

## Executive Function & Memory/Cognition Changes

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### Abstract

The following information describes **executive function**, brain-controlled functions that guide various functions of the body such as planning, solving problems, organizing and directing the body to carry out daily activities. In addition executive function involves developing initiatives, making appropriate decisions, considering consequences, working memory, prioritizing, paying attention (and not being distracted), focusing on important details, working toward a goal, shifting (to the next steps of a task or to the next task), and stopping a finished action or task.

Dementias, such as Alzheimer's disease, frontal dementia and other related dementias, lead to progressive decline in executive function as well as other thinking functions. Signs of decline in memory and executive function should undergo a full medical evaluation, and planning ahead for long-term management issues.

### Executive Function (of the Frontal Lobes of the Brain)

Managing our lives includes planning and carrying out many activities, such as getting ready for a meeting or appointment, making sure there are supplies and time scheduled for meals or for gardening, short-term plans such as putting together the day's outfit, and long-term goals such as every week adding to a savings account for car repairs or a new car, a summer trip, and retirement. Such planning and carrying out of activities depends greatly on the *executive function* of the frontal lobes of the brain.

Good executive function depends on healthy frontal lobes, which are located in the top front part of the brain, right behind the forehead. The frontal lobes have control over many body functions. This part of the brain continues to develop through adolescence and into adult life. Some of the functions of the frontal lobes include managing body movement (motor function), emotions, attention, motivation, and other thinking functions such as decision-making, judgment, abstract reasoning, planning and completing tasks, working memory (storing and using details to function), and meeting goals.<sup>1-5</sup>

Examples of some of the thinking functions of the frontal lobes include:

1. **Judgment:** using past experiences, considering values, and applying appropriate limits on behavior, for example considering appropriate timing and space limits and inhibiting behaviors that would ruin relationships or land us in jail. Another example of good judgment is not to buy that great offer from the unknown salesperson at your front door or phone because you do not know that person, the offer sounds too good to be true, and it may be a scam.

2. **Decision-making:** considering choices and selecting a preference (likes and dislikes) to make a decision. Examples of good decisions are choosing: a warm outfit from the closet during cool weather, a heart-healthy meal from the restaurant menu, and repairing an appliance instead of buying a too-expensive new one.
3. **Planning and doing all the activities of an event:** organizing a celebration for a future time, for example, planning an open-house for a large number of relatives and friends to celebrate a birthday, and carrying out the tasks for the event.

### **Executive Function: the Term**

The term *executive function* is used to describe the management of activities. The term comes from the business world where the top executive organizes or manager decides, adjusts, and supervises the activities of the business. Essentially, the executive function of the frontal lobes is to be “in charge of” the body. A way to think of *executive function* is to think of the idea and duties of a boss, chairperson, chief, or owner who is in charge of an organization or project, more specifically, in charge of the ideas, plans, budget and goals, the deadlines for all the work details, the products sold, and all the people in the organization.<sup>6,7</sup>

### **Executive Functions: Briefly Described**

The *executive functions* of the frontal lobes handle planning and paying attention to important needs and actions of the body. Executive function include: controlling, starting, stopping, regulating, adjusting to change, planning when faced with new settings or situations, forming ideas, storing information in and accessing it from working memory, controlling emotions, and thinking abstractly.

For example, to pay a bill, executive function includes choosing:<sup>5,8,9</sup>

- ◆ what to do (such as which bill to pay),
- ◆ how long to do a current step (find the checkbook or log into the web page for that bill),
- ◆ when to shift to the second step (such as fill in the details on the check or web page),
- ◆ when to shift to the next step (such as checking the figures and other details on the check or web page and then sign your name), and
- ◆ when to stop the completed task (such as put away the checkbook or close the web page) and then move on to a different activity.

Feedback about the quality of each completed step should lead to improvements at that step or fixing any errors before finishing the whole task.

### **Executive Function: Main Steps**

Another look at the multiple steps of planning provide an example of the high, intricate level of executive function work in the brain:<sup>5</sup>

**Step 1. Start:** Think about the problem and what needs to be done. Think of a way to solve the problem. Consider resources, past experience, new possibilities, values, deadlines, etc.

**Step 2. Maintain:** Start acting on the first step and continue until that step is done.

**Step 3. Switch:** Do each step and move on to the next step in order to complete the task or solve the problem.

**Step 4. Stop:** Evaluate the outcome. Is the end result good, is it adequate, is it finished, or is more action needed? When done, then stop.

Some finer brain actions within the main steps of executive function:

1. Forming ideas to do an action.
2. Starting an action.
3. Maintaining an action until the step is finished (knowing when a step is done).
4. Switching behaviors to do the next step needed.
5. Regulating, controlling, and adjusting body actions to deal with changes and new information along the way.
6. Planning a tactic down the road to deal with a new issue or new direction.
7. Holding details in the working memory.
8. Controlling emotions.
9. Thinking abstractly.
10. Knowing when the whole task is finished, stopping that task, and moving onto a different task or activity.

## **Executive Function Changes in Dementia (Progressive Memory Disorders)**

Research has shown some decrease in executive function as people age.<sup>10-13</sup> In the case of sudden injury to the frontal lobes such as in a stroke or a head injury from a fall, car accident, or sports injury, there may be sudden but not progressive loss of function(s) from this area of the brain.

When there is slow progressive decline such as with Alzheimer's disease, a frontal dementia, or a related progressive memory disorder, abilities may waver; some days the executive function may be better while other it may be worse. Slowly over time in a progressive dementia such as Alzheimer's disease or frontal dementia, executive functions decline and a caregiver has to take over more of the related responsibilities.

Brain cell changes that result in decline in executive function could interfere with memory, applying good judgment to choices, and paying attention long enough to a conversation to be able to respond appropriately. Examples of difficulties include:

1. Difficulty of the body to do the correct order of steps to perform an action, such as walking, speaking, lifting up an object and putting it down where it belongs, or operating a phone.
2. Difficulty starting, continuing, shifting, or stopping an action such as all the steps needed to eat a meal until one is full. The person may need reminding "to take another bite", have another spoonful of yogurt, etc. during the meal.
3. Difficulty holding pieces of information in memory storage to guide choices, thus forgetting key pieces of information and making wrong choices. For example, forgetting an announcement about a friend not coming to an event may lead to asking why that person has not come yet.
4. Difficulty being appropriate and honoring limits, for example knowing when to add comments to a discussion, not touching or speaking to strangers, or not handling an art object (next to a "Do Not Touch" sign) at a store or museum.
5. Difficulty holding back spontaneous actions or comments though they may be rude, hurtful, untimely, or against rules or the law. The person may be surprised when spontaneous action such as driving the car through a stop sign or red light, hits another car. The unsafe driver with executive function decline may accuse the other (not-at-fault) driver, "You should have gotten out of the way."
6. Difficulty keeping emotions stable, in other words having sudden outbursts of anger, acting irritated or rude, or laughing when others are serious or grieving the loss of a loved one. The emotion may be extreme or not fit the situation or the interactions of others. The emotions may appear disconnected from genuine concern (in other words the person may appear indifferent to the emotion which others express).
7. Difficulty keeping up with the pace of activity or conversation. Acting very slow when thinking, moving, and talking, as if one had "jet lag" or was in a slow motion movie.
8. Difficulty thinking about consequences before acting though still highly intelligent. Unable to apply past consequences to current choices or actions. For example, the person may spontaneously buy several magazines that are never read or buy (through the mail or at stores) several products that are never used.
9. Difficulty shifting from one set of ideas, a phrase, or actions to the next step or to a different idea or activity. Acting as if stuck in a rut for a period of time.
10. Difficulty planning new actions when there is an unexpected change, for example seeing that a street and sidewalk are closed for repair and walking there anyway.

11. Difficulty monitoring oneself to realize a mistake and apologize or do a more appropriate behavior.<sup>14</sup>

## **Dementia and Care**

**Dementia** is a general term that refers to decline in thinking and/or memory function while an individual is awake and alert. The decline is enough to interfere with normal daily functioning, on the job, at home, or in relationships. “Progressive” dementia progresses, in other words, it becomes worse over time.

When brain cells change and there is decline in executive function, family members may start noticing mild problems in finishing tasks, a lack of interest in visiting friends or family, or inappropriate behavior, such as getting too close to talk to someone, that makes other people uncomfortable. The new behaviors may be very different from the previous style of behavior for that person. Or, the behaviors may be more intense or an exaggeration of what used to be typical for that person. For example, in a group the quiet person may now talk too loud or too long, interrupt others, and answer questions posed to others. Or, the typically outgoing person may become withdrawn. It is important for anyone undergoing such changes to have a full medical evaluation.

### **Medical Evaluation**

The medical evaluation should be thorough. At least one family member (or significant other) should accompany the person with the health and function changes to medical appointments. They should list what decline occurred first, which one was second, which third, etc. The medical evaluation should include a physical exam, a neurological exam, a neuropsychological exam with tests of frontal lobe function<sup>15-18</sup>, information about the person’s medical and surgical history, the family medical history, a social history (information about education completed, jobs, skills, relationships, hobbies, interests, etc.), and a list of prescribed as well as over-the-counter medicines, vitamins, minerals, herbs, etc. Blood tests should examine electrolytes, sedimentation rates, cholesterol, triglycerides, urea, liver functions, vitamins such as folate and B12, body hormones (ie. a thyroid screen), and infections. Tests of urine are also important. If there is a suspicion of seizures, an EEG (electro-encephalogram) is appropriate. When the person reports that symptoms appear over a short period of time such as a few days or weeks, a spinal tap may help to rule out infection as the cause of the changes.<sup>19</sup>

The medical evaluation should include imaging such as an MRI (magnetic resonance imaging) or CT (computed tomography). MRI or CT films of the brain tissue that show a loss of brain cells, called atrophy, in the frontal lobes (front top part of the brain) may along with all the other tests point to a frontal type of dementia. The frontal lobe dementia may be of several different types such as a general frontal dementia, a frontotemporal lobar degeneration, a frontal subcortical dementia, or a small, more focused frontal lobe dementia resulting from a stroke.<sup>19-23</sup>

An MRI or CT that shows a wider spread of the atrophy may indicate the involvement of many brain systems such as in a possible Alzheimer’s disease. Alzheimer’s disease

shows a more general atrophy all over the “cap of the brain” (the cortex or top area of the brain) on MRI (or CT).<sup>18,23</sup>

### Care Management

Living a healthy lifestyle including having a sense of purpose, a meaningful routine, regular physical exercise (30 to 40 minutes a day for 5 days a week<sup>24</sup>), social activities, leisure activities, and brain exercise is important. Good nutrition should include fresh fruits and vegetables in the daily meals and drinking lots of water or related liquids (8 to 10 glasses or more a day unless a physician limits fluids).

### Treatment with Medicine

The physician will recommend that the person with the diagnosis switch or stop all medicines, such as antihistamines (many anti-allergy medicines, anti-spasm medicines, sleeping pills, and cough medicines), that interfere with memory, communication, and other cognitive (thinking) functions.

Research suggests that serotonin, a chemical that the body makes, is important to the function of the frontal lobes. Serotonin in the brain helps carry information from one neuron to the next. Low levels of serotonin increase with SSRIs (selective serotonergic reuptake inhibitor medicines). SSRIs have helped some patients with behavioral difficulties, not only depression, but also have helped with impulse control.<sup>25-27</sup>

Whenever there is a question about prescribed medicines or over-the-counter medicines, herbs, vitamins, etc., people should check with experts regarding the impact on health. Good sources to check regarding any therapeutic or, the opposite, negative effects of medicines, vitamins, herbs, etc., are a physician **and** a pharmacist (**ask both people!**).

### Driving Issues

With decline in executive function, driving may become unsafe. A medical evaluation may result in the physician recommending limits on driving, a comprehensive driver evaluation, or stopping any driving. A decline in judgment, decision-making, predicting consequences, and handling multiple details entering the brain, impair driver skills.

The following signs indicate clearly that a comprehensive driver test is needed or that the person should stop driving altogether:

- ◆ Any problems parking.
- ◆ Any confusion about operating the vehicle such as how to start, shift, park or stop the vehicle.
- ◆ Any trouble noticing cars or pedestrians on either side of the road and frequent passenger warnings to the driver, such as, “Watch out!”
- ◆ Any near misses such as almost hitting another car when changing lanes.
- ◆ Any side-swipes even side-swiping bushes along the driveway.
- ◆ Any accidents including a small fender-bender.

NOTE: A comprehensive driver evaluation test may take three to four hours and usually involves tests of the: memory, cognition (thinking functions), vision, movement, and other tests in addition to the on-the-road test.<sup>19,28</sup>

Not driving means not driving any type of motor vehicles such as cars, trucks, vans, all-terrain vehicles, snowmobiles, motorbikes, golf carts, rider lawn mowers, motor boats, etc. Planning ahead for alternative transportation should occur long before it is clear (because of an accident or near miss) that the family unit no longer has a safe or available driver.<sup>28-32</sup>

### **After the Diagnosis: Planning Ahead for Care**

After the medical evaluation and the diagnosis, education about the condition and planning ahead are essential for long-term care management.<sup>33</sup> A decline in executive function may disrupt family life when it affects a person in their 40s or 50s because of their multiple demanding responsibilities. The diagnosed person may be supporting a family, may be a full-time homemaker caring for children or grandchildren, may serve as a community leader or head of an organization and budget, and may be essential to the healthful daily function of so many other people and organizations.

### **Planning Ahead List**

As soon as possible the family should plan ahead; family matters, such as financial, legal, and health planning, should be discussed and organized.<sup>19,33</sup> A ***Checklist on Family Matters*** is available to guide planning ahead which includes planning about money and legal matters, health preferences, organizing bill payments, and keeping forms up to date (download a free copy of *A Checklist on Family Matters* from [www.AlzOnline.php.ufl.edu/en/reading/CHECKLIST.pdf](http://www.AlzOnline.php.ufl.edu/en/reading/CHECKLIST.pdf)).

These plans should be discussed with at least one trustworthy person who does not live under the same roof as the person with the disease. The back-up plans should consider resource people, such as family or neighbors, and resource programs and services such as local support groups and local chapters of the national Alzheimer's Association and Alzheimer Resource Centers.

People with a decline in executive function may be vulnerable to scams, spending large amounts of money on worthless products such as cures for aging, kitchen gadgets, or unnecessary home repairs. Family caregivers need to plan ahead to secure finances (bank accounts, credit cards, investments, etc.). A family attorney with a specialty in Elder Law, accountant, or a financial planner can help set up appropriate legal and financial matters so that family resources are managed appropriately with adequate checks-and-balances, especially in the event of any emergency.

A storm or other disaster that creates electrical shortages or destroys (or floods) the home may result in the person with the diagnosis and the family caregiver(s) moving to a temporary setting. If the people at this temporary setting have information about the health situation and daily care needs, it should ease the transition and the adjustment to the temporary setting.<sup>19</sup> Some community programs register people ahead of time for

local shelters that will provide a temporary place for people with special needs in the event of evacuations due to fires, bad weather or other emergencies.

It may help to set up ahead of time a “crisis carton”. The crisis carton should be a large plastic (waterproof) container with a tight-fitting cover. Items to pack include copies of important health information, a list of medicines with a copy of prescriptions, contact names and phone numbers, simple clothing for a few days, undergarments (disposable underwear for incontinence), family photos, paper and pens, a battery operated radio and flashlight, extra fresh batteries, a cell phone charger, a first aid kit, blankets, and snacks (canned liquids, bottled water, and dry food).

### **Simplifying Duties at Home**

Family and paid caregivers should try to keep the schedule at home as routine, simple, safe, and pleasant as possible. Since a decline in executive function affects judgment, limits thinking about consequences when making choices, and decreases sensitivity about appropriate timing and limits, it is important to partner or team-up to do some tasks. The caregiver should gradually decrease and later restrict responsibilities involving that person paying the bills, handling all the mail, using machinery with many attachments or controls, caring for others especially children, or doing complicated or multi-step tasks alone.<sup>19,33</sup>

### **Caregiver Tips**

Caregivers of someone with progressive decline in executive functions should gradually take on more household and personal care responsibilities over time. It is important for caregivers to learn how to conserve their energy by prioritizing tasks. They should consider limiting less enjoyable tasks, or unpleasant social events, or other stressful commitments. Doing what is most important and omitting unimportant chores help to conserve energy. Also they should decrease time spent on fussy housekeeping details and some burdensome friends.

A sense of humor when providing assistance or hands-on care can reduce stress, refocus the attention, and keep the setting positive. It is important to observe unpleasant or stressful behaviors early and try to avoid any problems before they start. Sometimes it helps to shift attention quickly with a change of subject, a change of pace, a louder voice or a softer voice, slower speech (repeating simple phrases), calming music, or a change of activity such as getting a snack. Sometimes the caregiver just needs to leave the room or go outdoors for a few minutes to clear her or his head. It may be better to start another, easier task and leave the problem task for a later time. Sometimes it helps to quiet the setting, such as closing windows, unplugging the telephone or T.V. or ushering visitors to another room, outdoors, or (their) home.

A clever way to think about providing care is to remember the word “**KISSSSS**”. In other words, **Keep it Sweet** (positive), the **Same** (routine), **Simple** (priorities only, doing only what is important and preferred), **Short** (brief: activities, explanations and conversations), and **Safe** (safe: activities, setting, behaviors for everyone especially the caregiver). A family or paid caregiver **must have respite**, a regular timeout for “down time”, rest and relaxation. **Regular respite is critical!**<sup>33</sup>

In addition to receiving medical advice to improve function, the family should educate themselves about the medical diagnosis in anticipation of future changes in abilities. The type and rate of changes and the decline in ability differ from person to person. Family members need to realize that everyone changes differently depending on which cells in the brain are getting weak or not functioning. There may be “good days” and then “not-so-good-days”. Later, there may be brief “good moments” and then longer “not-so-good-moments”.

### **Resources**

Many resources are available to help caregivers and care receivers with education, support groups or other services. A younger person who is employed and needs to file for disability benefits because of the executive function problems resulting in a diagnosis of a progressive dementia should contact the local social security office to apply (the national information number provides local contact phone numbers: Social Security 1-800-772-1213 or [www.ssa.gov](http://www.ssa.gov)).

Other important resources include local chapters of the Alzheimer’s Association, different groups that deal with progressive dementia such as the Alzheimer Resource Centers, the Association for Frontotemporal Dementias, adult day (health) care programs, senior centers, meal sites, religious organizations with programs or special services, assisted living facilities, nursing homes, volunteer groups and neighbors.<sup>28</sup>

Because information on the (computer) internet is available 24 hours a day, the internet provides readily available (usually free) help. Entering in a name of a diagnosis or a medicine or a challenging behavior will result in a wealth of explanations and suggestions. Some excellent internet web sites and toll free phone numbers are listed in the following table.

<b>Resources for More information</b>
<ol style="list-style-type: none"> <li>1. <b>Association for Frontotemporal Degeneration: <a href="http://www.theaftd.org/">www.theaftd.org/</a> or <a href="http://www.ftd-picks.org">www.ftd-picks.org</a></b></li> <li>2. <b>Alzheimer’s Association (USA): <a href="http://www.alz.org">www.alz.org</a>, (800)272-3900</b></li> <li>3. <b>Alzheimer Society of Canada: <a href="http://www.alzheimer.ca">www.alzheimer.ca</a></b></li> <li>4. <b>National Academy of Elder Law Attorneys: <a href="http://www.naela.org">www.naela.org</a></b></li> <li>5. <b>NINDS (National Institute of Neurological Disorders and Stroke) Frontotemporal Dementia Information Page: <a href="http://www.ninds.nih.gov">www.ninds.nih.gov</a></b></li> <li>6. <b>Social Security (800)772-1213 or <a href="http://www.ssa.gov">www.ssa.gov</a></b></li> </ol>

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