APPLICATION OF IE-BASIC PROGRAM TO PROMOTE COGNITIVE AND AFFECTIVE DEVELOPMENT IN PRESCHOOLERS: A CHILEAN STUDY

Abstract
This study explores the effectiveness of the Instrumental Enrichment Basic program (IE-B) in enhancing cognitive and affective functions of young children. The IE-B is a cognitive intervention program based on Feuerstein's theories of structural cognitive modifiability and mediated learning experience. Thirty 3 to 4 years old children were assigned to experimental and control groups. The experimental group received the IE-B program for seven months (for a total of 48 hours) and was compared to the control group before and after intervention on tests of knowledge acquisition and vocabulary. Cognitive change was evaluated using a Chilean assessment battery that measured children’s language, cognition and knowledge. The findings indicate that children in the experimental group improved their performance more than children in the control group. Results indicate that IE-B can be used with socially disadvantaged children as young as 3-4 and that it leads to improvement in their performance.

Key words: mediated learning experience, learning potential, preschool, cognitive intervention.
The National Board of Pre Schools (JUNJI) is a public institution of the Chilean government that takes care of about 135,840 toddlers and young children from poor and socially disadvantaged families (Mideplan 2007). These children have historically presented deficiencies in the development of their language and communication, which are reflected in very low scores demonstrated in the evaluations conducted by various institutions over time (JUNJI, 2006; 2008). The development of cognitive skills and acquisition of content knowledge of these children is declining, which definitively causes concern among the Chilean government. In addition, the results of recent research (CEDEP, 2007) indicate that the teaching programs these children received were not done in an optimal way and as a result their ability to develop new learning skills remained underdeveloped.

In this context, it is relevant to emphasize that educational orientations, central to the preschool curriculum in Chile, consider the human being to be an open and modifiable system, in which intelligence is not a fixed value but a dynamic auto-regulated process, sensitive to the intervention of an efficient mediator (Mineduc, 2001; Prieto & Pérez, 1990).

To improve the quality of the educational processes, and particularly the pedagogic interactions, has become the aim and central challenge for JUNJI in Chile. It is in this framework that the government allowed the application of the IE-B program to preschoolers that belonged to the Chilean system of preschool education. The present study is the first attempt to explore the effectiveness of the IE-B program with preschool children in Chile.
Cognitive Structural Modifiability and Mediated Learning Experience

The present study is based on the theory of Structural Cognitive Modifiability (SCM) developed by Feuerstein, Rand, Hoffman and Miller (1980). Feuerstein conceives the human being as an open system receptive to change, whose cognitive structure can be enhanced and modified. SCM becomes an essential characteristic of the human being who responds and adapts to new situations and constantly changing new requirements. It is understood as a capacity of human beings to change the structure of their cognitive functions aiming at adaptation towards the changing demands of the life’s situations (Feuerstein, Feuerstein and Rand, 2006). The structural cognitive change is not transitory and it differs from simple accumulation of experience or maturation. This adaptational capacity is manifested in different ways in each individual, since not everyone possesses the same capacity toward modifiability, and so change can vary from one individual to another, depending on the quality of the interaction offered.

The modifiability model focuses on such interactions between a person and his/her environment that are mediated by another person. Mediated Learning Experience (MLE) is defined as the quality of the human-environment interaction that has particular characteristics determined through the criteria of MLE. The development of cognitive abilities depends on a number of proximal and distal factors, MLE being the most important of the proximal factors (Feuerstein, Feuerstein and Rand, 2006). Not only human beings but also environments themselves can serve as mediators as long as they offer permanent challenging experiences that require adaptations that often reach beyond the current age or developmental status of the person (Feuerstein, Klein & Tannenbaum, 1994; Lidz, 1991).
Adequate MLE can generate openness for cognitive changes of structural nature and the development of an active learning disposition. The lack of adequate MLE may result in delays in the person’s cognitive development. The initial lack of adequate MLE can be compensated, however, via specially MLE-rich intervention programs. One of the best-known programs is “Instrumental Enrichment” (IE) (Feuerstein et al, 1980). The impact of IE, and the importance of MLE interactions, on the quality of cognition and learning has been researched extensively in different countries with various populations (Alvarez, Santos, Santiago & Lebron, 1994; Kozulin, 2000a; Kozulin, 2000b; Feuerstein, et al, 1980; Jensen & Singer, 1987; Klein, Wieder & Greenspan, 1987; Rand, Mintzker, Miller, Hoffman & Friedlender, 1981; Rand, Tannenbaum & Feuerstein, 1979; Romney & Samuels, 2001; Ruiz, 1985; Savell, Twohig, & Rachford, 1986; Shayer & Beasley, 1987; Tébar, 2007; Tzuriel & Alfassi, 1994).

A more recent program, aimed at younger children (IE-B), has been developed by Feuerstein and Feuerstein (2003) and researched by Kozulin, Lebeer, Madella-Noja, González, Jeffrey, Rosenthal & Koslowsky (2010). IE-B has been designed as a stand-alone program for cognitive enrichment of younger children and as a remedial program for older children with special needs. The IE-B program is based on the principles and operative criteria of SCM theory and emphasizes the quality of human mediation and educational interaction. The mediator has a task of selecting, organizing, framing, and planning the presentation of stimuli, changing their intensity, frequency, duration, and context in agreement with the dynamics of the learning interaction with the child (Martinez, Brunet & Farrés, 1997). The IE-B program focuses on children’s attention processes, general cognitive functions, verbal tools, social cognition as well as affective and emotional components.
The aims of the IE-B program include: 1. Enrichment of the cognitive repertoire of the child, 2. Enhancement of a set of concepts, vocabulary, operations and learning strategies, 3. Development of cognitive functions that serve as prerequisites for effective behavior, 4. Anticipating difficulties of learning caused by insufficient or inadequate development of cognitive functions that support learning, 5. Remediation of those thinking functions that are insufficiently developed, giving them better stability and strengthening their manifestation, 6. Making the child aware of his or her own learning process and cognitive resources, 7. Development of intrinsic motivation for learning and 8. Enhancement of the child’s feeling of competence in learning situations (Feuerstein, Feuerstein, Falik & Rand, 2002; Feuerstein and Feuerstein, 2003; Feuerstein, Feuerstein, Falik, 2004b).

Method

Participants

A total of 30 children from the Metropolitan Region of Santiago (Chile) participated in the study. All children came from two preschools, 15 children from each preschool. The two preschools had common characteristics, such as the same community, exposure to the same local programs and opportunities, and the age of the children. There was no ethnic or gender differences between two groups. The children belonged to one of Santiago’s most socially vulnerable communities. Exclusion criterion was clinical diagnosis associated with any disability. Children in one preschool were assigned to the experimental group and in the other to the control group. The age of the participants was between 3 and 4 years. Parents and children were informed in advance of the goals and contents of the IE-B program, and asked for their consent for participation in the study.
Measures

IEP-JUNJI\(^1\) –Pedagogical Evaluation Instrument- (Instrumento de Evaluación Pedagógica). To establish the children’s pre- and post intervention performance, a Chilean instrument called IEP-JUNJI was used. The IEP-JUNJI is nationally recognized and used in JUNJI preschools to evaluate children’s learning achievement. This instrument is applied every year to about 15,000 preschoolers.

The IEP-JUNJI instrument has six scales with 259 items that indicate the achievement of a specific ability of the child according to his/her age. These scales evaluate such parameters as child’s autonomy, body expression, creativity, socialization, knowledge and vocabulary. For the purpose of this study, only Knowledge and Vocabulary scales were used. The reason for this selection was to match the goals of IE-B intervention with the assessment instruments.

The Knowledge scale includes two aspects: knowledge of oneself and knowledge of the environment. It is composed of 16 items that evaluate the acquisition and use of information of physical, emotional, social, and cognitive characteristics of oneself, and the characteristics of the natural, social, and cultural environment in which the child lives. Two examples of items in this scale are questions such as “What is your hair color?”, “Do you know why it rains?”, “Why people get sick?” Children’s answers are scored according to a list of possible answers.

Related to the goal of intervention, the Knowledge scale allowed investigating changes in the children’s knowledge and concepts. These changes reflect children’s ability to use categorization and conceptualization of themselves and the world they live in:

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\(^1\) JUNJI stands for National Board of Preschool Education (Junta Nacional de Jardines Infantiles) which is the Chilean’s government agency for pre-schools.
Colors, shapes, sizes, why things work, feelings, cause–effect relations and space-temporal relations of the environment.

The Vocabulary scale includes three aspects: comprehension, expression and control of vocabulary. It is composed of 16 items that evaluate the ability of the child to communicate with others in a clear and understandable way, knowledge of language/vocabulary, use of accepted social-cultural patterns, and being able to interpret adequately communications made by others. Two examples of items in this scale are: “Can the child express his/her preferences, likes and dislikes verbally”, “Can the child constructs sentences following culturally acceptable linguistic rules”.

Related to the goal of intervention, this scale allowed investigating changes in the verbal repertoire and verbal etiquettes of children, their ability to use words for better understanding of their world. The Vocabulary scale also evaluated children’s comprehension of sounds, rhythm, meaning of verbal cues or figures, and order and functions of communications.

Previous studies have reported high reliability $\alpha = .85$ (Macchino, 2002) for the IEP items. Cronbach alpha reliability of the IEP scales based on the sample of the present study was $\alpha = .88$. Individual reliability for Knowledge scale was $\alpha = .79$, and for the Vocabulary scale $\alpha = .82$. These reliabilities are considered as satisfactory (Cohen, 1988).

*Learning Propensity Assessment Device Basic (LPAD-B)* (Feuerstein et al, 2004a). The LPAD-B was used for determining the learning potential of participating children and on this basis selecting IE-B instruments most suitable to their needs. An additional reason for using LPAD-B was to check whether the groups were sufficiently homogeneous. The following sub-tests of LPAD-B were used: The part/whole relationship test, the functional part/whole relationship test, and the concept-formation test.
LPAD-B assessment of the participating children revealed certain cognitive deficiencies, such as the lack of spontaneous exploration of the tasks and the lack of planning. The development level of the children was characterized by the lack of verbal categories and perceptual models essential for problem solving. Children’s actions were guided by functional and everyday experiential thinking rather than by abstract categorical thinking. The children lacked internal regulatory behavior and displayed impulsive and non-attentive behavior when reflective-analytic behavior was expected. This was observed in the impulsivity of children’s answers, their deficient motor control in tasks requiring precision, and lack of awareness that additional information should be collected for an adequate solution of the task.

Instrumental Enrichment Basic (IE-B) Program. From the LPAD-B results, and the identification of the group’s characteristics, the intervention program was designed to modify and develop children’s cognitive functions. The IE-B program includes a variety of instruments that can facilitate the formation of cognitive habits, enrich the learning repertoire, and develop systematic cognitive processes. The IE-B program is composed of 11 instruments, each having a different purpose and cognitive dimensions. The results of LPAD-B assessment allowed us to select two IE-Basic instruments crucial for the development of children’s cognitive functions: Organization of Dots and Compare and Discover the Absurd.

Organization of Dots-Basic is aimed at developing children’s cognitive functions in a figural and visual-motor modality, as well as planning behavior. The child is mediated to identify a geometric shape presented as a model in the form of dots. It provides a series of tasks in which the child has to develop a wide range of cognitive functions that allow integration of information, visualization of space relationships, and an ability to mentally
represent relations in systems and to infer implicit information. In order to achieve these goals the child is expected to overcome difficulties caused by the rotation of the figures and the proximity of the dots. The instrument promotes analytic perception of shapes, conservation of shape and size, planning, need for precision, motor control and restrain of impulsivity.

Below is an example of mediation provided by the teacher to children in the course of their work with Organization of Dots-Basic tasks.

\textit{M}^2: You can now look for vertical lines in objects of our classroom (CH1 gets up and touches the frame of the door)

\textit{M}: Excellent, it is amazing, look what CH1 found, a vertical line, here at the door, look (teacher points the vertical line in the door’s frame)

\textit{M}: now comes the hard part, you will have to discover the squares that are in the chalkboard, it is filled with dots, can you identify the squares? There are big and small squares.

\textit{CH1}: I can Miss; I can see the dots in the chalkboard and some squares.

\textit{M}: you can go to the chalkboard and then we can all work on these papers I am giving you (the papers have the same dots and the children start to find the squares with great expectation)

\footnote{In all examples, we will indicate the Mediator with the letter “M” and the children with the “CH”, and a number depending of the child that is interacting, for example “CH1” would indicate “Child 1”.

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*Compare and Discover the Absurd* is an instrument that develops the functions of comparison, analysis, decoding, comprehension, and enhances the child’s ability to seek information necessary for the establishment of functional and causal relations between different stimuli (situations in a cartoon modality). The situations include deliberately absurd or incongruent situation intended to activate children’s curiosity and lead them to first description and analysis, then comparison between objects, characters and situations, and finally to the re-establishment the congruence of the situation, using cognitive categories. To do this categorization children must learn to use systematic and well-planned exploration, consider two or more different sources of information, and to support their activities with appropriate verbal elements. Skills acquired through this instrument are essential in a wide range of everyday situations.

Below is a sample of mediation of *Compare and Discover the Absurd* to a child:

* M: This question is for CH2, How do people in figure 1 and figure 2 feel?
* CH2: this one is sad, and that one is happy.
* M: why do you think this person is sad?
* CH2: because he is
* M: can you give me a reason, how do YOU know he is sad?
* CH2: because he is tired
* M: good, he is tired, feeling down. Very good, CH2 thought very well his answer. How do we feel when we are tired?
* CH2: Like the ones in the figures
The IE-B intervention was based on group sessions; however special attention was paid to mediation of individualization and psychological differentiation. For example in some cases, the dynamics of learning called for a more individualized work and questions were directed at specific children. At other times questions were addressed to the group as a whole.

Procedure

This study was conducted during the regular school year (from March through December, 2008). All participants were pre-tested at the beginning of the research and post-tested at the end of the research using IEP.

Children in the experimental group received IE-B lessons by teachers from the Center for Cognitive Development, Universidad Diego Portales, who had experience in both IE-B program and in dynamic assessment techniques.

The IE-Basic intervention to the experimental group lasted seven months (April-November, 2008), for 30 min twice a week, for a total of 48 hours. Children in the control group continued receiving their regular preschool curriculums, with no cognitive intervention or special program.

Design and statistical Analysis

The study followed a typical experimental design with a pre test, an intervention and post test. The intervention was administered only to the experimental group. The dependent variable was the IEP scores in the pre- and post-testing phases.
Results

Statistical analyses consisted on a mixed method model repeated measures ANOVA (2 x 2) with Vocabulary and Knowledge as dependent variables. All statistical analyses were carried out using version 15 of the SPSS program. Table 1 shows the descriptive statistics of pre and post intervention results in the IEP tests.

TABLE 1 HERE

In the pre-test, no significant differences were observed between the experimental and control groups: Knowledge of one’s self, t (18) = .004, ns; Knowledge of the environment, t (22) = -.12, ns; Vocabulary Comprehension, t (20) =-.43, ns; Vocabulary Expression, t (17) = .013, ns, and Vocabulary Managing, t (16) = 1.25, ns. These results support the equivalence of the groups used in the present research.

Because the IEP scale theoretically proposes one dimension for Knowledge and one dimension for Vocabulary, the results for two sub-scales of the Knowledge scales and three sub-scales of the Vocabulary scale were aggregated. New scores for Knowledge were obtained from the average of "knowledge of one’s self" and "knowledge of the environment" (α = .63) and new scores for Vocabulary were obtained from vocabulary comprehension, vocabulary expression, and vocabulary control (α = .60). Table 2 shows the descriptive statistics of pre and post program results for the created dimensions.

TABLE 2 HERE
After Levene’s test for equality of variances, mixed methods analyses repeated measures ANOVA’s (2 x 2) were conducted assuming equal or unequal variances where appropriate. In all subtests, improvements in the experimental group were greater than in the control group. Difference reached a statistically significant level in Knowledge but only with principal effects (without interaction effects), Wilks’ $\lambda$, = .67, $F$ (1, 22) = 14.73, $p < .01$. There is a “large” size effect for the experimental group ($d = 1.35$) and “medium” size effect for the control group ($d = 0.38$). Post-test differences between experimental and control groups were also significant $t$ (23) = 2.29, $p < .05$, showing that the experimental group ($M = 79.08$, SD =12.33) scored higher SD than the control group ($M = 64.69$, SD = 18.25) (See Figure 1).

FIGURE 1 HERE

The results show a significant interaction of treatment by time on Vocabulary, Wilks’s $\lambda$, = .71, $F$ (1, 21) = 8.57, $p < .01$ (Figure 2). While no significant difference was found from pre to post-test in the control group, Wilks’s $\lambda$, = .99, $F$ (1, 21) = .15, ns, in the experimental group a significant improvement was found, Wilks’s $\lambda$, = .61, $F$ (1, 21) = 13.53, $p < .01$. Significant differences were also found between experimental and control groups at the post-test, $t$ (23) = 5.65, $p < .001$. The experimental group scored higher ($M = 77.78$, SD =10.76) than the control group ($M = 51.27$, SD = 12.53).

FIGURE 2 HERE
Results demonstrate that children who received IE-B program significantly improved Vocabulary and Knowledge. Some of the cognitive functions that would be involved in the improvement of vocabulary and knowledge, by the characteristics of the items used to measure this variables, would include better attention skills and less distraction, increase in the number of verbal units used, planned and systematic exploratory behavior, use of appropriate verbal etiquettes, ability to consider two or more sources of information, solving a problem using sequential steps, generalization and transfer from concrete things to abstract thoughts, aptitude to differentiate between relevant and irrelevant information, precision and accuracy, and diminished trial-and-error approach to problem solving.

Discussion

This discussion aims at describing the different actions and mediated experiences that were proposed to improve knowledge and vocabulary. The determination of this improvement was established in the results, were the experimental group obtained better, and significant, outcomes in these two variables.

The results of the study allow us to have a new look at knowledge acquisition and development of cognitive skills, within the acquisition of vocabulary, of young socially disadvantaged children. The study shows that knowledge, rather than being an individual construction of the child, is a co-constructed ability involving the child and his or her cultural environment. In our case IE-Basic instruments actively mediated the cultural environment. The mediation resulted in the enhancement of children’s vocabulary and knowledge, and the development of their cognitive functions. It seems relevant to recall in this context Vygotsky’s (1995) point of view that a learning process always involves more
than one human being. It is precisely this process of co-construction that allows the common actions between a speaker with a clear intention (mediator) and an active subject (child) to change the context of learning.

Intervention carried out in the children’s Zones of Proximal Development (Vygotsky, 1995, 1988) results in such a development of verbal and knowledge-acquisition functions that extend beyond the intervention situation into other contexts. At the same time it is important to mention that communication and knowledge acquisition performed by children during IE-Basic intervention went beyond those themes and the vocabulary typically used in their everyday life. In a sense, the children confronted here a new cultural reality.

The study underlines the importance of various criteria of mediation (Feuerstein et al, 2006), through MLE given in the IE-Basic. Each mediation strategy was constructed from the previous mediation strategy, providing the child with new cognitive abilities that lead to better vocabulary and knowledge abilities. An example for such mediation is reflected in pursuing answers beyond a first response, and acquiring an insight (metacognition) of the process of inquiry. The main criteria of mediation used during intervention included intentionality-reciprocity (e.g. telling the children what was expected in each activity and receiving feedback of what was understood), transcendence (e.g. expanding the information by providing rules), mediation of meaning (e.g. co-constructing with the child the relevance and explicit value of the activity within the cultural context), as well as mediation of sharing behavior (e.g. discovering relations of the different answers and actions), mediation of regulation and control of behavior referred principally to the control of the impulsiveness.
The intentionality-reciprocity criteria (Feuerstein, Feuerstein & Rand, 2006), was fundamental in two directions: first in the relevance of the stimuli presented to the group, and second in being explicit on what was the goal of the task. The relevance of the stimuli included modifications made in the size of the pages presented, the control of information presented to the children and activation of the cognitive functions related to the task. The intentionality of intervention also included the use of parallel pages that allowed the access to contents and processes necessary for successful internalization of principles and articulation of knowledge necessary for following the task. The explicitness of goals was manifested in the mediation of the objectives of the task, and the regulation and control of behavior needed as part of the reciprocity.

The criterion of transcendence refers to expanding the here-and-now experience to new situations, not limited by the interaction of the immediate activity, creating a propensity in the child to consistently enlarge his or her repertoire and need system (Feuerstein et al, 2006). In this respect IE-Basic intervention is aimed at developing children’s comprehension of the general usefulness of certain behaviors such as recognizing errors and correcting them to fulfill the task. In addition it was specified how different information and content relate to one another and to other things in the construction of new information, especially in the establishment of categories. Considerable effort was invested in facilitating the connections between the content of IE-Basic with other daily situations in the child’s environment, improving knowledge acquisition with these mediation.

The mediation of meaning, being the emotional, affective, energetic component of the interaction promoted the interaction between all children in the experimental group in every activity and situation. Children proposed, searched for, and offered different
opinions, examples and exercises to the group. To do so, new vocabulary was presented and activated. The experiences of the children were considered in every activity together with those of the mediated topic, opening an emotional space for obtaining new knowledge that could be sustained by the child’s daily experiences.

The mediation of sharing behavior, cultivated the need to reach out from the “self” towards others, enabling others to participate in thinking and emotional process, being evaluated in the knowledge of one’s self and the environment. This was realized by giving an opportunity for every participant to comment on his/her answers, acquiring new vocabulary by doing so. Later on, the activity focused on the group commenting on each intervention and on an articulation proposed by the mediator. This promoted, on a regular basis, the importance of listening to each other, which enabled the acquisition of new vocabulary and knowledge among the experimental group.

The mediation of challenge was generated by provoking the child to confront the tasks that were not familiar, as well as by the use of the surprise or suspense factor. These factors generated major motivation and adaptation to change, relevant to the context in which this study was situated.

The mediation also offered the possibility to acquire regulation and control of behavior, specifically control of impulsiveness. Other researches (Brooks & Haywood, 2003) have demonstrated a significant increase in the regulation, adaptation of roles, and classification in Bright Start programs. The present IE-Basic intervention succeeded in organizing activities in such a way that children who initially demonstrated anxiety or anti-social behavior were successfully integrated. Expressions of opposition, or non-participating behavior, were treated with the possibility of self-reflection and the necessary
feedback for decision-making based on the appropriateness of these behaviors. Modeling from peers and the mediator enhanced the child’s ability to adopt new modes of behaving. The limitations of our study include a small sample size and, more significantly, the fact that control group received no intervention while the experimental group received IE-Basic program.

CONCLUSIONS

Equal access to education in developing countries is important not only because of education itself but also because it promotes equality and opportunity for everyone. The high quality educational experiences that promote learning and development should be accessible to children, irrespective of their social condition. Scientific research provides extensive data of the fundamental importance of the first years of life as a base for future development of the individual and of the influence that the environment exercises in the processes of cognitive development and learning (Tébar, 2007). Authors like Rutter, Hodges and Tizard (1989, in Kotliarenco 1996) hold that a good education during infancy might constitute the important remedy against disadvantages generated in the circle of poverty. According to these authors, a quality pre-school education might contribute in a significant way in the decrease of the social inequality. Ivanovic and Bultron (1987 in OREALC, 2004) emphasize that a good school performance depends more on early educational programs than on the socioeconomic level of children, considering it a better predictor of the achievements of learning than other variables traditionally associated with these.
To provide favorable conditions by allowing positive educational experience to all children constitutes an imperative of Chilean social policy (CEDEP 2007). Given the existing evidence that poverty is associated with reduced achievement in learning and development of children, our study demonstrates that IE-Basic interventions can facilitate cognitive development in socially vulnerable children. The use of the IE-B resulted in the increasing of two major components: new knowledge and vocabulary, basic to future development of thought and cognitive functions. This result has a particular importance, both scientific and political, for the countries where social inequity limits the possibilities of good development and academic performance in children who belong to socially vulnerable groups. Our study demonstrates that theory-based cognitive development programs that include quality interactions can be implemented from the earliest ages, and can make a fundamental contribution for change in the beliefs concerning the possibilities of development in populations suffering from poverty.

REFERENCES


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TABLE AND FIGURE LEGENDS

Table 1. Pre and post-test results of experimental and control groups.

Table 2. Pre and post-test scores on knowledge and vocabulary of experimental and control groups.

Figure 1. Average pre-post and post-test results of experimental and control groups for knowledge.

Figure 2. Average pre-post and post-test results of experimental and control groups for vocabulary.
TABLES

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<td>Control (N=15)</td>
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Note: In all cases higher scores equal higher performance.

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FIGURES

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