# CHAPTER 4 INTRODUCTION TO THE spark*EL MODEL

In the previous chapters, the major features and components of executive functions and self-regulation and their complex interrelationships were reviewed. Typically, development of self-regulation extends over at least the first two decades of life and requires long periods of time to refine and adapt to changing life circumstances. Review of current research into self-regulation and executive functions in people with ASC showed that results may be variable but the challenges they face point to difficulties changing knowing into doing.

Before proceeding any further we need to examine different approaches for improving self-regulation. Also, we want to look at what seems to work best. These are reviewed in the next section.

## Intervention to improve self-regulation

Interventions for improving self-regulation and executive functioning in children and adults have taken four main forms: (1) individual or group executive function/self-regulation training programs, (2) neurofeedback, (3) physical exercise and (4) mindfulness training. Interestingly, very little of the research into these interventions involve people with autism.

### Executive function/self-regulation training programs

Computer programs have been developed to train improvement in executive functions. Typically, they focus on just one or two functions at a time. One area that has been studied is working memory. Both children[i,ii] and adults[iii] significantly improved their visual working memory after concentrated training with specially-designed computer programs. There was evidence of generalization of training effects from visual to verbal information[iv]. Interestingly, neurological changes were found in participants of one study[v], including increased activity in the prefrontal and parietal regions of the brain. Training inhibitory control in young children[vi] produced a significant improvement. However, there was a lack of generalization. The researchers

suggested that this may be due to either the restricted they used or the children developing strategies that were too task-specific. Cognitive flexibility was the focus of another study[vii] with three-year-olds. They found that cognitive flexibility was teachable but certain forms of instruction were more effective than others. Simply telling the children the rule for performing a task was significantly less effective than giving them opportunities for practice guided by an adult.

There are very few programs that address executive functions and self-regulation more generally. One such program is *Tools of the Mind*[viii], a curriculum developed to teach academic skills and behavioral and emotional self-regulation to typically-developing children. Activities are incorporated into daily routines and play and are intended to help children control impulses, ignore distractions, retain information and think flexibly. Significant gains in inhibitory control, working memory and cognitive flexibility have been found in preschool-aged children who attended the *Tools* program versus those who were in a traditional preschool[ix]. To date, this program hasn't been used with children with ASC.

*Unstuck and On Target*[x] (UOT) is a classroom-based executive function intervention approach for promoting cognitive and behavioral flexibility in high-functioning students ages 8–11. Studies of UOT found that, after 35 sessions, children with autism who participated in the program showed significant improvement in their flexibility as rated by teachers and parents[xi]. Further examination showed that children with autism who participated in 27 sessions of UOT exhibited significant improvement in parent rated flexibility only[xii] but no change in planning and organizing behaviors. A third study of UOT found that children who participated in the program showed significant improvement in flexibility as rated by the teachers and parents[xiii]. The children also displayed significant change in their abilities to compromise, follow rules and change from one activity to another. Performance-based tests showed that the children participating in UOT also had significantly improved flexibility and planning[xiv].

The ECLIPSE model[xv] is described as one that targets self-regulation, executive function, attribution retraining and sensory awareness in order to improve social competence. A 10-week pilot study with adolescents on the autism spectrum was reported[xvi]. Compared to pre-test results, participants showed improvements in behavior as well as positive change in shifting attention, inhibitory control, and emotional control. These promising results, however, didn't reach statistical significance; therefore, it can't be concluded that the changes observed were due to the intervention.

The Alert program[xvii], also known as *How Does Your Engine Run?*, is an intervention protocol typically used by occupational therapists with children with ASC. It's designed to help the children learn to recognize their arousal states and teach them sensory-based self-regulation

strategies. The only juried study of this program in its original form[xviii] didn't find significant change associated with participation in it.

### Neurofeedback

Neurofeedback is a form of therapy that helps people focus on and alter their brainwave activity by providing feedback about their brain's electrical activity on a computer screen. Children with ASC who were trained with neurofeedback, showed significant improvements in attentional control, inhibition of verbal responses, cognitive flexibility and planning[xix]. In addition, children showed significant improvements in social interaction, communication skills and behavior. Follow-up 12 months after the original intervention showed continued significant improvements in selective auditory attention as well as maintenance of all other executive functions, communication skills and behavioral gains[xx].

### Physical exercise

The impact of physical exercise on self-regulation has been examined in two basic forms, exercise programs alone and combined physical and meditation training, such as yoga.

Exercise programs can improve some areas of executive functioning. Children who participated in regular exercise programs showed significant improvement in inhibitory control[xxi,xxii,xxiii] as well as better selective attention[xxiv], focused attention[xxv,xxvi], resistance to distraction[xxvii,] and concentration[xxviii].

Physical exercise has been combined with meditative practices like martial arts and yoga. One study[xxix] that looked at the impact of tae kwon do found significant improvement in physical, cognitive and affective self-regulation, prosocial behavior, classroom conduct, and mental math.

Yoga is another form of physical exercise used with children and adults. In one study[xxx], children with severe forms of ASC practiced yoga daily for five months. Their imitation of movements, breathing and vocalizations all improved significantly. There was also increased eye contact and they modeled their behavior from peers more frequently. Children who did yoga for one month exhibited significantly stronger cognitive flexibility, planning and organization and behavioral inhibition[xxxi]. Young adults who were involved in yoga showed greater improvement in inhibitory control and working memory[xxxii].

### Mindfulness practices

Another approach used to improve self-regulation is mindfulness. Mindfulness is based in Buddhist meditation but has no religious components. It teaches a systematic approach to regulating your attention to focus on your immediate experience ('the here and now'). This allows for increased recognition of your thoughts and feelings in the present moment in a non-judgmental and accepting way.

Children who receive mindfulness training tend to make gains in behavioral regulation[xxxiii.xxxiv], attentional control[xxxv], metacognition[xxxvi], and overall global executive control[xxxvii].

Mindfulness practices with children on the autism spectrum also show promise. Teens with Asperger syndrome were taught to mindfully shift their attention from negative emotions that triggered aggressive behavior to the neutral soles of their feet[xxxviii]. After practicing for up to six months, aggressive behavior was reduced to zero. In a follow-up four years later, no episodes of physical aggression were observed among the three participants[xxxix].

## The spark*EL model

The ***Self-regulation Program for Awareness and Resilience in Kids*** – ELementary version (spark*EL) is based on spark*, an evidence-based approach to teaching self-regulation of behavior, cognitive processes and emotions. Spark*EL is intended for children from nine years of age to about 14. It was developed to be integrated into an overall program of development but can be used successfully as a stand-alone intervention or as part of individual or group therapy programs. spark*EL will be of interest to regular and special education teachers, education assistants, occupational therapists, psychologists, speech-language pathologists and parents.

spark*EL is designed to enhance children's self-awareness, awareness of appropriate time and place, resilience and self-advocacy in relation to self-regulation, attention and executive functioning. It's theoretically derived from the latest scientific research in the fields of neuroscience, social learning, positive psychology and ASC. spark*EL was developed and refined through clinical experience with preschool and school-aged children with special needs.

The main goal of spark*EL is to improve and brighten the future for children with ASC and other special needs. Outcomes will vary with different children but, through spark*EL, it's hoped that their abilities can be optimized. We want to move children along the road to improved self-regulation to increased success in learning and day-to-day life.

Some of those skills include:

- Willingness to tackle new tasks and unfamiliar situations with confidence.

- Persisting with task and situations that are challenging.
- Being able to cooperate, negotiate and collaborate with others, sharing and taking turns.
- Making reasoned choices and decisions.
- Planning and organizing steps toward achieving a goal.
- Finding resources and solutions without help from others unless necessary.
- Learning by observing others and from one's own past experiences.
- Being able to cope and learn, even in highly stimulating or distracting environments.
- Being able to inhibit impulses and ignore distractions.
- Being able to switch from one task or demand to another and from one situation to another and cope with change in general.

spark*EL works progressively from imitation through to self-direction and self-control of behavior, thinking and emotions. The major executive functions underlying self-regulation as well as selective, sustained and shifting attention are explicitly and deliberately highlighted and practiced. In the early stages of development, the adult acts as the child`s main regulator by teaching and modeling the skills. With practice, the child will learn to recognize usefulness of the skills and strategies and increasingly assume control over them. Generalization of self-regulation skills is taught through the Awareness of Need, Resilience and Self-advocacy activities to ensure practice and use in day-to-day settings. Resilience activities help the children increase their tolerance for distraction, disruption and temptations. Children are also taught to advocate for themselves so that they can promote and maintain their sense of equilibrium.

### Important features included in spark*EL

The review at the beginning of this chapter shows that, through intervention, executive functions and self-regulation skills can be taught and enhanced in children as well as in adults. Intervention leads not only to behavioral changes in everyday life but also to alterations in brain circuitry. A few studies also reported improvement in areas that weren't specifically focused on during intervention so extension across functions and skills can occur.

A number of important features have been gleaned from the intervention programs reviewed in the previous section and from the needs of people with autism summarized in Chapter 3. We also paid attention to the results from a review of 48 programs that were aimed at improving self-regulated learning[xl] in children[xli]. The needs and features identified from this information are summarized below:

*Need/feature identified*:

**Intervention focuses directly on executive functions** – it isn't necessary to concentrate on just one executive function at a time and may be better to focus on multiple functions[xlii].

***spark*EL features addressing this***:

Each spark*EL lesson places primary focus on two or more executive functions, with secondary attention paid to the others. In some lessons, all five of the target executive functions are addressed, including planning and organization, inhibitory control, self-monitoring, working memory and cognitive flexibility.

You'll notice that just two or three executive functions receive primary focus in the early stages of the first unit, Behavioral Self-regulation. Increasingly through that unit, more executive functions take on primary focus. In the Cognitive and Emotional Self-regulation units, four and five executive functions are focused on within each lesson.

*Need/feature identified*:

**Metacognitive strategies**, those that teach the child to think about his own thinking and behavior, are important features of a self-regulation program. Children who use metacognitive strategies are more likely to learn efficiently, improve their learning outcomes and generalize what they learned[xliii]. Metacognition promotes the children reflecting on their learning, their understanding, memory, knowledge, planning and self-monitoring. Metacognitive awareness helps the child become conscious of his thought processes and more engaged and in control of his own learning. The child then develops conscious understanding of his executive functions and self-regulation as well as how to help himself.

*Metacognitive knowledge has three main forms: declarative, procedural and conditional knowledge[xliv]. Declarative knowledge is our understanding about ourselves and how our brains work. Procedural knowledge includes our awareness of strategies and skills needed for doing things. Conditional knowledge is understanding where and when to use our knowledge. All three forms of metacognitive knowledge are addressed in spark*EL.*

*In spark*EL, we're aiming at not simply teaching skills to the children. We focus on making sure they understand what they're doing, why and how to take responsibility for their own behavior, thinking and emotions. Metacognition is crucial to developing self-regulation.*

***spark*EL features addressing this***:

Throughout spark*EL, children are encouraged to reflect on their own actions, thinking and emotions. The lesson plans outline how to help children think about what they're able to do and what they did so they can note changes and learn to self-monitor. The children are prompted to develop vocabulary related to their thinking, attention, understanding, behavior, etc. so they can engage in self-talk and self-reflection. The child's self-knowledge is emphasized throughout spark*EL; he's helped to understand his motivations and goals. Self-reflection transforms the way learning occurs[xlv].

*Need/feature identified*:

**Cognitive strategies** are important to helping the child engage more fully and autonomously in his own life. Mel Levine, a knowledgeable American pediatrician who championed people with learning differences, addressed this issue. He described "*the Essential Cognitive*

*Backpack*[xlvi]", a set of skills children with learning challenges need in order to become successful adults. The four main components in the Essential Cognitive Backpack are: (1) learning how to take in clear and complete verbal and nonverbal information and check to make sure they understand it; (2) learning how to organize activities and projects through discussion and brainstorming with others as well as making plans and setting priorities; (3) collaborating with others and forming productive and appropriate working relationships with people of different status; and (4) knowing your own strengths, passions and weaknesses and setting appropriate personal goals. These components blend well with the three main reasons for the failure of adults with ASC to achieve higher levels of education, employment and independence discussed in Chapter 1.

***spark*EL features addressing this*:**

To address these issues, spark*EL uses an information processing model to guide lessons in the Cognitive Self-regulation unit. The three main phases of processing in the model include: intake of information, integration and output or expression. At the intake stage, lessons focus on helping the child learn to work systematically and search for the most relevant information while ignoring distractions, look for signals, clues and models and retain the information long enough when determining what to do. At the Integration phase, the child is taught how to bring together multiple pieces of information to make a whole scene or image, visualize information he hears and check his understanding of things he hears and sees. At the output stage, the child learns to provide precise descriptions that are clear to other people. These all contribute to the skills in a Cognitive Backpack.

*Need/feature identified*:

**Generalization** of skills and strategies is typically weak in people with ASC and variable interventions for improving executive functions. It's critical that attention is paid directly to turning knowledge into action in realistic ways that represent everyday life.

***spark*EL features addressing this*:**

spark*EL includes clear and explicit ways of helping the children (a) understand the usefulness of the skills and strategies to their everyday life, (b) clearly identify times and places where the skills and strategies will be used, and (c) receive support and encouragement in using them in day-to-day life. Every skill presented in spark*EL is practiced first to help the children understand that they are capable of doing and modulating it (for example, walking slowly as well as fast). Then they help to identify (with input from parents) when and where in their lives the skill would be useful. To aid extension of the skill into everyday life, the children are helped to become more resilient and use the skill even in adverse situations (like, when they are tempted to run in their temple, church or mosque). The final step is to help the children learn how to advocate for themselves. That is, if they are having difficulty using their new skills in a situation, they learn many ways to help themselves regain a sense of equilibrium.

*Need/feature identified*:

**Mindfulness** is effective in helping children improve their self-regulation. We know that severe anxiety occurs in 40% of children with ASC[xlvii] but as many as 84% experience at least some symptoms[xlviii]. Anxiety-related concerns are among the most common problems for school-

age children and adolescents with ASC[xlix]. They may be reflected in specific phobias, obsessive compulsive disorder, social anxiety, separation anxiety and generalized anxiety[l,li]. Anxiety can cause acute distress, intensify the symptoms of ASC and trigger behavioral difficulties including tantrums, aggression and self-injury[lii]. In addition, anxiety has adverse effects on thinking and learning as well as executive control of attention and inhibition[liii].

***spark*EL features addressing this***:

Mindfulness brings an important element to improving self-regulation as well as to anxiety reduction. In the Behavioral Self-regulation unit, beginning mindfulness is introduced in the form of Turtle Breathing. This calming and centering strategy is used throughout the subsequent lessons and activities and is encouraged and supported in everyday life. Turtle Breathing is a way to redirect the child's attention to the sensation of breathing and away from other things that may be distracting or disturbing him. We also combine Turtle Breathing with 'cooling down' strategies like visualizing pleasant things and people.

*Need/feature identified*:

**Increasing independence from adult supervision and prompting** is an important focus. As seen in the support needs of children and adults with ASC in Chapter 1, specific work needs to be done in this area if true self-regulation and greater autonomy are to be achieved.

***spark*EL features addressing this***:

From the beginning of the Behavioral Self-regulation unit, there's specific focus on reducing adult direction. Each activity is practiced through a progression of three stages: (1) direct imitation of the adult to (2) imitation of a peer and finally to (3) self-direction.

Throughout spark*EL, the child is asked to evaluate his own performance ("How did you do?"). This is done deliberately and often in order to promote the child evaluating his own performance and not waiting for an adult to determine whether he did well or not.

*Need/feature identified*:

**Inclusion of a physical exercise/movement** has a positive impact on developing self-regulation skills.

Children with autism typically have sensory-motor difficulties[liv, lv,lvi]. They seem to have particular problems with motor acts that involve balance and finely-controlled movements. This may reflect impaired sensory processing in addition to motor control difficulties[lvii].

***spark*EL features addressing this***:

Quite naturally the Behavioral Self-regulation unit incorporates physical activity. An important part (and culmination) of this unit's the inclusion of yoga. It allows combining Turtle Breathing with whole body movement and balance.

*Need/feature identified*:

The program should involve **consistent focused teaching and practice that extend over multiple sessions**. Learning self-regulation is not a 'one shot' issue; it takes time and practice to become self-regulated. Remember, typical development of self-regulation takes at least two decades of learning and refinement. With many children with autism, there'll also be some un-learning that needs to take place in order to move ahead.

***spark*EL features addressing this***:
spark*EL has three main units and a total of 44 lessons. Although lessons may be combined, the structure of spark*EL requires multiple opportunities for practice and extension into everyday life. Each lesson describes the level of success/accuracy a child needs before moving to the next lesson.

## Main structure of spark*EL

spark*EL's three main units are: Behavioral, Cognitive and Emotional Self-regulation, as shown in Figure 5 below.

Each child must start the program with Behavioral Self-regulation so he has the opportunity to work successfully on consciously control his body and attention and calming and centering himself.

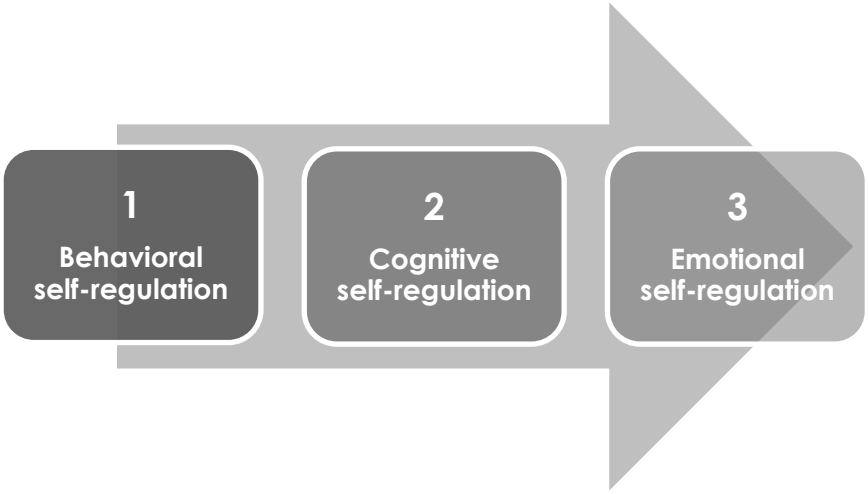


**Figure 1.** Diagram of the progression across the three main units of spark*EL.

Within each unit of spark*EL, the children learn skills and strategies that serve as foundations for skills and strategies presented in subsequent lessons. The child's newly-acquired ability to consciously modulate his body, attention and calmness is integrated into cognitive processing skills within the Cognitive Self-regulation unit which then combine to facilitate Emotional Self-regulation.

Because of this, it's **critical that all children start with the Behavioral Self-regulation unit,** complete it and then proceed to the Cognitive Self-regulation unit. Once the Cognitive Self-regulation unit is completed, the Emotional Self-regulation unit can begin.

### Behavioral Self-regulation

Behavioral Self-regulation is the first area addressed. It involves physical activities that can be directly prompted and shaped. In learning to self-regulate his actions, each child develops an understanding that he can vary how, when and where he uses his body and can do so in flexible, situationally-appropriate ways.

Behavioral Self-regulation skills are presented in two main areas of focus: breathing and whole body. These areas are practiced through a series of four different areas of skill development toward autonomy and self-direction: (1) Awareness of Ability, (2) Awareness of Need, (3) Resilience and (4) Self-advocacy.

### Cognitive Self-regulation

Cognitive Self-regulation refers to the ability to control and modulate how and when the child uses his cognitive resources. The child is helped to gather important and relevant information, ignore distractions, check his understanding of the information and form a response.

Cognitive Self-regulation skills are presented in three different areas of focus: (1) complete and accurate intake of information, (2) integration of information with specific emphasis on combining visual and verbal information and (3) clear and precise expression of knowledge. Each of these areas is practiced through the same areas of skill development used in Behavioral Self-regulation: Awareness of Ability, Awareness of Need, Resilience and Self-advocacy.

### Emotional Self-regulation

Emotional Self-regulation involves detecting, interpreting and responding to emotions, based on both internal and contextual information. The term 'regulation' may suggest controlling or stifling your emotions but this isn't the intent. Instead, Emotional Self-regulation is focused on helping the child understand situations and experiences more accurately and then selecting responses that are more appropriate. We want each child to manage his emotions in flexible, situationally-appropriate ways (for example, a child who becomes angry at a sibling but, through self-regulation, can tone his typical response down from hitting or scratching to walking away or telling an adult).

Emotional Self-regulation skills are presented in three different areas of focus: (1) detection of social clues, (2) interpretation of clues and (3) forming a response. Each of these areas is practiced through three of the same areas of skill development used in the Behavioral and Cognitive Self-regulation units: Awareness of Ability, Awareness of Need, Resilience and Self-advocacy.

## Key points in this chapter

Intervention in the form of specially-designed computer programs, some interpersonal programs (like, *Tools of the Mind and UOT*), neurofeedback, physical exercise and mindfulness practices can improve at least some aspects of self-regulation.


spark*EL is a comprehensive evidence-based program for improving self-regulation in children with special needs, with specific focus on children with autism.


spark*EL incorporates the main features of the most effective programs for improving executive functions and self-regulated learning.


spark*EL is comprised of three main units: Behavioral, Cognitive and Emotional Self-regulation.


The three units of spark*EL successively build skills and strategies that form the foundation for each other.

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