Early and Intensive Behavioral Intervention (EIBI) in Autism

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Early and Intensive Behavioral Intervention

Early and Intensive Behavioral Intervention (EIBI) is the use of evidence-based principles and procedures from Applied Behavior Analysis (ABA) to help young children with developmental delays to acquire adaptive and functional skills. In Targeted areas are communication, play, social, emotional, cognitive, and self-help skills. Moreover, the same principles and procedures are used to reduce problem behaviors such as stereotyped and ritualistic behaviors, eating and sleeping difficulties, attention deficits, and aggressive behaviors. The selection of specific intervention goals is guided by data from developmental psychology on typical development. Thus, intervention goals are based on the child's chronological age, an assessment of the developmental milestones reached by the particular child, and the developmental milestones that the child should have acquired according to typical development. To give the child as many learning opportunities as possible, the intervention is carried out in a specialized one-to-one teaching format (discrete trial teaching) as well as in a more naturalistic teaching format such as when the teacher or the parent is playing with the child or when they are helping the child getting dressed (natural environment teaching). To help the child to generalize treatment gains across different settings (such as home, school, playground, store), treatment is implemented in all relevant settings, though most of the treatment is carried out at home or in school. Also, to help the child to generalize treatment gains across different people (parents, teachers, other children, etc.), treatment principles are implemented by parents, teachers, and other adults who are important in the child's daily life. In most cases, the child is mainstreamed with typical peers while being shadowed by a therapist. This is done to help the child to use the skills learned in treatment when interacting with other children.

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EIBI is based on the assumption that children with autism are able to learn in the same way as typically developing children do, given the appropriate learning environment (Lovaas and Smith 1989). Autism is seen as a *lack of learning* certain behaviors that typically developing children seem to acquire spontaneously. Deficits in theory of mind, for example, are seen not as the cause of the syndrome, but rather as a class of behavior needed to be taught to enable the child to function adaptively in our culture. This is not a denial of the fact that autism is caused by genetic and neurobiological factors (Hall 2004). Instead, this explains the causal mechanisms from neurobiological and genetic factors, through the social environment and learning, to the behavioral pattern that define autism – in other words, the way in which biology and learning interact to cause the emergence of autistic behaviors.

In this chapter, the support for EIBI as an effective intervention for children with autism is reviewed. Next, the intervention is described both theoretically and in practice. Finally, a behavior analytic view on the autism syndrome is outlined.

Evidence for EIBI as an Effective Intervention

The first study reporting on the effects of using behavioral interventions for children with autism was published by Colligan and Bellamy in 1968. EIBI as a comprehensive treatment approach can be traced back to 1973, when Lovaas and colleagues (Lovaas et al. 1973) made six important observations that played a major role in the design of the Lovaas (1987) study, which has become the paradigm study on EIBI. Firstly, Lovaas and colleagues observed that the youngest children in the 1973 study appeared to make the greatest gains; hence, Lovaas and colleagues begun focusing on younger children. Secondly, treatment effects were found to be situation specific; hence, treatment was moved away from a clinic setting and into the children's homes. Thirdly, Lovaas and colleagues found limited evidence for response generalization (e.g., becoming more social after learning language); hence, treatment targeted most or all of the children's excess and deficit behaviors. Fourth, with training, parents became skilled teachers for their children, and they were the best allies in helping accelerate and maintain treatment gains. Fifth, treatment was provided for most of the child's waking hours, for 2 or more years, and focused on teaching the children to develop friendships with typical peers. This intervention resembled, according to Lovaas, more closely the type of learning environment available to typical children, who learn from their environment from the time they wake up in the morning and until they go to sleep, 365 days a year (Lovaas 2003).

Lovaas (1987) studied 19 children who received 40 h per week of one-to-one EIBI for a minimum of 2 years. A comparison group of 19 children received 10 h or less per week of one-to-one EIBI. A second comparison group of 21 children came from the same agency that diagnosed the majority of the other participants and had received services generally available for children with autism in the area. The diagnosis for all participants was set by an independent agency and based on the most current Diagnostic and Statistical Manual of Mental Disorders used at the

time of the study. Mean intake age was 33.3 months. Intake measures included IQ scores and behavioral observations. When reevaluated at a mean age of 7 years, children in the experimental group had gained an average of 20 IQ points to a mean of 83, and they had made major advances in educational placement. Forty-seven percent of the participants achieved IQ scores of 85 or above and were placed in regular education without assistance. In contrast, the control group that had received 10 h or less of behavioral treatment obtained an average IQ score of 52, and the group that had received services as usual obtained a mean follow-up IQ score of 58. Gains were maintained by eight of the nine best outcome children at a second follow-up conducted when the children averaged 13 years of age (McEachin et al. 1993).

Although creating a great deal of controversy (Gresham and MacMillan 1998; Lovaas and Smith 1989; Schopler et al. 1989), Lovaas' seminal study provided hope for parents and professionals, and it sparked a vast research interest.

Currently, more than two dozen peer-reviewed outcome studies have been published. However, the scientific merit of these studies varies. To help evaluate the quality of these studies, Eikeseth (2009) set up criteria to determine the scientific merit of the outcome studies. To achieve the highest scientific merit (Level 1), the study needed to include (a) randomized group assignment, (b) independent diagnosis, (c) independent or blind pre- and post-assessment of both IQ and adaptive behavior using standardized and normed measures, and (d) some measure of treatment fidelity or a reference to a specific treatment manual. Level 2 scientific merit was identical to Level 1 except that assignment to groups was not random. According to these criteria, one study has obtained Level 1 scientific merit (Smith et al. 2000). In this study, 28 children were randomly assigned either to an EIBI group receiving 24.5 h per week of one-to-one ABA for 1 year, and then continued treatment with gradually decreasing intensity for another 2 years, or to a comparison group that received between 3 and 9 months of training by parents. Participants had either a diagnosis of autism or PDD-NOS and the mean age at intake was 36 months. Testing was carried out by independent assessors. At intake, there were no significant differences between the groups on measures of either adaptive behavior (measured using the Vineland Adaptive Behavior Scales; VABS), IQ, language functioning, or socio-emotional functioning. When followed up, the EIBI group scored higher than the control group on IQ and language and also included more children in normal school placement. The group had gained a mean of 16 IQ points, compared to the control group, which had decreased by one point. However, the groups did not differ on measures of adaptive or socio-emotional functioning.

According to the criteria set out by Eikeseth (2009), four studies have obtained Level 2 scientific merit (Cohen et al. 2006; Eikeseth et al. 2007; Howard et al. 2005; Remington et al. 2007).

The studies all report more positive outcomes for children in EIBI groups than in comparison groups. These studies are described in more detail in Table 1. The remaining outcome studies have more limitations in scientific rigor.

Table 1 EIBI outcome studies with high scientific merit

Study	N	Age at intake (years)	Mean treatment hours/week	EIBI results	Comparison results
Smith et al. (2000)	28	3.0	25	IQ: +16	IQ: −1
				VABS: −2	VABS: −7
Eikeseth et al. (2007)	25	5.5	28	IQ: +25	IQ: +7
				VABS: +12	VABS: −10
Howard et al. (2005)	61	2.8	25	IQ: +31	IQ: +9
				VABS: +11	VABS: −2
Cohen et al. (2006)	42	2.8	38	IQ: +25	IQ: +4
				VABS: +10	VABS: −3
Remington et al. (2007)	44	3.1	25	IQ: +12	VABS: −2
				−1	IQ: −2

Based on these findings, Eikeseth (2009) concluded that EIBI "is demonstrated effective in enhancing global functioning in pre-school children with autism when treatment is intensive and carried out by trained therapists" (p. 175). Rogers and Vismara (2008) and Eldevik et al. (2010) reached similar conclusions based on slightly different inclusion criteria.

Meta-analysis and Effect Size

The results from the group studies can be summarized using meta-analytic methodologies, with results varying slightly as a function of inclusion criteria of studies. For example, Eldevik et al. (2009) reported on the derived results using individual participant data from nine studies reporting data from both an EIBI group and a comparison group. A common figure for reporting treatment effects is effect size, which is the change before and after treatment, given in standard deviations (e.g., if a group has improved their IQ score, on average, from 85 to 100 between intake and follow-up and the standard deviation is 15, the effect size is 1.0). The effect size for IQ and adaptive behavior reported by Eldevik et al. was 1.10 and 0.66, respectively. This change in developmental trajectory on a group level can be graphed, as in Fig. 1, or presented as change in standard scores, as in Fig. 2.

A review of published meta-studies reporting on the effects of EIBI can be found in Reichow (2011) showing that effect sizes for IQ and adaptive behavior are large to moderate across studies.

Another consistent finding in published outcome studies on EIBI to date is the large individual variation in treatment gains: The vast majority (approximately 90 %) increase their IQ score as a result of EIBI (Hayward et al. 2009), and the

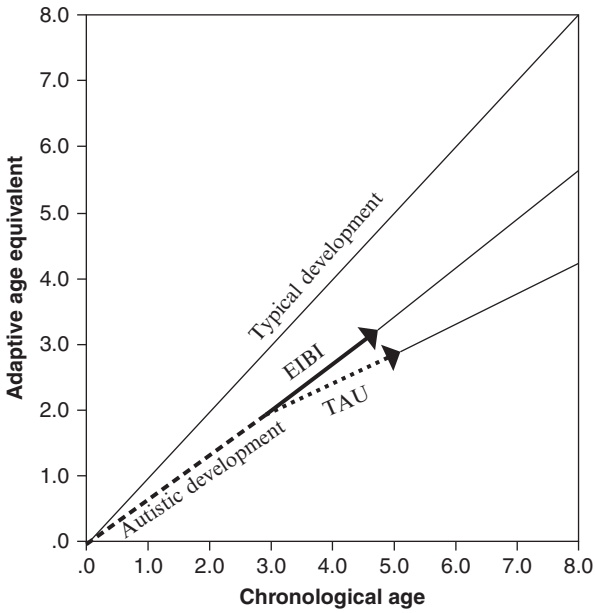

Fig. 1 Learning trajectories for autistic children who receive EIBI or treatment-as-usual (TAU). Lines continuing after 5 years are projected trajectories after end of treatment. Data from Klintwall et al. (in press)

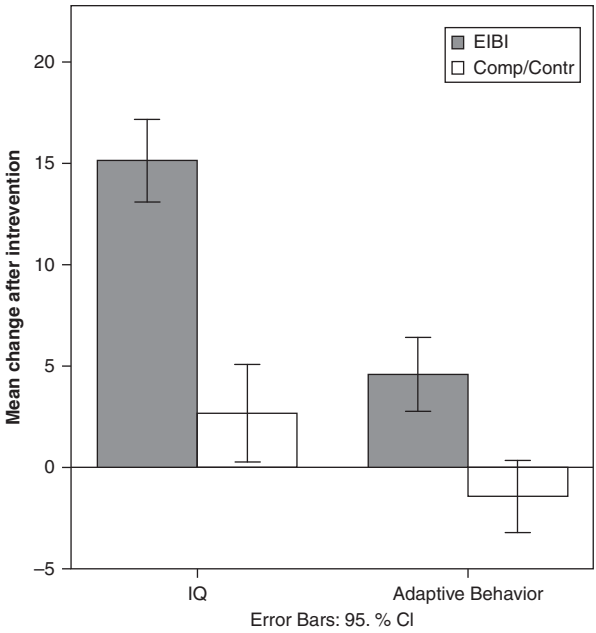

Fig. 2 Change in IQ and VABS standard scores for children receiving EIBI or treatment-as-usual (TAU). Data are based on participants from 24 published outcome studies. Data from Klintwall et al. (in press)

average increase in IQ across studies is slightly more than one standard deviation. However, some children increase their scores in the range of two standard deviations or more, whereas others may lose IQ points.

An interesting study utilizing such reported pooled average effects of EIBI and comparing it to the arguably quite high expenses of running an intensive program in the USA is Chasson et al. (2007). Assuming the costs of running a 3-year EIBI program and a conservative measure of how many of these children may then achieve a level of functioning that enables them to attend mainstream schools and then comparing this to the costs of, and effects achieved with, running low-intensive special education, these authors report that EIBI is still cost-effective in the long run. Similar estimates have been found for European countries (Peters-Scheffer et al. 2012).

Moderators and Mediators of Treatment Outcome

Interest in predicting individual treatment outcome can be divided into roughly two categories: (a) predicting which children will achieve normal functioning (which could be defined as IQ in the normal range, no longer fulfilling criteria of diagnosis, or normal academic functioning) and (b) predicting which children will benefit most (improvement in IQ or in adaptive behavior standard scores). To achieve normal functioning (defined as IQ in the normal range), intake functioning is not surprisingly the best predictor (Klintwall et al. in press). Also, it seems that starting treatment before the age of 4 years also increases the chances of achieving normal functioning (Klintwall et al. in press). However, when focusing on the relative individual gains of individual children (as measured by change in IQ scores for a particular child between intake and follow-up), it appears that EIBI is equally effective for older children (Eikeseth et al. 2007; Eldevik et al. 2010) as well as for those who are low functioning at intake in terms of IQ and adaptive functioning (Eldevik et al. 2010). It seems that the rate of learning early on in treatment is predictive of further gains (Hayward et al. 2009; Sallows and Graupner 2005; Weiss 1999).

A consistent finding is that the higher the intensity of the intervention, the larger the individual gains. For example, analyzing data from 309 individual children drawn from 16 group design studies, Eldevik et al. (2010) found treatment intensity to be the most influential moderator of individual treatment outcome. In a study reporting on the results of low-intensity ABA for children with autism (Eldevik et al. 2006), results were found to be lower than those reported for high-intensity EIBI but still significantly better than those found in a control group.

Behavioral Terms Frequently Used in EIBI

As already noted, EIBI is based on ABA, which is a branch of learning psychology. What follows is an outline of technical terms typically used in EIBI, followed by a description of the some central treatment principles and procedures used.

Antecedent Stimuli (Instruction)

Although a child might be able to produce certain behaviors, it is equally important for the child *when* to produce them. Antecedent stimulus control concerns the extent to which a response is produced under the appropriate stimulus conditions. For example, although it is a good thing to be able to say "car," it is even better to say "car" when seeing one, wanting one, or being asked "Do you know any vehicles?" instead of just saying "car" randomly regardless of the situation. Thus, an antecedent for a response can be what other people say, visible objects, people or activities, a situation, the child's own behavior, or any combination of these.

Response (Behavior)

A target response must be precisely defined in behavioral terms. An incorrect response is a response that does not meet the criteria defined in the program. Correct responding can be either prompted or independent, and teaching gradually moves from the former to the latter. Correct responding is followed by praise and other more tangible consequences (e.g., access to a favorite toy). Incorrect responding, or no responding at all, does *not* lead to any negative consequences. Instead, it leads to the absence of a desired consequence and/or to some type of instructional verbal feedback. Next, a new trial is started, this time with an effective prompt, that helps the child respond correctly.

Consequence (Reinforcement)

Reinforcement is the engine in learning. Children differ widely in regard to which consequences function as reinforcers: some like praise and some do not; some like certain toys that others have no interest in. Some commonly used reinforcers are praise, tickling, hugs, raisins, crackers, YouTube, toys, music, and soap bubbles – but every child is different and the teacher must be very creative in finding items that are truly of interest to the child. There are many ways of identifying powerful reinforcers for a specific child, such as interviewing parents or teachers (Fisher et al. 1996), observing the child in a free-choice situation, or simply presenting the child with many alternatives to choose from (Pace et al. 1985). When working with children with autism, the most important thing to remember about consequences is that social praise is rarely an effective reinforcer. Although typically developing children work hard and creatively to gain attention and approval from adults and peers, children with autism often lack this social motivation.

The reinforcer is presented immediately after the target response, so that the child understands what behavior was reinforced. To maintain a high rate of learning trials, the reinforcement interval should not last long. For instance, if the reinforcer is to watch a favorite DVD, then this should be limited to a brief moment of video and then immediately followed by a new trial (giving the child an opportunity to

respond correctly and thus keep watching). Another possibility is to introduce token economy: the child collects a set number of tokens that can then be exchanged with a backup reinforcer. For instance, after every correct response, the child is given a plastic marker (a token) which is collected on a board with ten slots. The full board then means that the child can watch the video for 5 min. Using token economy, the possibilities for what can be used as a reinforcer are vastly expanded so that anything from bus rides to playing hide-and-seek can be used to reinforce very specific responses.

Eventually, new skills must be maintained by naturally occurring reinforcers. For example, simply imitating a teacher saying "cookie" needs not be reinforcing for a child, but then being able to ask for cookies is very easily maintained if the child likes cookies and if the child is given a cookie once in a while when asking for one. Skills taught in EIBI either are those that may be maintained by natural reinforcers immediately or else are responses that can be combined to produce more complex behaviors that in turn will be naturally reinforced.

It should be noted that the treatment often changes the consequences that actually function as reinforcers for participating children. As the child is taught more complex play skills, these often become motivating for the child and can later be used as reinforcers for subsequent teaching. Indeed, the high frequency of delivered reinforcers in the teaching situation often results in that social interaction and praise become more and more reinforcing for the child (Dawson 2008), although there are many exceptions to this (Lovaas et al. 1966).

Prompt (Help)

The purpose of the prompt is to help the child produce the correct response after the instruction (i.e., antecedent stimulus) has been presented (MacDuff et al. 2001). The teacher might ask the child to "touch nose" and then manually guide the child's hands to touching his/her nose. This is called a physical or manual prompt. If the task is a question requiring a verbal answer, the teacher may model the correct answer so that the child can imitate it. For example, the teacher would present a doll and ask: "What is this?" and a verbal prompt would be to immediately follow this with saying "say 'doll'." Obviously, this prompt requires that the child has already been taught to imitate speech. Other types of prompts might be pointing prompts (e.g., pointing to the object <car> after saying "touch car"), position prompts (e.g., putting the object <car> closest to the child), time delay (e.g., across trials gradually delaying the onset of the prompt after providing the antecedent, with the hope that the child might produce the correct response before the prompt is given), and modeling prompts (e.g., the teacher shows the child the correct response).

All prompts must be faded so that the target response is produced by the antecedent stimulus only. For example, initially the teacher might manually guide the child to touch his/her nose, but then over successive trials, the teacher can let go of the child's hands earlier and earlier until the child can touch his/her nose independently. Such fading of prompts is one of the cornerstones of effective EIBI.

Task Analysis

Another key feature of EIBI is to break down complex behaviors into component behaviors. For example, if a child with autism would benefit from improving his/her independent play skills, playing independently, and a chosen activity that will hopefully be of interest to the child is playing with a toy train. This can then be broken down into subparts. These subparts might be (1) assembling the track piece by piece, (2) putting together a train, (3) pushing the train around the track, and (4) saying "choo-choo." These responses can be taught independently and then combined to form playing with toy trains.

Language is broken down either into phonological units (e.g. "ba", "mmm" or "sk") or into specific words (nouns, verbs, pronouns, etc.). Grammar can also be broken down this way, into specific constructions that can be taught separately until mastered, for instance, plurals (Baer et al. 1972), grammatical tense and pronouns (Lovaas 1977), and adjectives (Risley et al. 1971).

Teaching Procedures

Discrete Trial Teaching (DTT)

DTT is a specific type of one-to-one, teacher-child-directed instruction that individualizes, simplifies, and structures teaching in a specific way to maximize learning (Smith 2001).

Firstly, learning targets are carefully matched in difficulty to the child's current level of functioning. The targets selected for teaching are operationally defined and judged to be relatively easy for the child to acquire. As the child acquires these targets, either they are combined with other acquired targets into more complex tasks or the complexity of the targets is gradually increased in a stepwise manner.

Secondly, prompt and prompt fading techniques are used. Over successive presentations of the learning task, the teacher gradually makes the prompt less and less salient, so that the child eventually responds correctly to the task without any prompt. This results in a high degree of error-free learning, which by itself makes it easier for the child to learn the tasks. In addition, learning with few errors keeps the child's motivation high.

Thirdly, DTT involves the systematic use of reinforcement and the systematic repetition of tasks until particular targets are mastered. The consequences provided for correct responses are any item or activity that the child enjoys, such as praise, happy faces, stickers, brief access to favorite toys, blowing bubbles, a small piece of a favorite food, listening to music, or watching YouTube films for a minute or two.

DTT is used for teaching a large variety of skills such as motor imitation, verbal imitation, matching, receptive and expressive language, pre-academic and academic skills, and self-help skills. Each trial is a period of 5–15 s, which starts with the teacher presenting the child with an antecedent stimulus (an instruction and/or the task). If the teacher thinks it necessary, the antecedent is then

Table 2 The components of a trial and some examples

Antecedent	Prompt	Child response	Consequence
Another child saying "hi!"	The teacher whispers "say 'hi'!"	"Hi!"	The other child smiles
The teacher presents a cup and asks: "What is this?"	The teacher says: "say 'cup!'"	"Cup"	The teacher says "good boy!" and tickles the child
The teacher clap hands and says "do this!"	The teacher physically helps the child clap	Clapping	The teacher says "good clapping" and blows some soap bubbles
Other children clapping hands to a song	The teacher whispers "do this" and claps hands	Clapping	The child is given a token for the token economy
Seeing a favorite cake on a shelf	The teacher says "say 'cake'!"	"Cake"	Getting the cake

immediately followed by a *prompt* to help the child produce the target *response*. The target response is whatever behavior the child is learning to do given a certain instruction or situation. A correct response is then followed by a *consequence*: a reinforcer. The trial is then repeated if the child has not mastered the target response. The speed of trials that a teacher can achieve is indicative of the number of learning opportunities for the child. Trials are thus quick and the pauses between them short. Ideally, 10–15 trials are presented per minute. These learning blocks of 2–5 minutes are interspersed with breaks of a few minutes. Some examples are given in Table 2, and an illustration of teaching is given in Fig. 3.

Natural Environment Teaching

To maximize learning, all parts of a child's day need to be included in the program. This includes mealtimes, getting dressed, play, and social interaction. Although correct responding in these situations could be taught using DTT, it might be more efficient to simply define target responses in the specific situation and reinforce them with naturally occurring reinforcers. For instance, if the child needs to get dressed to go outside, prompting to achieve correct responses and verbal praise can be used to teach the behavioral chain of getting dressed. These prompts and reinforcers are faded as the child masters each component within the chain of behaviors. Going outside is a naturally occurring reinforcer for having completed getting dressed, which will hopefully maintain the behavior after training has ceased. Thus, natural environment teaching differs from DTT in that it is less structured, teaches behaviors in the situations that they naturally occur, and requires less use of artificial reinforcers. Parents can be very effective teachers in natural settings (Sundberg and Partington 1998), and as in DTT, continued documentation and evaluation are necessary components in this procedure.

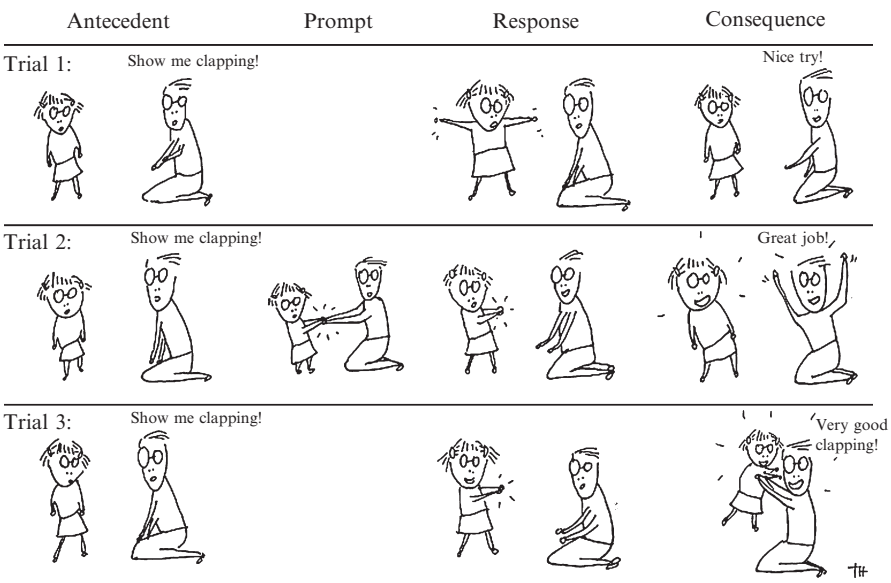

Fig. 3 An example of three trials of discrete trial teaching (DTT). Illustration by Tale Hendnes

Incidental Teaching

There are some limitations to what behaviors are optimally taught using DTT. To teach communicative initiatives and also to generalize behaviors to natural situations outside of the DTT settings, incidental teaching is a good complement (Hart and Risley 1982; Smith 2001). Incidental teaching entails that a situation is arranged in which the child can make some kind of initiative, such as the adult putting a cookie on a shelf clearly visible to the child and then waiting for any initiative from the child. For instance, the child might point to the cookie or try to move the teacher toward the shelf. The teacher acknowledges the initiative but also prompts a slightly more elaborated initiative from the child. If the child points to the cookie, the teacher might say "say 'cookie!'" The elaborated response is then reinforced by giving the child access to the cookie. Incidental teaching is effective for teaching children that already show initiatives in natural settings. However, many children with autism show few initiations or have only a narrow range of interests, making elaboration of communication harder. Also, many skills are hard to teach using only incidental teaching: language comprehension, academic skills, and play skills. However, even complex language skills such as grammar can be taught using incidental teaching. Take, for example, a child who says "John want a cookie" about himself wanting a cookie. Even though this might be accepted at first (this response is reinforced by giving the child a cookie), the criteria of a correct response can be made gradually more stringent, so that later on the child is prompted to say "I want a cookie" before giving him access to the reinforcer. An example of incidental teaching is shown in Fig. 4.

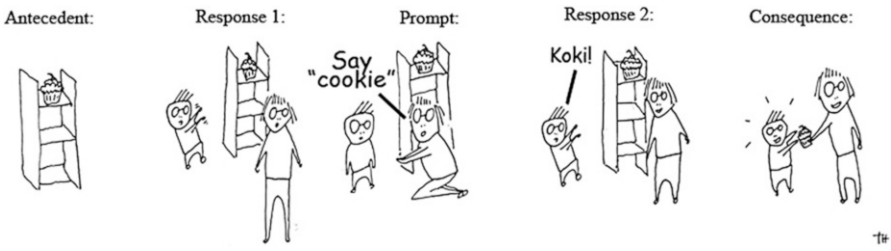

Fig. 4 An example of an interaction in incidental teaching. Illustration by Tale Hendnes

Curriculum

Behavioral techniques are necessary for optimal learning but must be combined with an appropriate and comprehensive curriculum for the child to make maximum gains. The content of the curriculum is comprehensive and addresses all areas of deficit, and it must be individually tailored for each child's needs. A special emphasis is placed on teaching key behaviors, also known as behavioral cusps (Bosch and Fuqua 2001). Many curriculum guides have been published and can be studied for details (e.g. Leaf and McEachin 1999; Lovaas 2003; Maurice et al. 2001). Generally, however, a curriculum can be divided into three different levels, as outlined below.

Beginning curriculum. The first behaviors that are taught are those that are needed for further learning. These include verbal and motor imitation (to be used as prompts), sitting on a chair, paying attention to the teacher, and basic interactions (such as throwing a ball back and forth with the teacher). The child is also taught some basic receptive language, such as pointing to some objects as they are named, responding to instructions, and matching identical objects to each other, imitating sounds and words, naming objects, and playing independently with toys. Alternative communication (PECS or sign language) could be taught in addition to or instead of vocal language.

Intermediate curriculum. The child is taught skills such as dressing and undressing, going to the bathroom, expanding the repertoire of accepted foods, parallel play, more elaborate receptive and expressive language such as colors, categories, and some grammar such as plurals, grammatical tense, prepositions, and two- and three-word sentences.

Advanced curriculum. The most advanced skills that are taught in EIBI are pretend play, conversation, cooperative play, theory of mind, observational learning, reading, writing, and paying attention to a teacher in a classroom. The curriculum on this level of functioning depends to a large degree of the interests of the child.

Inclusion

EIBI aims for the inclusion of the child in regular mainstream settings and fading out of the intervention itself. Accordingly, the child is prepared to attend a mainstream school, by teaching skills enabling the child to function as independently as possible in

the school setting. This requires that the child be taught how to interact with peers, paying attention to a teacher addressing a group of children, and to work on assignments with only sparse reinforcement from teachers and parents (just as typically developing children do). These skills are part of the advanced curriculum and are taught after the child has mastered the beginning and intermediate curriculum. When the child is ready to attend a mainstream school setting, a teacher will shadow the child and make sure that the child can take advantage of every possible learning opportunity. This includes both social learning with peers in recess and academic learning in class. Whenever the child gradually begins to benefit from the teaching in class and has begun to function appropriately with the peers, the ABA interventions and shadowing are faded. If the child does not benefit fully from placement in the regular school, the teacher must continue to shadow the child in class and in recess and, in addition, intersperse the day with ABA sessions targeting skills that need special attention. Some elements from the EIBI program can also be retained in a normal classroom without much interference, such as continued use of a token economy for some key behaviors (such as attending to teacher, refraining from engaging in stereotypic behaviors, and being on task during independent assignments).

Accountability

A key feature of EIBI is that the intervention is evaluated continuously for effectiveness. This is achieved by having an individual logbook for each child in an EIBI program (Lovaas 2003). For every teaching area, the current target responses to be mastered are defined along with their antecedents and suggestions for effective prompts and reinforcers. Any material used is described, as well as criteria for defining the target response as mastered (for instance, the child responds correctly and without prompts the first attempt a new day, or correctly on five consecutive trials). Time spent on each area is recorded so that lack of progress can be identified and analyzed and teaching methods adjusted. When a target response is mastered, the logbook gives suggestions for future items or programs. If a program is particularly difficult for a child to master, the logbook usually includes sheets for taking trial-by-trial data, enabling detailed analysis of which prompts are effective, or unintentional reinforcement of incorrect responding. How to program generalization to novel settings and persons is indicated in the logbook, and success or failure to generalize is recorded to monitor progress. The logbook is updated after each teaching session, to facilitate treatment integrity by helping each teacher to work on the same tasks in the same way. The logbook is also updated on weekly or biweekly supervision meetings. On such meetings, time spent on different tasks is summarized, prompts and target responses are discussed and revised, and mastered skills are replaced by new targets.

The effects of the intervention should also be monitored using standardized tests, preferably before the intervention starts and subsequently on a yearly basis. A comprehensive psychological assessment including all aspects of the child's functioning (cognitive skills, verbal skills, social skills, self-help skills, motor skills, and

autistic symptoms) should be used. Also, problem behaviors such as tantrums, stereotypic behaviors, and aggression should be assessed. This assessment should be used as input for the intervention team, both as a guide for what skills the child needs to master, and to evaluate the effectiveness of the intervention for the particular child.

Considerations for Implementation

Settings

EIBI can be implemented either in the child's home, in a mainstreamed nursery, preschool or kindergarten, in a specialized clinic, or preferably in all of the above (Lovaas 2003). It is also advisable that the child be integrated with typically developing peers, to function as role models and to maximize opportunities to learn adaptive behaviors by observation.

Staff Training

Given the high intensity and range of settings that EIBI should be delivered in, a team of adults should participate in the program. This includes parents, teachers, teacher's aides, members of the extended family, and sometimes older siblings. These tutors need to be educated both in some of the theoretical basis of EIBI and on how to deliver the specific teaching programs that the child is currently learning (Thomson et al. 2009). Staff training is usually performed both through theoretical education in the form of lectures and written material (treatment manuals) and through hands-on supervision when working with the child. Role-playing the learning situation can also be used to increase teacher skills. It is important to include both theoretical education and actual training skills, as several studies have shown that staff do not necessarily generalize from theory to practice (Gardner 1972; Mörch and Eikeseth 1992). Indeed, even the setting for educating staff might be important, as research has shown that staff may increase their clinical skills significantly during training, but fail to transfer these new skills when they go back to work with their own clients (Smith et al. 1992). Thus, it seems that optimal staff training takes the form of workshops combining theoretical lectures, role-playing, and hands-on training with the child, preferably in the actual settings that the training will take place (Arco 2008). Although most studies on staff training have been conducted on DTT, the challenges for increasing teacher skills for incidental teaching seems similar (Ryan et al. 2008).

Quality and Intensity of Supervision

Although there are treatment manuals that are widely used, the idiosyncrasies of each child make it necessary for supervisors to be widely read in the ABA literature

and in developmental psychology in general and posit extensive clinical experience (Eikeseth 2010). However, EIBI supervisors are a heterogeneous group and little is known about what qualities are important to create an effective treatment team (Bibby et al. 2002). In an attempt to set standards of ABA professionals, the "Board Certified Behavior Analyst" (BCBA) has been established. A BCBA certification requires a Masters degree, substantial education in behavior analysis, a minimum number of hours of experience with ABA, and having passed a certification exam. Although a BCBA supervisor is knowledgeable in ABA, the BCBA does not ensure that the professional is qualified to supervise an EIBI program. Additional training and experience are required (Eikeseth 2010).

The intensity of supervision that the treatment team receives also varies (Bibby et al. 2002). In a study with 20 children with autism who received EIBI with variable supervision frequencies, Eikeseth et al. (2009) found that intensity of supervision correlated positively with treatment outcome. Outcome studies also support the recommendation that supervision should be given on a weekly or biweekly basis (Eikeseth et al. 2009).

Autism from a Behavior Analytic Viewpoint

Diagnosis as Behavior

A cornerstone in a behavior analytic view of autism is the recognition of the psychiatric diagnosis as a label of certain behavioral excesses and deficits. The symptoms defining certain disorders as described in diagnostic manuals such as DSM and ICD are behaviors. For example, an autism diagnosis is given to a child who exhibits too little of certain behaviors (e.g., joint attention, pragmatic communication, and social interests) and too much of other behaviors (e.g., hand flapping, eye gazing, or other stereotypic behaviors). Theories of the etiology of autism are hypotheses of the cause of these behaviors or symptoms. Because autism is defined by exhibiting these behaviors, the symptoms themselves cannot be caused by autism per se, since this would be circular reasoning. Autism must be caused by something outside of the syndrome itself. A common misunderstanding is that in saying this, behavior analysts deny that autism exists at all. Obviously, ther behaviors defining autism are very much real (Hall 2004).

In searching for the etiology of autism, behavior analysts have attempted to see how children with autism differ in the way they learn on a very basic level and how they differ in such learning from a young age.

Some Possible Biological Deviances Leading the Child to Develop Autistic Behaviors

A number of different etiological theories of autism have been proposed. One theory that has received much attention lately is the *Social Motivation Hypothesis*

(Chevallier et al. 2012; Dawson 2008). According to this hypothesis, autistic behaviors develop because the child is not motivated by social interaction. However, the Social Motivation Hypothesis does not describe the mechanisms underlying social interaction, neither does it give any clear definition of "motivation." Using a behavior analytic framework, the mechanisms underlying social interaction can be more precisely specified, and motivation can be defined in operational terms. From the moment a normal developing child is born, certain social stimuli exhibit powerful effects on the behavior of the infant. Such stimuli are known as social reinforcers and examples are voices, faces and cuddling. Reinforcers are stimuli that result in learning (development), and the type of behaviors that are learned (or developed) as a result of social reinforcement are social behaviors such as eye contact, smiling, joint attention, imitation, and communication. Alongside with this learning, other and previously neutral social stimuli such as smiling, intonation of the voice, laughter, and praise acquire reinforcing properties. The need to access these social reinforcers motivates the child to engage in a variety of social behaviors. For example, by the baby looking at the caregiver, the caregiver is likely to respond by smiling, talking, and/or cuddling. These reinforcers in turn motivate the learning of new and even more complex social behaviors (talking, imitation, theory-of-mind reasoning, and so on).

The lack of social stimuli functioning as reinforcers for children with autism (inborn and/or acquired early) may be related to the fact that these children instead show a particular interest in certain sensory stimuli. Research shows that children with autism prefer to look at nonsocial sensory stimuli rather than social stimuli, whereas the opposite is the case for typically developing children (Pierce et al. 2011). Hence, it can be hypothesized that children with autism are born with (and/or quickly develop) a deviant and exaggerated interest in nonsocial sensory stimuli (e.g., auditive, tactile, and/or proprioceptive) and that these stimuli have stronger reinforcing effects on the behavior of children with autism as compared to social stimuli. Examples of such nonsocial stimuli may be a ceiling fan, the corner where the roof and the wall meets, the movement of a mobile, certain lights, or repetitive sounds (other than voices). Most children are interested by such stimuli, but children at risk for the development of autism might be overly interested and not lose interest even after repeated exposures (i.e., deviant habituation). The child's attention to and interest in such stimuli may not be salient enough to be easily detected by the parent. In this case, the child will try to maximize access to such nonsocial reinforcers rather than trying to access the social stimuli produced by parents and peers. As the infant grows older, he/she may produce these sensory stimuli himself/herself. This is done by engaging in stereotypic behaviors such as body rocking, hand flapping, or looking at a magazine or assembling the same puzzle over and over again (whichever behavior produces the overly motivating stimulus). This is turn may lead to a lack of social learning and that the child loses interest in social interaction in general (Eikeseth 2005). According to this hypothesis, stereotypic behavior is the core symptom of autism, and the etiology of autism is related to the mechanism which causes stereotyped behaviors to occur.

A Relative Reinforcer Explanation of Autistic Behaviors

These two models for why some children develop autism are not mutually exclusive: they may be complementary. It can be speculated that it is the *relative* valence of these two classes of reinforcers (social and sensory) that lead to either normal or autistic pathways. These early motivating properties of specific stimuli might be used as endophenotypes of autism, linking the syndrome to specific genes. Lack of social interest has been reported as one of the first behavioral deviations in children who will later develop autism (Ozonoff et al 2010).

Given that the deviant motivation is detected early enough, autism could perhaps be preventable (Dawson 2008). From a behavior analytic perspective, such prevention could be achieved by establishing social stimuli as reinforcers as early as possible, thus giving the child the motivation needed to develop social skills and communication (Lovaas et al. 1966).

Future Research and Conclusions

Although EIBI has proven to be effective in teaching many children with autism adaptive behaviors and also for decreasing autistic symptoms, much is to be improved. The large variation in treatment gains, as evident in published outcome studies (Eldevik et al. 2009), needs to be explained. Some children gain little from treatment, and if the reasons for this can be identified, then treatment can hopefully be modified to enable these children to benefit more. Also, even though the majority of children profit considerably from EIBI, only a minority achieve normal functioning. Thus, both the components in EIBI and their relative effectiveness must be further investigated to optimize treatment effects. Efforts have been put into identifying behavioral cusps (i.e., key behaviors that are necessary for further development (Bosch and Fuqua 2001; Rosales-Ruiz and Baer 1997). However, there is only limited consensus over which behaviors are cusps, and more research is needed to clarify this issue. Also, there is a need for longer follow-up studies of the effects of EIBI. It has not yet been shown that treatment gains may be maintained into adulthood and, if not, how they could be maintained.

Perhaps most needed are studies on how EIBI can be most effectively disseminated. Research on effective ways of training staff and parents to optimize teacher skills is needed, as well as the development of computerized aids in intervention programs.

Key Terms

Behavioral deficits. Behaviors or skills that the individual child lacks, such as eye contact, grammar, or adaptive behaviors.

Adaptive behaviors. Skills that the child needs to function independently. These include language, social skills such as playing, feeding behavior, dressing, and motor skills.

Antecedent. Stimulus that is present when certain behaviors are emitted and reinforced. For example, the question "What is your name?" is a stimulus present before the behavior of saying one's name occurs and the teacher reinforces with praise for answering correctly.

Response. A behavior with a certain antecedent and usually maintained by a certain consequence. In EIBI, the target response to be learned following an antecedent is operationally and objectively defined to optimize learning and teaching.

Consequence. For a behavior to be learned or maintained, a reinforcing consequence must follow, at least sometimes. Many children with autism are not reinforced by social consequences such as praise or smiles. Effective reinforcers for children with autism may be tickling, bubbles, mechanical toys, certain foods or drinks, music, videos, etc.

Prompt. The support or cue that a teacher gives the child to produce the target response successfully. The prompt is gradually phased out so that the child can perform the behavior independently.

Cusps. Key behaviors that are targeted in EIBI because they are important for further learning or for the quality of life for the child. Examples of cusps are joint attention, eye contact, generalized imitation, and reading.

Key Facts of EIBI

- EIBI is an evidence-based intervention applying principles and procedures from Applied Behavior Analysis to help young children with developmental delays to acquire adaptive and functional skills in the areas of communication, play, and social, emotional, cognitive, and self-help skills.
- Treatment effect has been shown in IQ scores and on adaptive behaviors. Treatment intensity is the most stable predictor of individual outcome.
- Skills that the child lacks are broken down into component behaviors. These component behaviors are taught separately and then combined when mastered. In this way, complex social behavior such as conversation and play skills can be taught. Given that a large behavioral repertoire is successfully acquired, the child can function both flexibly and creatively in social settings.
- Treatment is highly individualized by identifying each child's behavioral deficits, needs, and motivating stimuli to ensure functional and effective learning.
- EIBI differs from other treatment in being firmly based on basic research on operant and classical conditioning, the highly structured teaching, and the support from controlled studies.

Summary Points

- This chapter describes a behavioral intervention for children with autism: EIBI.
- Several outcome studies have indicated that children who receive EIBI make greater progress in adaptive behavior and IQ than comparison groups. The largest effects are seen in IQ.
- EIBI entails teaching behaviors that the child lacks in a structured fashion and on the level that the child can master. Help is given when needed and then phased out.
- EIBI can be used to teach language, social interaction, active daily living skills, and academic prerequisites.
- A treatment team consisting of parents, teachers, and a supervisor conduct teaching in all areas of the child's life. Optimally, treatment is given with an intensity of 30–40 h per week, for a minimum of 2 years.
- In behavior analysis, autism is seen as a learning disorder. In this chapter, it is argued that this learning disorder is a specific deficit in social motivation. This lack of reinforcing effects of social stimuli may emerge because of an innate lack of social interest or because of an excess interest in stimuli maintaining stereotyped behaviors.

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