Realistic estimations indicate that some 780 million children may experience intellectual disabilities between birth and the age of five years (Olness, 2003). This figure represents the growing number of identifiable biological and environmental factors associated with intellectual disability, as well as those conditions that mean children are placed at risk.

Apart from the growing number of genetic and infectious causes of intellectual disabilities that are now recognized, conditions that can also lead to intellectual disability include: malnutrition, fetal alcoholism, cranial trauma, lead poisoning, low birth weight, and cancer, among many others. Environmental causes include the effects of poverty, the abuse of minors, and child neglect (Guralnick, 2000). These environmental causes often work in conjunction with biological conditions (Msall et al., 1998; Fujiura and Yamaki, 2000; Park et al., 2002). Furthermore, when we consider potential causes or risk factors, it is the cumulative effect that represents the greatest threat to the intellectual development of children (Sameroff et al., 1987; Burchinal et al., 2000). The number of children who are likely to experience intellectual disability in the world is overshadowed only by the diversity and complexity of the developmental patterns (Guralnick, 2005a).

However, expectations are relatively optimistic with regard to what can be achieved during the first six years of life if good early intervention (EI) programs are applied; that is, systematic, multidisciplinary programs based on experimentation (Guralnick, 1998).

Why are we focusing on Down syndrome?

Of the 750 to 1000 genetic–chromosomal disorders that cause intellectual disability, Down syndrome (DS) is the only one with a research record that dates back to the early nineteenth century (Seguin, 1846). As the most frequent genetic cause of intellectual disability, DS has served in numerous studies as the control or contrast group for those analyzing other forms of disability (Hodapp, 2008). DS is also the only genetic disorder for which life expectancy has doubled in the last 30 years (Bittles & Glasson, 2004) and which has been etiologically linked to the neurological modifications of Alzheimer’s disease (Zigman & Lott, 2007). Moreover, it is detected at birth and children with DS represent an etiologically homogeneous group, although one of its most notable characteristics is precisely its diversity as regards developmental progress (Perera, 1999).
This is why we are regarding it here as the paradigm of intellectual disability, because we believe that in general, and without underestimating syndrome specificity (discussed below), the principles and practices of EI are useful for other disorders of genetic origin (fragile-X, Williams, Turner, Cri du Chat, Angelman, Prader-Willi, Asperger syndromes, etc.) that have not been as widely studied as DS.

**Definition of early rehabilitative intervention**

Since the 1970s in the United States and Europe, especially Spain, numerous definitions of EI have been put forward (Bricker & Bricker, 1971; Hayden & Dmitriev, 1975; Shearer & Shearer, 1976; Villa Elizaga, 1976; Coriat, 1977; Hanson, 1977; Gutiérrez et al., 1993; Candel, 1998; Dunst, 1998; Guralnick, 1998). From the 1990s onwards, a great deal of research has also been undertaken on how children with DS and other developmental disorders function at various stages of their development, in order to design intervention strategies that are more closely adjusted to their specific needs (Dunst, 1990, 1998; Candel & Carranza, 1993; Spiker & Hopman, 1997; Wishart, 1997; Beeghly, 2000).

In parallel to this, a greater implication of the family has made it possible to design and execute numerous studies that have attempted to investigate the family characteristics of children with DS, their reactions and their ability to adapt to the new situation of having a child with DS, and the relation of a series of family variables with the child's development (Crnic et al., 1983; Erickson & Upshur, 1989; Harris & McHale, 1989; Sloper et al., 1991; Candel et al., 1993; Minnes, 1998; Stoneman, 1998).

Furthermore, on reviewing the research carried out on the plasticity of the central nervous system, two intriguing issues arise: (1) It is clear that neurophysiological events are revealed in response to experience, allowing the brain to organize itself. This is a strong argument in favor of intervention, given that experiences are translated into specific changes at the level of the nervous system and behavior. (2) There is also evidence that modifications of the nervous system are not limited to the first months of life, which raises the question as to whether intervention could be effective at other periods of life (Nelson, 2000). Indeed, there are those who claim that intervention should not only be early (i.e. during the first years of childhood) but rather should continue throughout a person's lifetime (Flores, 2005).

From this, two principal assumptions also arise that provide the basis or reason for EI: on the one hand, the fact that genetic and biological problems can be overcome or minimized; on the other hand, the supposition that early experience is important for the development of children. As a result, there are three theoretical arguments that form the basis of the development of EI programs:

1. Children with developmental problems need more and/or different early experiences compared to children without problems.
2. Programs with specialized personnel are necessary to help provide the early experiences that are required to compensate for developmental difficulties.

These days, all over the world EI is envisaged as comprehensive care provided to children and their families during the first months and years of life, as a result of disorders in development or because of high-risk situations. Intervention consists of medical, educational, and social
treatment that directly or individually influences the functioning of the parents, the family, and the child.

Along this line the Spanish White Paper on Early Intervention (Libro Blanco de la Atención Temprana) defines it in Spain as “the set of interventions directed at infants between birth and six years of age, the family and the environment, with the aim of providing as rapid a response as possible to the transitory or permanent needs that the children present, or have the risk of presenting, in their development. These interventions, which have to take the child as a whole into account, must be planned by a team of professionals with interdisciplinary or transdisciplinary training” (GAT, 2000).

Objectives

The following objectives result from the definitions above:

- Reduce the effects of a deficiency or deficit against the child's overall development.
- Optimize, as far as possible, the course of the child's development.
- Introduce the necessary mechanisms of compensation, elimination of barriers, and adaptation to specific needs.
- Avoid or reduce the appearance of secondary or associated effects or deficits produced by a disorder or high-risk situation.
- Attend to and cover the needs and requirements of the family and the environment in which the child lives.
- Consider the child as an active subject in the intervention.
- Consider the family as the main agent of the intervention.

As a result, EI programs aim to:

1. Provide parents and the entire family with the necessary information, support, and advice, so that they can adapt to the new situation and maintain adequate affective relations with the child.
2. Enrich the environment in which the child is going to develop, providing adequate stimuli in all aspects to favor development.
3. Encourage the parent–child relationship, preventing the appearance of inadequate interactive styles.
4. Increase the child's progress as far as possible to achieve independence in the different areas of development.
5. Employ intervention strategies in a natural context and through the child’s routine situations, avoiding excessively artificial formulae.
6. Take preventive action as EI programs make it possible to slow down the progressive deterioration of development levels to some extent, thereby preventing the child from presenting more serious disorders in different developmental aspects. This preventive facet also extends to the rest of the family environment, with adequate behavior that is better adapted to the reality of the situation being established from the start.

Early intervention models

Traditional models based on behavioral criteria that inspired EI programs up until the 1980s are now obsolete, and today models are employed that have at least two points in common:
they envisage human development as a transactional process, and they have been widely applied to deficient or high-risk children.

Over the last decade three theories have been proposed that have had a decisive influence on the incorporation of new approaches: the Ecological Systems Theory developed by Bronfenbrenner (1979), the Transactional Model by Sameroff and Chandler (1975), and Feuerstein's theory of Structural Cognitive Modifiability (Feuerstein, 1980).

The ecological model underlines the complexity of development and the large number of environmental influences on children (Sameroff & Fiese, 2000). Ecological theories posit that ecological frameworks and social units, as well as people and what happens to them, do not operate in isolation, but that each influences the other, both directly and indirectly, so that changes in a unit or subunit have an impact on and influence members of other units (Dunst & Trivette, 1988). The theory of social support attempts to describe the properties of social units, the relations between these and how social support improves the well-being of the individual, family, and community (Cohen & Syme, 1985).

Human ecology places emphasis on the interactions and adjustments between children undergoing development and their animate and inanimate environments, and on how events in different ecological frameworks directly and indirectly affect a person's behavior (Bronfenbrenner, 1979; Cochran & Brassard, 1979). Adaptive theory attempts to explain how ecological influences affect reactions to the birth and upbringing of a child with problems, and how diverse ecological forces have positive and negative influences on the ability of the family to deal with and adapt to the birth and education of a child with developmental difficulties (Crnic et al., 1983).

The Transactional Model is based on the capacity of social response of the environment and on the interactive nature of the child–environment exchange. From this perspective the child's development is the product of constant dynamic interactions between the child and the experiences provided by the family and social context. The innovative aspect of this model, according to Sameroff and Fiese (2000), is that it places equal emphasis on the effects of the child and the environment, so that the experiences provided by the environment are not envisaged as independent from the child. The child may have been a determining factor in current experiences, but developmental performance cannot be described systematically without an analysis of the effects of the environment on the child.

The main consequences of applying this model to the field of EI are as follows: (1) the parent–child dyad must be the objective of home-based intervention; (2) children learn and develop by means of positive, reciprocal exchanges with the environment, especially with their parents; (3) the parents or carers, where appropriate, are the most important figures in the child's environment; (4) childhood is the best time to initiate intervention for children with developmental problems, children with a biological or environmental risk, and their parents, within the context of the family.

The theory of Cognitive Structural Modifiability maintains that by means of systematic, consistent intervention, it is possible to bring about changes of a structural nature that can alter the course and direction of cognitive development. In this context, cognitive development is the result of the combination of the direct exposure of the organism to environmental stimuli, related to maturing processes, and of mediated learning experiences, with all cultural transmission processes being implicated.

With good mediation there are no limits to cognitive development, irrespective of individual deficiencies. What is important is good interaction between the organism and its surrounding environment (Feuerstein et al., 1991).
This theory states that two types of factor have an influence in cognitive development: (1) distal factors, linked fundamentally to genetic, organic, environmental, and maturation factors, which do not cause irreversible damage to people; (2) proximal factors, related to the conditions and contexts of learning. Feuerstein and colleagues claim that it is possible to offer mediated learning experiences successfully to all individuals, whatever their condition or age, as the relevant factor consists only of the use of an appropriate type of mediated learning.

The active modifying environment must have the following characteristics: (1) organize the child's life in such a way that it provokes structural cognitive modification; (2) create positive reinforcements – trigger an imbalance in order to create changes; (3) promote challenges; in other words, planned, controlled confrontations with the new and the unexpected; (4) the heterogeneity of the environment is an important element for the development of higher cognitive processes; (5) individualized mediation.

As well as the three models outlined above, it is also worth making reference to the activity-based approach (Bricker & Cripe, 1992), which is founded on the theory of learning and on the work of various authors, such as Vygotsky, Piaget, and Dewey. It is based on three elements: (1) the influence and interaction of the immediate socio-cultural and larger environments; (2) the need for the active involvement of the child; (3) improvement in learning, occupying children with functional, meaningful activities.

According to this approach, the acquisition of knowledge and learning skills must take place within authentic conditions. These must include activities that reflect the reality and demands of everyday life. Children thus learn and practice skills that will improve their capacity to adapt to the numerous demands of their physical and social environments.

Finally, one of the models that is most widely used today as a result of the solid basis that it offers for intervention is that of early development and risk factors, contributed recently by Guralnick (1998). This model has three main components: family patterns, family characteristics, and potential stress factors. Both the family characteristics and stress factors tend to be distal to the child, while the family patterns are proximal and directly influence the child's development.

The family patterns component consists of three elements: the quality of parent–child transactions, family-orchestrated child experiences, and the environmental measures that improve the child's health and security. These factors are influenced, in turn, by the model's two other components. One of these, family characteristics, includes two wide contextual factors: the personal characteristics of the parents and the characteristics of the child, which are not related to his or her disability. The third component, potential stress factors due to the child's disability, can also distort the family dynamic. Guralnick classifies these factors into four categories: information requirements that arise as a result of the child's disability; interpersonal and family anxiety (reactions that arise as a result of the child's disability, relationship problems between the parents, negative reactions from people who are close to the family); resource requirements; loss of confidence in the ability to bring up a child with problems.

Guralnick (1998) proposes, moreover, that the intervention program should include the following components: resource supports (coordination and access to services); subsidiary supports (financial help, family relief programs); social support (parent groups, family guidance, friends, community networks); and information and services (formal intervention programs, communication between parents and professionals).

All these intervention models have common elements and coincide as regards principles that constitute the basis of the majority of current EI programs: (1) the importance of
socio-communicative exchanges between children and their environment is highlighted; (2) children are active learners; (3) emphasis is placed on learning in a natural context; (4) in order to achieve objectives, functional activities are employed that have meaning for children and which are inserted into their daily routine; (5) natural reinforcements are used; (6) the parents are the principal agents of the intervention and not mere recipients.

“Whatever the case, every professional has their own preferences and will have recourse to those premises that best adapt to their personal and professional circumstances. Experience tells us that, with the passing of time, we become eclectic and begin to take the best of the different options available until we create a tailor-made suit. Perhaps the models outlined above may be useful in making this selection” (Candel, 2003b).

The short- and medium-term challenges of early intervention

Challenge 1
Advances in genetic research in animal models and possible application to human beings
Laboratory experiments with trisomic, transgenic, and transchromosomal mice models are attempting to achieve results from three angles: (1) relating the phenotypic characteristics of DS precisely with the genes whose overexpression is responsible for these appearing. Which gene(s) are involved in the appearance, for example, of intellectual disability, cardiopathy, etc.?; (2) discovering the mechanisms as to why this happens: what does the overexpression of a gene do, so that a pathological modification of a specific organ appears at a specific age, in a specific person with DS?; (3) testing therapeutic measures that could be useful in the short and medium term: some gene related (gene therapy), others of a chemical nature (drugs that inhibit the excessive presence of a product caused by the overexpression of a gene), others of an immunological nature (vaccinations that neutralize the negative action of those same products, and others of a general nature (interventions directed at improving the mechanisms of learning or behavior) (Flórez, 2001).

In Chapters 3–6, and the final chapter of this book, extensive information is given about the advances made in genetic research in animal models and its possible application to human beings.

Challenge 2
Early intervention research and praxis have to be established from a multidisciplinary and interdisciplinary perspective
Environmental enrichment (the environment is capable of modifying cerebral function and structure), gene therapy (the possible substitution of a damaged gene for a normal one), and health and education programs have to converge necessarily with the objective of understanding the genotype and its specific causes. For many years, in developed countries, EI has been very fragmented and compartmentalized. In many nations controversy still exists regarding powers and jurisdiction (Social Services, Health, Education), which needs to be overcome. It is necessary to join forces. We must try to integrate the knowledge from molecular genetics, animal models and their experimental manipulation, new science, medicine, developmental psychology, cognitive science, family therapy and systemic practice, educational technology and school integration – and this can only be achieved by well-trained multidisciplinary teams with an open outlook, which are capable of synthesizing current knowledge and establishing new joint objectives for research and intervention.
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Challenge 3
The urgent translation of growing scientific findings into specific intervention programs. We need good intervention programs that are backed up by serious, verified scientific research and which, therefore, serve to alleviate or cure what they say they do.

In EI, the strategy consists of taking advantage of early childhood to activate, boost, and optimize neurobehavioral structures and processes that would remain undeveloped owing to adverse genetic effects in neurobehavioral genesis (Rondal & Perera, 2006).

There are various reasons for carrying out this systematic strategy. In the case of a congenital intellectual disability (DS), assuming early diagnosis, it is advisable to begin intervention during the weeks following birth in order to reduce, as far as possible, retardation in the socio-personal, physical, and cognitive aspects of development. Ontogenesis is highly accumulative. This means that the earliest acquisitions serve as the basis for later development. The sooner the basic structures are established, the better the prognosis for subsequent progress and, assuming continuous training, the greater the probability that the highest levels of development permitted by the condition can be reached.

A second reason is that neuroplasticity, as we know, is greater during the first years of life, and this also applies to children with intellectual disability; in this way a more fertile terrain is provided, as it were, for the undertaking of well-designed interventions.

The two reasons mentioned above suggest that the application of EI is probably more beneficial than any other intervention carried out at a later stage in life. However, this does not mean that the latter is not important or that intervention in children with DS should stop after the age of six (Perera, 1995).

Guralnick (1997, 2005b) has evaluated underlying current knowledge in a series of dimensions that improve development, and concludes that decades of study on a large and small scale indicate that we are capable of modifying individual development as a result of good EI programs, and that comprehensive EI programs have demonstrated that we are capable of preventing, to a large extent, the decline in cognitive development in children with DS that typically appears during their early years.

Although demonstration of the long-term effects still represents a methodological challenge, long-term results have also been documented for various developmental conditions, including DS.

Finally, the challenge lies in the need to translate scientific findings into specific intervention programs, strategies, and therapeutic methods that can be used in EI services and in educational classrooms to improve maturity, health, and cognitive, memory, linguistic, and behavioral aptitudes of children with developmental problems of a genetic origin (Perera, 2007).

Challenge 4
The need to gain further insight into the “specificity” of each syndrome. The scientific approach to intellectual disability needs to take into account the etiological dimension (Rondal & Perera, 2006). For theoretical and clinical reasons it is necessary to gain further insight into knowledge of various types of intellectual disability, beginning with those of genetic origin, and to determine, with a firmer empirical base, which traits are different in one entity and another and to what extent, and which symptoms are found in various or all syndromes (Rondal et al., 2004).
The perspective of specificity seems to be clearer at the systemic level. Recent research has revealed a high number of symptomatic characteristics in DS which, together, show a specific picture of the syndrome that some have called partial specificity (Dykens et al., 2000), and others syndromic specificity (Perera, 2006).

The key methodological dimension for the study of specificity must focus on inter-syndromic comparison, as it is not possible to discuss specificity in any syndrome without carrying out systematic comparisons with other syndromes.

The theoretical and practical implications of the existence of behavioral phenotypes and their possible specificity are of the highest importance. On the theoretical side, the evidence of partial specificity between genetic syndromes, or those associated with intellectual disability, seems to indicate that there are certain shared relations between particular genes and some behavioral development patterns with important variations. On the practical side, the verification of specific development and functioning patterns leads to the strategic question of whether single or different intervention methods should be used.

The consequence of this is that if at least partial specific patterns can be demonstrated in individuals with different genetic syndromes, then intervention strategies would have to be designed precisely around the particular needs of the genetic group, leaving only functional characteristics shared with other groups to common rehabilitative strategies (Hodapp, 2008).

In addition, the most reasonable criterion is that “Specific aspects require particular intervention methods, non-specific aspects require more general methods that can be extended to various entities” (Rondal & Perera, 2006).

It therefore seems evident that good intervention has to follow this criterion, because if programs, strategies, therapeutic methods, and didactic instruments used in EI or educational classrooms are designed by taking into account these specific aspects that pertain to certain syndromes and which refer to specific forms of capturing, processing, and assimilating information (in their cognitive, linguistic, perceptive, memory, sensory aspects, etc.), they would be more direct and effective at teaching children to think, speak, read, write, etc.

Challenge 5

Promote the role of parents (especially the mother) as principal agents of EI. This is because it has been demonstrated that the effectiveness of EI is closely linked to the level of responsiveness to and good intervention of the parents with their children.

Mahoney, in Chapter 16 of this book, presents the results of his longitudinal studies and research on the role that parents play in EI in children with DS and other developmental conditions. His findings were, among others, as follows:

1. That the way in which parents interact with their young children with DS has an effect on much of the variability in cognitive and communicative outcomes that these children achieve during their first three years of life.
2. That this is also linked to academic and developmental achievements in the years following infancy.
3. That the outcomes in development that children reach in EI programs that do not work with their parents are related with the parents’ style of interacting with their children, but not with the type of intervention the children receive.
4. That the effectiveness of EI is very closely linked to the impact it has on the degree of acceptance and responsiveness of the parents toward their children.
That the only way of involving parents in EI that systematically improves the development of their children and their emotional and social functioning is that which encourages parents, through their coaching, to learn and use responsive interactions with their children. The term responsive interactions means following the children’s interests, responding to their needs, adapting to their rhythms, and gently correcting their errors. This focus has served to improve children’s cognitive, communicative, social, and emotional functioning (Mahoney et al., 1998).

All this should probably lead us to insist less on standardized programs and focus much more in the future on the interaction between parents and children.

**Challenge 6**

**Encourage governments and political representatives to trust and invest in EI services** I am not going to linger over this point, but convincing politicians wherever we live is a responsibility that involves us all. The effectiveness of programs during the early years of life has been scientifically proven, even though there are still methodological challenges to demonstrate their long-term effectiveness, as has been stated previously.

We can probably do more for people with DS during the first six years than during the rest of their lives. If good EI is provided, we will be able to compensate for their limitations and strengthen their skills, which will mean that children will come to be active, independent, autonomous individuals, rather than passive, dependent people. It is therefore necessary to convince governments to prioritize EI in their medical, educational, and social programs.

**Challenge 7**

**Professional qualification and teamwork** The concept of interdisciplinarity goes beyond a simple parallel sum of different disciplines. The preparation of professionals who are involved in EI implies both training in a specific discipline and in a conceptual framework common to all these disciplines that should have its own space for development through reflection and teamwork. The drawing up of regular training plans and the need for continued supervised professional experience is an essential condition for the organization of qualified EI services, at a level in accordance with their responsibility (GAT, 2000).

**Quality** It is not enough to say that we are good. It is necessary to prove it. In the business world, this is demonstrated by means of external certificates that make it possible to use rigorous controls to analyze the compliance of internationally approved regulations with criteria of continuing improvement, client satisfaction, efficacy, and efficiency.

Quality in EI services is a right and guarantee for the user and an obligation for the professional team. Furthermore, it has special significance and importance in situations with children who have developmental disorders where the application of good or bad practices can seriously affect their biological, psychological, or social progress.

In the concept of intellectual disability (AAMR, 2002), developmental disorders go from being considered an absolute trait of an individual to being the result of interaction between a person with specific limitations and his/her surroundings. This concept, moreover, is not limited to studying children and intervening in their environment, but rather raises the need to evaluate and intervene where children develop. This is why the so-called supports acquire such special significance.
Early intervention is not a refuge for beginners. It requires solid multidisciplinary training, demonstrated experience, systematic continuity, rigor in procedures, and continuing evaluation of results (Grupo PADI, 1996; GAT, 2000; ICASS, 2001; European Organization for Quality, 2002; Millá, 2003; Ponte et al., 2004).

A key challenge therefore is to demand an international quality standard for EI.

Conclusion

To conclude, I would like to sum up and present three future perspectives which, in the short and medium term, could introduce important improvements in the results of EI.

The first is current and future research in genetic intellectual disability using animal models, which is extremely important, as has been explained previously. In addition, very important is the difficult matter of extrapolating the relevant data and findings from lower order mammals (mice, etc.) to human beings. This research will promote better understanding of some of the organic difficulties and limitations that are important in DS and, furthermore, will make it possible to define the drugs and early environmental enrichment that can best help to improve developmental results and compensate for deficits.

The second is the stimulation that may soon be possible to carry out in the uterus – especially auditory stimulation if the fetus is detected to be at a disadvantage as regards commencement of early language acquisition compared to babies that develop normally.

Advances that have been made over the last few decades have transformed neonatology. Changes in therapy and in the development of newborn babies, and other groups, with a very low weight have been very important.

Treatments carried out on the fetus before birth represent one of these advances. The induction of the maturation of fetal tissues by means of the use of corticoids has been shown to be effective at preventing not only hyaline membrane disease, but also cerebral hemorrhage and necrotizing enterocolitis which, when they occur, represent a risk to survival and later development of the newborn.

Postnatal handling of these patients has also changed. Better knowledge of the pathophysiology of diseases typical of prematurity has made it possible to introduce new treatments.

In the 1980s, it would have been difficult for a newborn with a weight below 800 grams to have been viable. These days the viability thresholds that are established are a gestational age of 24 weeks and 400 grams in weight. However, these limits become blurred in the face of the need to individualize each situation.

In this context, as well as in specific therapeutic guidelines, there has been an increase in the measures aimed at improving the development of the newborn through interventions that favor the infant and the family, with the understanding that, in actual fact, both constitute a whole. Such measures are known as “care focused on development and the family.” This represents a radical change, not so much of a technological nature, but in the involvement of health personnel and the family of each infant in such care. It is a question of trying to create as favorable an environment as possible by reducing macroenvironmental noxae (noise, light) and microenvironmental noxae (posture, handling, pain), and attempting to involve the family in the infant’s care, promoting breast feeding and skin-to-skin contact between the infant and parents, and allowing families entry into care areas as far as possible. This philosophy should be understood as a form of EI which, through improvement to the relationship between the infant and its carers and to the environment, attempts to prevent the appearance of less serious morbidities but which can determine limitations in the long term.