ayres, P. Chandler; P. and Sweller, J. (2003). "The Expertise Reversal Effect". *Educational Psychologist*. **38** (1): 23–31. doi:10.1207/S15326985EP3801\_4.
14. Chandler, P.; Sweller, J. (1991). "Cognitive Load Theory and the Format of Instruction". *Cognition and Instruction*. **8** (4): 293–332. doi:10.1207/s1532690xci0804\_2.
15. Kirschner, Paul A.; Sweller, John; Clark, Richard E. (2006). "Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching" (PDF). *Educational Psychologist*. **41** (2): 75–86. doi:10.1207/s15326985ep4102\_1.
16. Ginns, P. (2006). "Integrating information: A meta-analysis of the spatial contiguity and temporal contiguity effects". *Learning and Instruction*. **16** (6): 511–525. doi:10.1016/j.learninstruc.2006.10.001.
17. Clark, R.; Nguyen, F. & Sweller, J. (2006). *Efficiency in Learning: Evidence-Based Guidelines to Manage Cognitive Load*. San Francisco: Pfeiffer. ISBN 0-7879-7728-4. (Sweller et al., 1998, p. 265)



18. Paas, F.; Tuovinen, J.E.; Tabbers, H.K. & Van Gerven, P.W.M. (2003). "Cognitive load measurement as a means to advance cognitive load theory". *Educational Psychologist*. **38** (1): 63–71. doi:10.1207/S15326985EP3801\_8.
19. Fredericks T.K.; Choi S.D.; Hart J.; Butt S.E.; Mital A. (2005). "An investigation of myocardial aerobic capacity as a measure of both physical and cognitive workloads". *International Journal of Industrial Ergonomics*. **35** (12): 1097–1107. doi:10.1016/j.ergon.2005.06.002.
20. DeLeeuw, K.E. & Mayer, R.E. (2008). "A comparison of three measures of cognitive load: Evidence for separable measures of intrinsic, extraneous, and germane load.". *Journal of Educational Psychology*. **100** (1): 223–234. doi:10.1037/0022-0663.100.1.223.
21. Scandura, Joseph M. (1971). "Deterministic Theorizing in Structural Learning: Three Levels of Empiricism". *Journal of Structural Learning*. **3** (1): 21–53. CiteSeerX 10.1.1.532.3585 . ISSN 0022-4774. ERIC: EJ085112.
22. voorhies, D.; Scandura, J. M. (1977). "Determination of memory load in information processing". In Scandura, J. M. *Problem Solving: A Structural Process Approach with Instructional Implications*. New York: Academic Press. pp. 299–316. ISBN 9780126206500.
23. Murphy, Gregory L.; Wright, Jack C. (1984). "Changes in conceptual structure with expertise: Differences between real-world experts and novices.". *Journal of Experimental Psychology: Learning, Memory, and Cognition*. **10** (1): 144–155. doi:10.1037/0278-7393.10.1.144.
24. Mani, A.; Mullainathan, S.; Shafir, E.; Zhao, J. (29 August 2013). "Poverty Impedes Cognitive Function". *Science*. **341** (6149): 976–980. doi:10.1126/science.1238041. PMID 23990553.
25. Hackman, Daniel A.; Farah, Martha J. (February 2009). "Socioeconomic status and the developing brain". *Trends in Cognitive Sciences*. **13** (2): 65–73. doi:10.1016/j.tics.2008.11.003. PMC 3575682 . PMID 19135405.
26. Biernat, Monica; Kobrynowicz, Diane; Weber, Dara L. (October 2003). "Stereotypes and Shifting Standards: Some Paradoxical Effects of Cognitive Load". *Journal of Applied Social Psychology*. **33** (10): 2060–2079. doi:10.1111/j.1559-1816.2003.tb01875.x.

27. Gilbert, D. T. (1989). Thinking lightly about others: Automatic components of the social inference process. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought* (pp. 189–211). New York, Guilford Press.
28. Wingfield, Arthur; Stine, Elizabeth A.L.; Lahar, Cindy J.; Aberdeen, John S. (June 1988). "Does the capacity of working memory change with age?". *Experimental Aging Research*. **14** (2): 103–107. doi:10.1080/03610738808259731.
29. Andersson, G.; Hagman, J.; Talianzadeh, R.; Svedberg, A.; Larsen, H. C. (2002). "Effect of cognitive load on postural control". *Brain Research Bulletin*. **58** (1): 135–139. doi:10.1016/s0361-9230(02)00770-0. PMID 12121823.
30. Faulkner, Kimberly A.; et al. (2007). "Multitasking: Association Between Poorer Performance and a History of Recurrent Falls". *Journal of the American Geriatrics Society*. **55** (4): 570–576. doi:10.1111/j.1532-5415.2007.01147.x. PMID 17397436.
31. Calderwood, C.; Ackerman, P. L.; Conklin, E. M. (2014). "What else do college students "do" while studying? An investigation of multitasking". *Computers and Education*. **75**: 19–29. doi:10.1016/j.compedu.2014.02.004.
32. Frein, S. T.; Jones, S. L.; Gerow, J. E. (2013). "When it comes to Facebook there may be more to bad memory than just multitasking". *Computers in Human Behavior*. **29** (6): 2179–2182. doi:10.1016/j.chb.2013.04.031.
33. Sana, F.; Weston, T.; Cepeda, N. J. (2013). "Laptop multitasking hinders classroom learning for both users and nearby peers". *Computers and Education*. **62**: 24–31. doi:10.1016/j.compedu.2012.10.003.
34. Gathercole, Susan E.; Pickering, Susan J.; Ambridge, Benjamin; Wearing, Hannah (March 2004). "The Structure of Working Memory From 4 to 15 Years of Age.". *Developmental Psychology*. **40** (2): 177–190. doi:10.1037/0012-1649.40.2.177. PMID 14979759.
35. Alibali, Robert S. Siegler, Martha (2004). *Children's thinking* (4th ed.). Upper Saddle River, N.J.: Pearson Education/Prentice Hall. ISBN 0131113844.
36. Ping, Raedy; Goldin-Meadow, Susan (2010). "Gesturing Saves Cognitive Resources When Talking About Nonpresent Objects". *Cognitive Science*. **34** (4): 602–619. doi:10.1111/j.1551-6709.2010.01102.x. PMC 3733275 . PMID 21564226.

37. Ballard, Dana H.; Hayhoe, Mary M.; Pook, Polly K.; Rao, Rajesh P. N. (1 December 1997). "Deictic codes for the embodiment of cognition". *Behavioral and Brain Sciences*. **20** (4): 723–42; discussion 743–67. doi:10.1017/s0140525x97001611. PMID 10097009.
38. Paas, Fred; Sweller, John (2011). "An Evolutionary Upgrade of Cognitive Load Theory: Using the Human Motor System and Collaboration to Support the Learning of Complex Cognitive Tasks". *Educational Psychology Review*. **24** (1): 27–45. doi:10.1007/s10648-011-9179-2.
39. Longo, Luca (2014). *Formalising Human Mental Workload as a Defeasible Computational Concept* (Ph.D.). The University of Dublin, Trinity College.
40. Barrett, H. C.; Frederick, D.; Haselton, M.; Kurzban, R. (2006). "Can manipulations of cognitive load be used to test evolutionary hypotheses?" (PDF). *Journal of Personality and Social Psychology*. **91** (3): 513–518. doi:10.1037/0022-3514.91.3.513. PMID 16938033.
41. Cooper, G. (1990). "Cognitive load theory as an aid for instructional design". *Australasian Journal of Educational Technology*. **6** (2): 108–113. doi:10.14742/ajet.2322.
42. Cooper, Graham (1998). "Research into Cognitive Load Theory and Instructional Design at UNSW".
43. Plass, J.L.; Moreno, R.; Brünken, R., eds. (2010). *Cognitive Load Theory*. New York: Cambridge University Press. ISBN 9780521677585.
44. UNSW Cognitive Load Theory Conference - Sydney Australia 24-26 March 2007
45. Khawaja, M. Asif; Chen, Fang; Marcus, Nadine (2014). "Measuring Cognitive Load Using Linguistic Features: Implications for Usability Evaluation and Adaptive Interaction Design". *International Journal of Human-Computer Interaction*. **30** (5): 343–368. doi:10.1080/10447318.2013.860579.
46. Sweller, J. (1994). "Cognitive Load Theory, learning difficulty, and instructional design". *Learning and Instruction*. **4** (4): 295–312. doi:10.1016/0959-4752(94)90003-5.
47. Sweller, J. (1999). *Instructional design in technical areas*. Camberwell, Australia: Australian Council for Educational Research. ISBN 0-86431-312-8.