

Cognitive enhancement and rehabilitation for the elder population: application of the Feuerstein Instrumental Enrichment Program for the Elderly

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Abstract

The rapidly expanding proportion of elderly individuals in the population demands systematic efforts to maintain quality of life, prevent mental deterioration, and restore lost or declining mental functions. The Feuerstein Instrumental Enrichment (FIE) Program for the Elderly is proposed as an effective way of meeting these needs. The program is described and suggestions made for designing research and intervention protocols. Preliminary results of program participant responses from early implementation projects are presented. Benefits for the elder client, the caretakers, and care providing settings are discussed. Implications for the care providing settings and caretakers are also identified.

Keywords: Mediation, Instrumental Enrichment, Cognitive deterioration, Neural plasticity

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1. Introduction

The focus of this paper is on interventions related to elder populations, although the applications described are equally well suited for a broader range of population, specifically those affected by traumatic brain injury, strokes, and other debilitation conditions.

It is recognized that different care giving settings require differential task accomplishment and structural goals. This can be reflected in specifically adapted training programs that - while incorporating similar core elements - are tailored to differential levels of care, needs of client populations, types of interventions, etc.

The revolution in the brain sciences presents the opportunity to intervene to modify vital aspects of the human condition. Evidence from research in neurophysiology, and brain plasticity, indicate that the structure of the brain itself, and not only behavioral functioning, is highly modifiable (e.g., Rizzolatti & Craighero, 2004). It is now clear and well defined that using a systematic approach to the modifiability of functioning will both benefit the elderly client and broaden the range of functioning in the caregiver and care providers.

The approach proposed in this paper is that of cognitive modifiability and the application of mediated learning experience (Feuerstein, 1980; Ben-Hur, 1994; Feuerstein, Feuerstein, Falik, & Rand, 2002). There is a clearly defined technology supporting the potential for cognitive modifiability in the elderly that not only improves their day-to-day functional potential but also promises to have more lasting and salutary effects. We propose utilization of the Feuerstein Instrumental Enrichment for the Elderly (FIE-E) as especially appropriate as it encompasses all of the elements that have been determined to promote neural plasticity. We describe both these elements and the FIE-E program below.

2. Frameworks for application

The FIE-E program can be applied in a number of different settings (Hadas-Lidor, 1977; Cohen & Englander, 1995; Katz & Hadas, 1995; Lifshitz, 1997), each of which will have their own strategic and care provision options (that must be reflected in the program implementation and caregiver training models - see below). The differing venues for application are:

- adult day care settings
- in-home, individualized care
- independent living environments

- skilled nursing facilities
- hospitals and rehabilitation settings
- community centers

The data presented in this paper comes from applications in adult day care settings with a population with differing levels of mental and physical competencies.

3. Cognitive modifiability and neural plasticity

Researcher in the neurosciences relating to the function of the brain have identified a number of principles and elements that summarize the general processes that need to be present in the mental experience that activate the potential for the neural plasticity that is present in all human beings. Kleim and Jones (2008) have summarized them, and we have developed some descriptive and summarizing labels, with brief descriptions relating specifically to our view of cognitive modifiability and the way in which the FIE-E program encompasses them. Based on our clinical observations we have added two additional elements (consciousness and multi-sensory effects) that we believe are closely related to Kleim and Jones' ten.

(1) *The Activation Effect*: Specific brain functions must be activated and stimulated to develop and sustain behavioral functions. It is the manifestation of the phrase use it or lose it. Others have described this element in a slightly different way, drawing upon an early Hebbian concept of cell assemblies: neurons that fire together, wire together. Researchers have described the loss of neural functioning through disuse, a phenomenon that has been called pruning. We believe that activity is a critical dimension of neural plasticity. Properly selected and structured contributes to structural modifiability.

(2) *The Specificity Effect*: Interventions need to be specific to the particular cortical function that is the target of behavioral change. There is a relationship between the nature and type of intervention and the resulting plasticity and modifiability of functions. This requires assessment and the provision of varied activities and patterns of intervention. This has specific implications regarding the types of activities selected.

(3) *The Repetition Effect*: Repetition is required for the functional changes to be structurally implanted and manifested in behavior. The amount and duration of the repeated exposures is unpredictable, influenced by the nature of functioning, the type of interference, and the like. However repetition alone is insufficient. There must be variation in task structure to promote plasticity—simple redoing of activities without systematic variation is not enough.

(4) *The Intensity Effect*: Neural plasticity also requires a degree of intensity of intervention. These variables relate to the amount of time spent in practice and contact with the intervention modalities. Structural cognitive modifiability requires durations of time and intensity of exposure that typically goes well beyond traditional and accepted patterns of sessions (in the FIE program, moving toward 20 hours per week instead of the typical one or two hours of therapeutic or instructional contact) in order to have the modifiability created become established in the neural structures.

(5) *The Persistence Effect*: Different forms of neural plasticity take place at different times, requiring the provision of both intensity and repetition, which must be reflected in a degree of persistence in treatment planning and implementation over time. That is, when immediate gains are not evident, one must not give up, but push forward knowing that there is a pace of acquisition that occurs, often latently, but eventually materializing. One is often surprised at the gains that emerge after seemingly endless unproductive encounters. When they do emerge, they become catalyst for rapid and significant changes.

(6) *The Salience Effect*: The intervention must be important and meaningful to the individual. Interventions that do not convey this element will not be responded to as successfully as those that are meaningful. This has been described as the salience of the intervention. In the application of mediated learning experience (MLE) that is a central aspect of the implementation of FIE-E, this is the mediation of meaningfulness of that to which the individual is exposed. Meaningfulness is directly related to creating awareness as the learner becomes aware of his/her functioning, of its value, of the changes that are experienced, and the importance (value, salience, etc.) of these changes. Research has shown that this is an important element in neuroplastic activation.

(7) *The Optimal Timing Potential Effect*: While we (the authors) do not believe in critical periods as a barrier to change, it has been recognized that some kinds and propensities for change are age related. For example, although it may be easier to induce plasticity in younger brains, adult and the brains of the elderly are also amenable to change. The issue is the level of persistence, effort, and the types of intervention required to promote plasticity at various ages and stages of development. The research cautions us not to take the dimension of optimal timing as a reason to withhold or not initiation interventions.

(8) *The Novelty Effect*: Research has shown that learning experiences must be new and challenging for them to stimulate neural plasticity. If all one does is repeat familiar tasks learning will not progress or be elaborated. Challenge and novelty are required, thus questioning many popular and accepted activities that do not challenge the learner's cognitive structures to change.

- (9) *The Spread of Effect*: Changes in functions resulting from a particular intervention can affect changes in other functions not directly targeted by the original intervention. This has been described as a transference effect, aided by the mirror neuron systems that have been discovered and tracked in neural anatomy. Specifically, it has been shown in monkeys and humans that activation in one part of the brain will generate activities in other parts, often without awareness or conscious intention. In the application of MLE, this is described as the parameter of the mediation of transference and must also be embedded in the structure and provision of the intervention (as it is in the FIE-E program).
- (10) *The Selection Effect*: There can be interference, whereby plasticity stimulated or experienced in one area may interfere with changes in other areas. This must be accounted for in the interventions selected, based on an analysis of the needed behavior changes and the tasks selected for the intervention.
- (11) *The Consciousness/Awareness Effect*: The learner must be aware of the effect of functions on behavioral outcomes, and this awareness serves to reinforce other changes in functioning. It also creates engagement, and a willingness to accept frustration and the need for increased effort in response to stimuli and situations.
- (12) *The Multi-Sensory Effect*: The tasks should require perceiving and responding to stimuli from many different, but intersecting, modalities. Seeing, hearing, feeling, and doing (the proprioceptive feedback loops). This creates a participation with the input information that leads to structural integration and generalization.

4. Structure and activities of the FIE-E program

The FIE-E program consists of 14 instruments that represent organized activities to stimulate mental development through perceptual and motor planning, searching for relevant information, solving problems of increasing complexity, using rules and strategies in situations that vary from one another but elaborate from what has been learned and practiced to higher levels of complexity and abstraction. The learner develops accuracy at gathering information, applying information to solve problems, using strategies on both similar and different problems, and applying what has been learned to a wide range of life experiences. Specific applications for the elderly individual are:

- (1) mental stimulation affecting various populations of defined need: e.g., memory loss, dementia, palliative care, in various settings, etc.;
- (2) palliative and restorative activities effecting residents in various settings: e.g.,

day care, residential, home care, etc.; (3) potential interactive effects in regimes of medication management; and (4) affecting client responses (depending on variables such as intensity and duration of program exposure) on aspects of mental functioning defined in terms of time and space awareness, self care awareness and skills, short term and long term memory, and social functioning (defined as general awareness of surroundings, verbal and nonverbal interaction, self- and other-awareness, autonomy, etc.

Benefits are also projected for care providers. Orientation to cognitive aspects of resident behavior and care-taking demands (those that are typically summarized as "activities of daily living" or ADL's) can improve the functioning and satisfaction of care providers. Some of the specific benefits are: (1) retention, satisfaction/morale, staff participation in program development and evaluation consequent to training; (2) adding to the repertoire of care taking techniques applied to ADL's; (3) providing relevant and interesting activities for residents to participate in during activity periods; and (4) raising levels of professionalism in care takers, leading to retention, decision-making, and care management planning and implementation.

Adopting the FIE-E program will enable the caretaker to undertake the usual and needed interventions with clients, but do so in the context of cognitive awareness, adaptive responses, sensitivity and empathy toward clients, and problem-solving abilities that achieve these goals. The learning processes are oriented toward using the natural and needed tasks in the environment, but also the learning of specific tools that will enhance functioning and client outcomes.

Although the focus of this paper is on the application of the program for the elderly client, it is necessary to keep in mind the interface of effects with regard to the care-givers, as outlined above. Some of the data to be presented below has significant implications for this interface.

5. Identifying elements of change: for the elder client and caretaker

As the elder client participates in and is benefited by the program, their responsiveness and functioning will change. As an "outcomes-based" intervention, it is necessary to define successful and efficient functioning. Some of this definition will come from the setting and its "external" needs and demands. This has significant potential to alter the caretaker's insight and awareness regarding the provision of care, and observations about the needs of the client and the efficacy of functioning.

In the training and support of caretakers, it is assumed that this level of professional and functional self insight serves the needs of the setting, and improves outcomes for all involved - the client, the caregiver, and the provision setting. This occurs through the following dimensions of building a cognitively oriented approach to the provision of care, and acquiring the ability to use mediated learning experience (MLE) as the primary interactional modality. We will briefly mention their contribution here:

- (1) *Awareness*: the development of a need and belief system in the caregiver, centered on the caregiver's recognition that care taking is a positive life and mentally enhancing experience and that the adult client can learn and be modified to improve the quality of life. A clear goal of this level of training is to have the caregiver believe, and convey to the elderly client that he/she can change, will change, and is not too old to be able to learn, retain, and develop competence.
- (2) *Assessment*: evaluating and adapting interventions to the client's levels of functioning and response to mediation. In some instances, application of systematic dynamic assessment, such as the Learning Propensity Assessment Device (LPAD) (Feuerstein, Feuerstein, Falik, & Rand, 2002), has proven to be useful in gathering information on the nature of cognitive modifiability, styles of learning, and aspects of cognitive functions to direct mediated learning experience interventions toward.
- (3) *Task Analysis*: analyzing the needs of the clients and the setting in which the care giving occurs.

This is done as a learning experience, to focus on needs and objectives, and to build upon (1) and (2) to create a process of problem solving and focusing. This is done by paying attention to (a) identifying the problem, what are the needed outcomes, what is desired to occur to address the stated problem; (b) observing client responses and levels of functioning; (c) if a problem is detected, determining the reason why the problem exists (assessment), gathering additional data and focusing on relevant issues; (d) developing a plan of action - what will be done and how will it be done; (e) evaluation of outcomes, to what extent does or has the plan of action been successful; and (f) revision of the plan and action based on the above.

Once the above elements are identified acted upon, intervention occurs through the adaptation and implementation of the program, reflected in specific program exposure and follow up in regular on-site activities. For example, lessons from the FIE-E program can be used to build relevant problem solving skills for the resident/participant clients. Ongoing formative evaluation should take place to continuously assess the degree to which the training program is meeting needs and affecting change in the caregivers and their clients, with cali-

bration of program elements (time and content of training) reflective of information gathered and collaborative decision-making.

6. Results from demonstration projects

In this section we will present the results from 12 demonstration projects undertaken in Israel in 2012. They occurred in adult day activity centers, presented to elder participants as a program option that they could choose from (others being craft activities, current event discussions, book readings, etc.). They were described as activities to improve memory and thinking. The 12 groups were quite heterogeneous from one another, but attempts were made to compose each group with participants that shared functional levels, thus creating homogeneity within the groups.

Sample: The total number of participants in the 12 groups was 108. The average age was 79.8. 82% were female, 18% were male. Educationally, 43% of the participants had not completed secondary school, 37% completed secondary schools, and 20% had university experience. Interestingly, level of educational attainment did not correlate with outcome results.

Method: A number of questionnaires were devised and administered to participants and other significant personnel related to the project implementation. Table 1 describes the tools, targets, timing, and respondents.

Table 1 - *Assessment instruments, timing, and goals*

<i>When administered</i>	<i>Assessment instrument</i>	<i>Respondents</i>	<i>Assessment goal</i>
prior to program initiation	opening questionnaire	day care center staff	abilities and attitudes of participants
during first meeting	initial capacity assessment	program teachers	using FIE to estimate initial skills
after 6 weeks	teacher questionnaire	program teachers	interim feedback
one month prior to program termination	executive questionnaire	site managers	program feedback
at completion of program	summative evaluation	program teachers	participant functioning/change
at completion of program	concluding questionnaire	site management and staff	participant functioning/change

Because these were the first implementations it was decided to begin in an informal and relaxed manner, and no systematic assessments of the participants were undertaken. This was to be left to the subsequent applications, after we had gained some sense of participant responses, program structural dimensions, and the like. The data is preliminary, offering observational and anecdotal information.

The questionnaires used a five point, Likert type scale, with a response of 1 indicating "not at all," 2 being "to a small extent," 3 being "to a moderate extent," 4 being "to a great extent," and 5 indicating "very much."

Table 2 shows the ratings on the opening questionnaire. The variables rated are designed to elicit observations from day center staff about the participants functioning in three general areas: memory, capabilities, and knowledge.

Table 2 -*Staff assessments of participant functioning prior to program initiation*

<i>Functional variable</i>	<i>Performance Rating</i>
1. Remember things about family and friends	3.39
2. Remember events that happened recently	3.68
3. Remember content of recent conversations	3.39
4. Remember own address and telephone numbers	3.46
5. Know day and month	3.46
6. Remember where things are usually kept	3.14
7. Know where to find things in fixed locations	3.61
8. Can operate home appliances	3.04
9. Able to use new devices	3.04
10. Able to learn new things	3.68
11. Makes decisions on everyday issues	3.04
12. Shops independently	2.18
13. Handles own financial matters	2.18
14. Knows to calculate, what to buy	3.21
15. Knows immediate environment	3.43

The numbers are average ratings for the group. No attempt was made to do any statistical analysis. The raters were staff that had individual and detailed knowledge about the participants (social workers, case managers, etc.) and could offer an accurate picture of general levels of perceived functioning. Variables 1-7 reflected assessments of memory functioning (much like that which is measured in "mini-mental status examinations), 8-12 reflect capabilities, and 13-15 levels of functional knowledge. Data was accumulated for each program setting so that variables could be compared and contrasted—they will not be included in this presentation of the data however.

They did show differences from group to group that could be accounted for by ways in which the participants were selected for the groups. Table 2 shows that overall the participants begin the program with moderate levels of functioning, somewhat lower in areas of capabilities and knowledge.

Four questions were added to the questionnaire administered at the conclusion of the program. Table 3 shows the questions, isolated from the others, and the respondent's ratings for all 12 groups.

Table 3 - *Variables added to end of program ratings*

<i>Variable</i>	<i>Rating</i>
Self-expressive	4.20
Level of motivation	3.92
Ability to deal with new material	3.90
Level of confidence	3.90

They show ratings that are consistently above the level of the other ratings (cautioning that there is no way of establishing statistical significance), with particular focus on the "affective" aspects of process.

Finally, Table 4 shows the teacher's evaluations of the change in capabilities of the participants for all 12 groups, at the end of the program. The first five variables questionnaire items were constructed to show levels of functioning on the basis of observed progress on aspects of cognitive functioning emphasized in the Instrumental Enrichment program that served as the basis for the activities and mediation in the program.

Table 4 - *Teacher's evaluation of change in participants capabilities*

<i>Variable</i>	<i>Rating</i>
Ability to deal with new material	3.43
Ability to orient	3.23
Ability to understand and follow instructions	3.38
Ability to compare	3.28
Expressive oral	3.23
Confidence	3.43
Level of motivation	3.84
Quality of participation	3.72

The ratings are at the moderate and slightly above level for all items except for "ability to deal with new material."

7. Discussion of results

We are well aware of the limitations of such questionnaire data, providing only descriptive statistics based on impressionistic ratings. Nevertheless, we feel it has value as a starting point to focus on the kind of variables that can be identified and studied with regard to improving the cognitive processes and thus levels of functioning in elder populations. The heterogeneity of our groups indicates that efficacy of the kinds of intervention provided by the FIE-E program is not limited to particular levels of functioning or diagnostic assessments. Certainly various outcomes may differ according to these conditions, but the overall value of engaging elderly individuals in mediated cognitive activities can be shown.

From an overall perspective, the participants were judged to be moderately competent in areas of memory and capabilities, and lower in knowledge. More homogeneously grouped, lower functioning participants would presumably be differentially observed on these variables. However, at the end of the program, there were consistent gains observed in those functions that we know to be related to FIE-E program dimensions. Of course this requires considerable further examination.

A vivid demonstration of the gains was made available to us when Professor T. Dwolatzky, director of the Geriatric Department and Memory Clinic at Ben-Gurion University of the Negev (Israel) approached our research team with the following information: four of his patients, who had been assessed using the MindStreams assessment battery developed by Neurotrax (Simon, Schweiger, Dwolatzky, Chertkow, Miller, & Joffe, 2002), returned for their periodic re-assessments, and showed significant gains in cognitive functions. When asked what had happened to them in the interim (between assessments, occurring over a 8-10 month interval) they each indicated that they had been participating in a learning activity program - one of the 12 projects that is the focus of this paper.

Another perspective for consideration is the anticipated and predicted needs of the population of participants (see our differentiation of the needs earlier in this paper). Although the duration of the program is not sufficient to show such changes, one can anticipate (demographically) flat or declining performance. We did have three groups where we have pre- and post-assessment data. In one group functioning was stable or mildly increased. In the other two there were mild declines in rated functioning. Observers commented that these two groups turned out to be lower functioning (initially) than the others.

We did not have data for all 12 groups, and the "statistics" on these three groups are so "rough" that we have not included them in this paper. Certainly, fully understanding the benefits and changes requires more systematic information, and assessment of the participants' levels of functioning directly and not through second party observations. This is the next step in our overall research plan. It is encouraging that levels of functioning were seen as remaining stable and improving, and - importantly - the affective aspects (motivation, interest, levels of engagement in tasks and with co-participants) of participation were positive. This was reinforced anecdotally by interviews conducted with the participants, and their regular attendance and aspects of their increasingly responsive interactions within the groups.

8. Conclusions

Several demonstration projects, in the United States and Israel, have given us indications of the relevance and appropriateness of this approach. Based on the experience and results reported here, research designs and further data gathering efforts are being undertaken, and will be analyzed and presented in subsequent publications. For instance, the experience of those few participants who were assessed "pre- and post-treatment" and showed gains has encouraged us to plan a systematic assessment of their "entry" and "exit" levels of performance. We hope to reflect this level of results in our subsequent publications. However, every indication has been positive regarding the potential of this approach to meet the needs of the elderly and this preliminary set of data provides a demonstration of the effectiveness of the FIE-E program. Based on this, we are confident that the FIE-E has important contributions to make, from the perspective of the effects of implementing a cognitive development program, or as a tool for the research into various conditions and outcomes related to cognitive processes of the elderly. Our subsequent research efforts will extend to conducting pre- and post-participation assessment of cognitive functioning, using both standardized and dynamic instruments to determine the extent and nature of changes, and begin to identify contributing factors.

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