

## Self-Regulation and the Management of Childhood Obesity

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### Abstract

Failure in self-regulation has been proposed as a moderator in the development of overweight and obesity, primarily through its effects on deregulated eating behavior. As a result, it might cause regulatory problems in the energy balance, as well as rapid weight gain from early childhood through adolescence. Self-control is the exertion of control over the self by the self. Self-control occurs when a person (or other organism) attempts to change the way he or she would otherwise think, feel, or behave. Thus, self-control may be viewed as part of self-regulation. Parents and health care providers face the challenge of helping children practice regulation and develop coping skills alongside the ability to take care of their own well-being.

This paper attempts to bridge the gap between self-control theories and interventions for the management of childhood obesity. The dietary restriction approach will be compared with the trust paradigm, which emphasizes children's internal hunger, satiety cues and a division of responsibilities between parents and children.

**Keywords:** Childhood obesity; Self-control; Self-regulation

### Introduction

The term *self-regulation* refers to the cognitive processes that govern drives and emotions [1]. *Self-control* refers to the ability to deliberately regulate one's emotions, urges and desires and can be viewed as aspect of self-regulation [2]. Several studies implicate difficulties in self-regulation in the development of overweight and obesity, primarily via deregulated eating behavior [3]. In a prospective longitudinal study, Duckworth et al. [4] found that self-controlled children are protected from weight gain in the transition to adolescence. Francis and Susman [5] found that children with low self-regulation had significantly higher body mass index (BMI) and more rapid weight gain from age 3-12 than other children. These findings suggest that in early childhood, self-regulatory problems are important longitudinal predictors of weight problems in early adolescence.

Children learn to practice self-control skills in the home environment by settling disagreements rationally rather than taking revenge, eating healthy food rather than junk, saving rather than spending, concentrating rather than disrupting the class, being careful rather than thrill-seeking and considerate rather than greedy [6].

With significant burdens of disease attributable worldwide to the obesogenic environment and to weight-related problems, the role of parents has perhaps never been more important in the management of deregulated eating [7,8]. They must find a way to help their children internalize self-regulation, develop coping skills and become physically and emotionally independent.

This paper will explore the relevance of self-control theories to the management of childhood obesity. The relationship of dietary restriction to self-control theories will be examined. The dietary restriction approach [9] will be compared with the trust paradigm, which emphasizes children's internal hunger, satiety cues and a division of responsibilities between parents and children [10].

### Self-regulation

"Self-regulation" often refers broadly to the capacity to alter thoughts, feelings, desires, and actions with respect to certain goals. It infers active agency and is vital, since without it we would be helpless spectators. Self-regulation involves self-observation, judgment, and self-reaction [11]. The ability to regulate and control feelings and

behaviors is a major accomplishment of the human species, yet the psychological mechanisms involved are incompletely understood. The absence of self-regulation skills is often related to interpersonal difficulties, addictions, emotional eating and weight-related problems [2]. While the capacity to self-regulate may vary across situations, some studies suggest it is more trait-like than state-like [12]. Self-regulation in early childhood has been linked to parental and teacher ratings of self-regulation or impulsivity later in life [13] and recent studies indicate it is both a trait and ability [14]. People with strong self-regulatory abilities can control their impulses much more easily than those without them, and are thus less prone to emotional eating and indulgence when tempted [12].

### Self-Control

Self-control refers to the capacity to alter one's responses and align them with ideals, values, morals, and social expectations, and the capacity to pursue long-term goals. Whereas 'self-control' and 'self-regulation' are often used interchangeably, those who make a distinction typically consider self-control as a deliberate, conscious, aspect of self-regulation. Self-control facilitates the restraint of overriding of a response, enabling a different response [11].

Self-control comes into play when people are torn between long-term goals to restrain behavior and immediate impulses promising hedonic fulfillment. Like self-regulation in general, it involves self-observation, monitoring and behavioral control. Monitoring requires awareness of the discrepancy between impulsive reactions and goals or values. Behavioral control includes resisting the urge to respond impulsively to temptation [15].

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Self-control deficiencies and *impulsivity* or impulse control problems are related [16], and often imply a failure to consider the consequences of one's actions. Resisting the temptation of immediate pleasure leads to behaviors indistinguishable from those that occur without forethought.

Posner and Rothbart [17] coined the related term “*effortful control*” that is needed to adapt to social demands. Effortful control includes managing attention (*attentional regulation*) and either inhibiting (*inhibitory control*) or activating behavior (*activational control*). It underlies, for example, the ability to focus on health and exert self-control despite a tempting smell of cake, and involves: 1) Alerting (maintaining an alert state); 2) Orienting (focusing on desired information); 3) Executive attention (focusing on goals, planning and decision-making).

Extending this view, Hoffman et al. [18] suggest a *dual system perspective* involving the interplay between: (a) reflection (evaluation of reward value, restraint); (b) impulsive precursors of behavior, such as motor impulsivity; and (c) determination of situational and dispositional boundaries, such as weakness or negative emotionality, which may involve a shift to a different reward value. ss

In their seminal work [19], Mischel and colleagues define “*delay of gratification*,” as the time individuals wait to obtain a reward of greater value [20]. They explored when children forego a small, immediate reward for a larger future reward. Similar concepts include “delayed reward,” “self-discipline” and “self-regulation” [21-23]. Delay of gratification behavior follows different patterns for different people [17]. This interconnection between cognition, behavior and situational/dispositional boundaries is supported by brain research [24]. There is evidence that positive and negative emotionality activate the prefrontal cortex differently [25], possibly affecting attention and self-control [26].

Moreover, the reward-surfeit model of obesity holds that hypersensitivity of reward circuitry leads to overeating and substance use [27]. However, findings suggest that obese humans show less activation of reward regions to food receipt, but greater activation in regions that encode the reward value of food cues [28,29]. Stice et al. [30] found that normal-weight adolescents at high-risk versus low-risk for future obesity showed greater activation in the dorsal striatum in response to palatable food receipt. This suggests that the initial vulnerability that gives rise to obesity may be elevated.

### Moderators of Self-regulation

Several moderators may be related to difficulties in self-regulation and thus to weight-related problems:

#### Individual differences and state variations

Although self-regulation generally develops over the life span, people differ in their degree of impulsivity when faced with temptation [17]. These individual differences no doubt result from genetic, pre-natal and postnatal environmental influences, as well as learning history and current need states [31-34].

#### Hierarchy of values and reward value

A person strongly tempted to accept a piece of chocolate yet wanting to restrain caloric input will experience internal conflict between the value of pleasure and the value of restriction [35]. Immediate value is coded by the *reward system*. The value of sensory stimuli has been called *reward value* [36]. Higgins' regulatory engagement theory [36] related this concept to value estimations

and engagement. Overcoming temptation to do something pleasant strengthens engagement and increases the reward value of *the related actions*, as occurs in dieting. Fishbach & Zhang [35] proposed that we represent goal actions either in terms of progress toward a desirable end state, or in terms of commitment to this end state. In a self-control conflict, a high order goal offering delayed but larger benefits conflicts with a low order “temptation goal” offering immediate but smaller benefits [31] For an obese person, for example, food restriction offers delayed long term benefits. Eating large quantities of rich foods, on the other hand, offers immediate, yet smaller benefits. In self-control failures, people diminish the discrepancy between their goals and the temptation (“food restriction won't help slim. I'll never lose weight”) and find a “balance” that protects them from a conflict between goals and temptations. These self-control failures result, paradoxically, from a lack of awareness of the intensity of internal conflict [35].

### Emotional distress and ego depletion vs. ego strength

Emotional distress may work against a general pattern of impulse control because it leads to a short-term focus, whereas impulse control requires a long-term focus. Emotional distress probably enhances the tendency to seek immediate sources of good feelings. Many of the common foci of self-regulatory restraints offer immediate pleasure: alcohol, drugs, high-calorie foods, illicit sex, extra sleep, shopping, and entertainment. In weight-related problems, impulse control may fail because distress leads to affect regulation [37], which takes priority over the value of healthy eating.

As a consequence of the short-term need to suppress negative emotions, overeating may deplete long-term self-control resources [37]. According to Baumeister and colleagues' *self-control strength theory* [14], self-control is a limited resource that works like a muscle. Exertion depletes this energy, which replenishes itself periodically [22]. ‘Ego depletion’ [22] is used to denote low-energy states with impairment of the mental activity necessary for self-control. Baumeister et al. reported that participants who controlled themselves by trying not to laugh while watching a comedian later performed more poorly on a task requiring self-control than participants who did not control their laughter while watching the video [22]. Nevertheless, they continue their muscle analogy by claiming that muscles tire after exercise, but are strengthened by it in the long run. Stice et al. [38] found that a positive mood stimulus helped restore depleted energy.

Actions leading to self-censure are unlikely to be pursued. This idea is of relevance to eating. Vulnerability to overeating in non-eating-disordered overweight individuals is associated with increased negative affect [39]. Social-emotional self-regulation and cognitive self-regulation are interconnected; the same neural system is responsible for emotional control and meta-cognitive functions [24]. If the capacity to mentally represent, shield, and update restraint standard is reduced, self-monitoring resources may be depleted [40].

The reflective system is responsible for deliberate judgments, strategic action plans for goal pursuit, and inhibiting or overriding pre-potent responses such as impulses or habits [28]. These processes are relatively slow and controlled, based on symbolic representations and operations [41]. Limited control resources may impair the reflective system by undermining its ability to symbolically represent restraint standards and monitor behavior according to those standards. The reflective system may then fail to activate, inhibit or override behavioral schemas. Karpinski & Steinman [42] measured automatic affective reactions to candy under two conditions. Participants drank orange juice with (alcohol condition) or without (control condition) vodka. An intermediate filler task allowed the alcohol to take effect. As expected,

only participants in the control condition, but not participants in the alcohol condition, restrained their candy consumption according to their dietary restraint standards. Automatic affective reactions predicted candy consumption for intoxicated but not sober participants. These results indicate that under alcohol intoxication, strong impulses affect the quantities of food we consume.

### Restrained eating

Self-regulatory resources also moderate the influence of restraint on eating behavior. Restraint standards normally guide behavior effectively in tempting situations, but not when participants' self-regulatory resources are depleted [43]. Both automatic affective reactions and approach-avoidance tendencies are affected by physical deprivation [33,44]. Dieters, who constantly seek to restrict food intake, therefore eat more when self-regulatory resources are depleted. In contrast, non-dieters, who eat freely according to internal hunger and satiety, do not eat more than usual when their self-regulatory resources are depleted [44]. Nevertheless, choosing not to eat for intrinsic reasons may deplete less strength than feeling compelled by extrinsic reasons to exert self-control when eating [45]. Lowe [46] argues that dieting to reach a weight lower than one's desirable weight for height is potentially harmful. For individuals, overweight or gaining weight, he believes the potential benefits of dietary restriction may outweigh the risks overeating in response to restraint.

### Exposure to temptations and tempters

Exposure to temptation can undermine self-regulatory functioning [22] whereas preschool-age children can self-regulate energy intake in controlled laboratory conditions [23], this ability is easily disrupted by social and situational factors [36].

*Contextual factors* can suppress the appeal of a temptation. Leander and colleagues [47] found that individuals with chronic self-regulatory problems who were tempted to smoke marijuana were more likely to resist temptation if they had a distant rather than a close relationship with the tempter. So even if no important goal exists, the natural shield of chronic self-regulatory tendencies may sometimes prove sufficient in temptation-laden social contexts. Since obese people tend to control their eating better with company than without, family meals may be a protective factor for obese children.

Fisher & Kral provided evidence that large portion of energy-dense foods increases energy intake in children as young as two [48]. A reward must be both immediate and self-relevant for people to be tempted by it [49]. Thus, we tend to buy more food when we are hungry. It may be hard for a restrained eater to resist food when it is available and (s)he is hungry. Jansen [50] provided evidence for "cue reactivity": when sensory cues were systematically associated with food intake, they reliably triggered early (cephalic phase) effects of food, such as increased blood sugar and salivary flow. Overweight children fail to regulate their food intake when tempted by the smell and taste of appetizing food. In this case, overeating is related more strongly to induce salivation flow than to psychological factors [50].

### Development of Self-Control

Self-control is a psychological skill involving higher mental processes and attention-focusing abilities that can help prevent weight-related problems or help manage them. Although biologically based, it can be learned. Research suggests that it develops with the repeated activation of relevant neural systems, just like a muscle [51].

According to Vygotsky's cultural-historical cognitive theory, with

the development of self-regulation, we become able to control certain behaviors to acquire "higher mental functions" [52]. Self-regulated behaviors enable children to make the critical transition from "slaves to the environment" to "masters of their own behavior". Vygotsky explains that this process involves the mastery of specific cultural tools like language and other symbolic systems, to gain control of physical, emotional and cognitive functions. Children's self-regulatory abilities originate in social interactions before being internalized [53].

Though influenced by individual temperament, self-regulatory competence involves skills that develop during childhood and adolescence. These are taught formally or informally within the social context and can therefore be enhanced by intervention programs [54]. Values or norms are most effectively transmitted when perceived as a choice rather than a by agents of socialization and are then adhered to in the absence of external surveillance, hope of reward, or fear of punishment.

Vygotsky [53] suggested three conditions for the development of self-regulatory behaviors in children. Firstly, they need the opportunity to engage in "other regulation", to be the subject of others' regulatory behaviors (as in most interaction with adults) as well as agents regulating others' behaviors (as in most interaction with children). Secondly, they learn to master specific cultural tools that allow them to start using self-regulatory behaviors independently. When, for example, they engage in *self-talk* or "*private speech*", they take words that adults once used to regulate their behavior and use them for self-regulation purposes. Thirdly, well-developed, make-believe play provides opportunities to practice self-regulatory components of mental functions. During play, children fulfill their desires in symbolic form, learn to delay gratification, and adopt different perspectives.

1. Gottman was the first to define "*meta-emotion*" [55] as an organized approach to the understanding of emotions. He said that parental meta-emotion influences children's capacity for physiological and emotional regulation and that talking about emotions develops self-regulation [56]. He claimed that parents can coach their child: Being aware of their child's emotions
2. Seeing their child's emotion as an opportunity for intimacy or teaching
3. Helping the child to label his/her emotions
4. Empathizing with or validating the child's emotion
5. Trying to understand the feelings underlying misbehavior
6. Helping their child down-regulate emotions
7. Setting clear limits on behaviors, joint problem solving.

Self-regulatory capacities develop optimally when both parents practice meta-emotion coaching and model self-regulation.

According to social cognitive theory, the ability to regulate one's health can be taught via social modeling, support, and feedback. External supports are gradually withdrawn as self-regulation develops. According to Bandura's triadic model [1], we regulate our health by adopting self-care strategies, setting goals, and monitoring feedback on the effectiveness of the strategies used. Perceived self-efficacy in turn enhances motivation to self-regulate health.

The repeated activation of a neural system causes it to expand [51]. Current brain research underscores the importance of the environment (training) in the development of self-regulation. Repeated acts of self-regulation increase our total pool of energy [49]. According to

Strayhorn [6], self-control is fostered by: 1. a positive, long-term relationship with a dependable person who communicates the value of this goal; 2. carefully chosen self-control challenges at a suitable level of difficulty; 3. positive self-control models; 4. frequent, graded practice; 5. enjoyment of valued rewards obtained by effort; 6. fantasy rehearsal; 7. compliance skills; 8. relevant verbal concepts (including a term for self-control itself); 9. Removing oneself from temptation; and 10. Self-monitoring skills [6].

Diverse and complex strategies to improve self-control and bolster the value of long-term goals in the face of temptation [20,57-59] have been suggested. Hoffman et al. [18] suggest that self-control interventions are most effective if they simultaneously (a) change attitudes, beliefs, and control standards via interventions such as cognitive restructuring, education, or persuasion, (b) create situational and dispositional circumstances conducive to effective self-control, and (c) change problematic impulsive precursors of behavior. Recently, they demonstrated that mental self-control strategies such as “cooling” thoughts (imagining chocolate in a non-consummatory manner) and implementation intentions (instructions not to eat the chocolate) reduced the strength of automatically activated affective responses to a tempting stimulus [60]. Baumeister and colleagues [61] posited that self-control skills may be strengthened by exercise and practice just as a muscle is fatigued in the short run but strengthened in the long run by exercise.

## Parenting, Self-Control and Weight-Related Problems

Although self-control is a trait, it can be developed and enhanced [62]. By regularly adopting the above guidelines, parents can help their children develop effortful control and the ability to delay gratification. Gottman [55] suggests placing clear limits on behavior to promote self-control and self-regulation. However, parents who are overweight, who have problems controlling their own food intake, or who are concerned about their children’s risk for overweight sometimes adopt controlling child-feeding practices (authoritarian parenting style) in an attempt to prevent overweight in their children [56]. This may be counterproductive in the challenge of developing internalized self-control. According to Baumrind’s theory of parenting style, a child is more likely to comply with parental control and internalize it when it is perceived as fair and reasonable [63].

Parenting style is a complex notion denoting specific behaviors that work individually and collectively to influence outcomes in children. It is intended to describe normal variations in parenting, with a focus on issues of control [64]. Two important features of parenting style are [65]: 1. Responsiveness, or “the extent to which parents intentionally foster individuality, self-regulation, and self-assertion by being attuned, supportive, and acquiescent to children’s special needs and demands”; and 2. Demandingness, or “the claims parents make on children to become integrated into the family whole, by their maturity demands, supervision, disciplinary efforts and willingness to confront the child who disobeys.” Baumrind uses these features to define three parenting prototypes: permissive (indulgent), authoritarian and authoritative styles [64].

## Permissive parents

Permissive parents are more responsive than demanding and essentially allow children to make their own decisions and regulate their own activities. Such parents may avoid setting boundaries recommended by the American Academy of Pediatrics Committee [66]. Parental over-permissiveness, over-protectiveness and a lack of authority can lead to uncertainty, insecurity and self-regulation

difficulties in children [67,68]. Since self-regulated eating is difficult in the obesogenic environment, it is hardly surprising that the permissive parenting style has been shown to be counterproductive in the management of weight-related problems [67].

## Authoritarian parents

Authoritarian parents are high in demandingness and low in responsiveness [69]. This style correlates negatively with children’s psychosocial well-being [70] and positively with obesity [71,72] and eating disorders [73]. Authoritarian parents lack the sensitivity to assess their child’s self-regulating ability before making behavioral demands and may expect behaviors beyond the child’s developmental ability. Authoritarian parenting style, negatively associated with healthy child development [74,15], involves overt psychological control via parenting practices such as the induction of guilt or shame and the withdrawal of love, which hinders children’s psychological and emotional development and control over food intake [74]. Faith et al. [75] found that parental restriction of their child’s food intake predicted increase in BMI two years later. Parental style was not measured in this study, so we do not know whether psychological control was an element of the parental restriction.

Authoritarian and authoritative parenting styles seem to impact children’s eating behaviors and responses differently. The association between authoritarian parenting and poor internalization of self-control [76], and between authoritative parenting and successful internalization [77] appear to be strongest in middle-class Anglo-Europeans. In other cultural contexts, authoritarian parenting is more likely to be the norm and less likely to be associated with negative outcomes. Since individualism is a supreme value in North American and Western European societies, authoritarian parenting style is perceived psychologically controlling. Yet in collectivist cultures, which value socialization, parents promote interdependence, cooperation, and unconditional compliance. They aim not to facilitate autonomy, and tend to inhibit a child’s personal wishes [78].

In Western cultures, overt authoritarian parenting may also enhance children’s greediness for food. According to Winnicott [79] the word ‘greed’ brings together the psychical and the physical, love and hate. He suggested greed appears in disguised form, even in infants, and that greediness is a symptom secondary to anxiety. Anxiety and greediness may be one outcome of authoritarian parenting, which lacks warmth [63], a factor important in motivating children to follow parental wishes [80]. Authoritarian parents also tend to make dispositional attributions for children’s misdeeds [81]. They tend to be angry, use reasoning to teach appropriate behaviors, and humiliate their children, which may lower the children’s capacity for self-regulation [82]. Many people in Western consumer society are highly anxious. Hypervigilance, attention bias and lack of self-regulation have been found to be key features of anxiety [83,84]. Greediness, emotional eating, disordered eating and lack of self-control may form a part of a coping mechanism with the anxiety associated with our society.

## The authoritative parenting

The authoritative parenting style, characterized by high levels of warmth and low levels of coercive control, has been associated with positive outcomes in child development across gender, ethnic and socioeconomic backgrounds [9]. Expectations from children are balanced by responsiveness to their needs. Authoritative parents are neither intrusive nor restrictive and tend to maintain an authoritative stance and to view the parental role as more collaborative and supportive than the authoritarian parents. Authoritative parenting

has consistently been linked with social competence and with a lack of behavioral problems in children of all ages [69]. Findings suggest that children raised in authoritative homes ate more healthily, were more physically active and had lower BMI levels, compared to children who were raised with other styles (authoritarian, permissive/indulgent, uninvolved/neglectful). General parenting has a differential impact on children's weight-related outcomes, depending on child and parental characteristics [85,86].

To prevent the counterproductive impact of authoritarian parenting style and its negative influence on children's ability to focus on their internal needs and develop self-control, Satter [87] suggests health care providers and parents rely on a "trust" paradigm instead of the currently widespread "control" paradigm. She proposes a division of responsibilities [87] between parents and children. Parents provide structure (e.g. regular mealtimes, sitting during meals), support, and new foods that children can reject or accept, and children choose how much to eat. According to this "authoritative feeding style", parents communicate age-appropriate demands to their children and model self-control while maintaining a non-intrusive stance. The risk for overweight in first graders is five times greater for those with authoritarian versus authoritative mothers [88]. Children of permissive or neglectful parents are twice as likely as children of authoritative parents to be overweight. Caregivers generally know what foods are healthy for their children but do not apply this knowledge during meal times [89].

Satter's trust paradigm appears to provide support for permissive parenting since parents trust their children to consume appropriate amounts of food. This may, however, be counterproductive in a child-centered environment, when career-oriented parents feel guilty for being insufficiently available. Despite good intentions, obese children may experience subjective failure when offered too many choices [9]. When permissive parents trust their children's ability to choose from many food options, they may be overlooking a tendency to feel overwhelmed and experience a lapse in self-control [90]. Parental trust in their children's eating behavior is warranted when the child has healthy eating habits and effective self-regulation [91]. However, when children are not offered a varied enough diet, they may make a habit of always eating the same foods. The tendency of morbidly obese children to overeat also presents parents with challenging decisions about when and how to intervene. With experience, we can learn to override innate self-control in order to obtain various short-term rewards, and develop creative control strategies.

The ability of three- to five-year-olds to determine appropriate portion sizes was examined in a study by Leahy et al. [92]. Breakfasts, lunches, and afternoon snacks were served two days per week for two weeks. During the first week, energy density of the foods served was low. During the second week, energy density was increased by adding fat and sugar and decreasing fruit and vegetable intake during the day. Dinner and an evening snack of constant energy density were sent home with children. Children consumed a consistent weight of foods and beverages over two days in both conditions, and their energy consumption was therefore 72 kcal (14%) less in the lower energy density condition, a significant result ( $P = 0.0001$ ). Reducing the energy density of children's diets may therefore be an effective strategy for reducing energy intake.

Kirschenbaum and Kelly [9] argue that dietary restriction is often an ineffective weight control strategy. Nevertheless, there is evidence that excessive restrictiveness leads to poor self-regulation and may contribute to child obesity [93]. Arguably, there is insufficient evidence

to determine the effectiveness of dietary interventions in treating excessive weight gain in children and adolescents [93]. However, a meta-analysis supports the effectiveness of some interventions including dietary modification, though effectiveness may decline over time. Luttikhuis et al. concluded in their review that childhood obesity interventions works, but only if combined with behavior modification [94]. The most effective interventions may be those that encourage parents to decide what is served (reducing energy density rather than food quantities) and children to decide how much they eat [91].

## Conclusion

Self-control and self-regulation can be developed and serve as buffers against emotional dysregulation and problematic eating behavior. There are no empirically-based guidelines for effective parenting practices or for external interventions promoting weight control. Not all children need to moderate their energy intake, so the need for reductions in energy density should be "weighed" carefully. Neither inappropriate levels of trust nor extensive restriction of food intake are effective in fostering self-control and self-regulation in eating.

Since restrictive feeding practices increase children's preferences for restricted and palatable foods [95] and promote overeating when restricted foods are freely available [4], parents should aim to control the environment rather than children's behavior. Moderate restrictions should be imposed on less nutritional foods. Social contexts promoting alertness (rather than vigilance) to long- versus short-term rewards should be provided to enhance self-regulation and self-control. This can be achieved without overt psychological control in most cultures via an authoritative parenting style and effective communication.

Self-regulation is built via effective communication at home, at school and in the health system. Three interrelated processes, in which language skills are paramount, contribute to it: information exchange, behavior influence, and problem solving [96]. As language is internalized, competent children and adolescents make increasing use of self-talk to describe and evaluate their thoughts, feelings and actions, and monitor their own behavior [97]. This enables children to acquire the foundations of self-regulation, on which affective, social and cognitive competence depend. A growing sense of competence enhances the development of self-regulation that paves the way to complex abilities that surpass mere compliance. These abilities include delay of gratification, impulse and affect control, modulation of motor and linguistic activities, and the ability to act in accordance with social norms in the absence of external monitors [98].

## Recommendations for future research

Additional research is needed to further study the association between self control mediating and moderating factors and child's weight status.

The next generation of programs should engage new models such as behavioral economics to foster self control among children with hyper or hypo sensitivity of reward circuitry. Future research needs to identify the components or types of treatments that achieve the most comprehensive and persistent effects on child's self control. How parenting programs address the need to train parents to enforce self regulation and self control in their children.

Given the lack of current intervention studies addressing general parenting and their impact on child's self control and weight status, further development and testing of theory and practice based interventions is strongly recommended, preferably employing a longitudinal design with more extended follow-up periods to establish causation.

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