INCAS Neurocognitive Laboratory; Four Years of Intensive Efforts to Build up Experimental Understructures for Human Subjects in Iran

1. Introduction

In the period between 2000 and 2004, a number of medical students studying at Tehran University of Medical Sciences (TUMS), in collaboration with Iranian Institute for Cognitive Science Studies (ICSS) and the university's Student Research Center, established a group which aimed to examine different functions of the prefrontal brain cortex. The results obtained by the activities of the mentioned group were published between 2002 and 2005 in eight peer reviewed scientific articles in Persian journals. In 2005, due to their interest in studying the higher cognitive functions of prefrontal cortex in patients with drug abuse, the members of this group relocated to the Iranian National Center for Addiction Studies (INCAS), which had been recently established in TUMS. After carrying out a number of research projects in INCAS, and with the agreement of the board of directors of the center (directed by Dr Mohammad Emran Razzaghi), the group founded the laboratory for psychological assessments (Psycholab), as a subset of the clinical department (directed by Dr Azarakhsh Mokri). With the financial sponsorship of Rose Industrial Group (chaired by Mr Esmaeel Zamanian Brujeni), and through a four-year persistent endeavour, the lab was able to establish an assembly of different laboratory units presently known as "neurocognitive laboratory" in an area of about 300 square meters in the Iranian National Center for Addiction Studies.

2. A Review of Activities in Recent Years

The neurocognitive laboratory of National Center of Addiction Studies launched its activities in circumstances where almost no similar experiences, as organized laboratories, were present in this area in the country. Even though sporadic activities in the form of cognitive or neuropsychological assessment studies had been carried out in on a number of brain illnesses, it could be claimed that except for very rare instances, the projects were limited to individual and independent studies with no planned and consistent course, whose outcomes were limited to a few articles published in recent years. Almost everything had to be planned and commenced from the scratch in these circumstances. Accordingly, the laboratory started its activities in the following areas:

2.1. Development of culturally and ecologically validated instruments for neurocognitive assessment of Persian speaking subjects: Although the activities of the lab began with the assessment of prefrontal functions, the necessity to carry out more extensive assessments of other brain areas drove the investigators to work on other areas such as attention and concentration, executive functions, working memory, various forms of long term memory, spatio-motor representation, social cognition, motor processing, etc., in addition to areas related to judgment and decision making; and in order to provide hardware and software required for the assessment of the mentioned cognitive functions. The list of tests in Table 1 contains instances of instruments that their Persian versions were developed during years of persistent endeavour.

2.2. Developing functional and structural brain imaging infrastructures: The brain imaging unit of the lab, in collaboration with the brain imaging department of Science and Technology Research Center in TUMS (Dr Mohammad-Ali Oghabian), and through international interactions with Oxford, McGill and Duke Universities, managed to provide the infrastructures required for imaging studies using MRI and processing functional and structural brain images. A list of various methods of brain imaging processes used in the lab in recent years is presented in Table 2.

2.3. Execution of neurocomputational modelling projects in collaboration with schools of mathematics and engineering: Creating inter-disciplinary interactions with the goal of executing multi-field research projects were among the principle activities of the lab in recent years. Collaboration with schools of mathematics, computer science, control, artificial intelligence, and economics of Tehran, Sharif, and Amirkabir Universities, and the execution of neurocomputational and cognitive modelling projects in the area of addictive behaviours in the course of these collaborations, are among the outcomes of this inter-disciplinary interaction approach.

2.4. Execution of qualitative or mixed method studies to define domestic and national theoretical frameworks: Development of infrastructures and obtaining experience required for the design and execution of qualitative studies in the lab in order to meet local needs, were

made possible through collaborating with Georgetown University (Dr Irene Jillson). The execution of numerous projects with the aim of assessing the efficiency of abstinence oriented residential treatments and detoxification programs using opium tincture, as well as the assessment of causes leading to addiction and its continuation and the barrier for treatment among female addicts, are among the outcomes of these infrastructures.

2.5. Employment of cognitive assessment tools as a means of outcome measurement in the treatment of addiction: In the approach to addiction as a "brain disease", methods of neurocognitive assessment provide the means for "examining the complex functions of the brain". Applying cognitive assessment tools along with common therapeutic methods for addiction such as maintenance therapy, detoxification and abstinence based methods as indexes of determining the appropriate method of treatment (patient selection), assessing the efficacy of treatment, prediction of treatment success and the assessment of impaired brain functions due to treatment effect, has been one of the lab's priorities in these years.

3. Collaboration in other Fields of Addiction Medicine

In addition to the aforementioned activities in applying neuroscientific knowledge in addiction medicine, the lab has provided other efficient assistance considering its experience, to other clinical and research teams in the field of addiction medicine; including the following:

3.1. Providing consultation and collaboration for the preparation of the comprehensive file for substance abuse assessment or treatment or ISAP: ISAP (INCAS Substance Abuse Profile) is a file for the assessment of patients with substance abuse in Iran, establishing treatment programs and weekly and monthly follow-up. This profile was prepared in the National Council for Compilation of Educational Resources, through the collaboration of the lab with the clinical department of INCAS.

3.2. Development of validated Persian tools for the assessment of clinical disorders related to substance abuse: Considering its experience in tool development and the requirements of addiction care in the country to various tools in the field of addiction medicine, the lab has attempted to provide local instruments in fields related to pain, physical activity, sleep disorders, and sexual disorders related to substance abuse.

3.3. Collaboration in providing educational booklets and prevention posters for patients and the medical staff: The lab has attempted to provide and publish useful local information about brain functions and their improvement in the course of addiction treatment for the layperson, based on its research output.

3.4. Collaboration in the design of interventional packages for treatment and prevention, based on cognitive-behavioural models: Research outputs of the lab in the field of cognitive assessments have provided a good opportunity for developing interventional tools based on documented scientific observations in the fields of treatment and prevention of addiction. Seeking to develop prevention interventions based on interfering in the cognitive function of riskful decision

Table 1. Computerized tasks and questionnaires in Farsi, designed and used in the neuro-cognitive assessment unit of the lab

I	Neuropsychological Tasks
1	Iowa Gambling Task
2	Delayed Discounting Tasks
3	Balloon Analogue Risk Task
4	Wisconsin Card Sorting Task
5	Baron-Cohen's Eyes Task
6	Facial Emotional Recognition Task
7	Time Perception Tasks (estimation , production & reproduction)
8	Stroop Tasks (Word , Color & Number)
9	Pictorial Craving Assessment Task (Heroin , Crack & Opium)
10	Trail Making Task
11	Mini-Cog Task (for Dementia Screening)
12	7 Minute Screen (for Dementia Diagnosis)
13	Rey Auditory Verbal Learning Task
14	Finger Tapping Task
15	Paced Auditory and Visual Serial Addition Task
16	Addiction Modified Stroop Task
17	Verbal Fluency Task
18	Go- No/ Go Task
19	Positive Priming Task
20	Dot Probe Task
II	**Persian Questionnaires**
1	Eysenck's Impulsiveness Questionnaire (EIQ-7)
2	Zuckerman's Sensation Seeking Scale (SSS-6)
3	Barrat Impulsivity Scale (BIS-11)
4	Dickman's Impulsivity Inventory (DII-2)
5	INCAS Substance Abuse Profile (ISAP)
6	Obsessive Compulsive Drug Use Scale (OCDUS)(Heroin and Methamphetamine)
7	Drug Drive Questionnaire (DDQ)(Heroin and Methamphetamine)
8	Craving Inducing Words Checklist (CIWC)(Heroin and Methamphetamine)

making and designing therapeutic interventions in the fields of copying skills, relapse prevention and control of craving, are among the executed activities.

4. Collaboration Regarding Other Neurological Disorders

In addition to the aforementioned areas of activity, the lab has attempted to make use of its experience in neurocognitive assessments and interventions in the illness of addiction, for other neurological illnesses as well. In this regard, the following activities have been carried out in recent years:

4.1. Collaboration for the development of national screening and the diagnosis tools of various types of dementia, e.g. Alzheimer's disease: In collaboration with the memory and behavioural neurology department of TUMS (Dr Maryam Noroozian), the lab has attempted to design series of screening and diagnostic tests for different types of dementia in Iran; including The Short Cognitive Screening Test and the Persian Seven Minute Test for Dementia Diagnosis.

4.2. Collaboration for the development of a comprehensive file of patients with cerebrovascular accident and their cognitive assessment: in collaboration with the neurovascular department of Shariati Hospital (Dr Hajir Sikaroodi), the lab has attempted to develop an assessment file for patients with cerebrovascular accidents (e.g. cerebral infarction), and designing local protocols for executing cognitive assessments for these patients.

4.3. Collaboration for the assessment of cognitive disorders of patients with Multiple Sclerosis (MS): in collaboration with the Iranian Association for MS, the lab has executed a project for the assessment of functions of prefrontal cortex in MS patients. The results of this study have been published in a number of articles and abstracts and presented in peer reviewed journals and international congresses. The suggestion for designing local methods for the assessment of cognitive impairments in MS patients and applying the results in the course of treatment of patients, are among the outcomes of this collaboration.

5. Active Units of the Lab

The lab launched its activities in the beginning with the aim of carrying out psychological and cognitive assessments in patients. However, subsequently and with the expansion of activities of different researchers, various units were formed within it. Four main units are active at present in the research organization of the lab:

5.1. Neurocognitive assessment unit: This unit examines different aspects of brain functions related to addiction, using paper/pencil and computerized tools produced in the lab. It also provides psychometric services to different research projects.

5.2. Structural and functional brain imaging unit: Using MRI machines in different centers in the cities of Tehran and Karaj and images acquisition for research projects in these centers, this unit attempts to analyze and process the mentioned images in the lab and provides functional or structural outputs.

5.3. Navigated non-invasive brain stimulation unit: This unit attempts to intervene in the function of different brain areas with technologies using Transcranial Magnetic Stimulation (TMS) and Transcranial Direct Current Stimulation (tDCS). TMS stimulations are localized by brain navigator according to maps obtained by functional MRI images in the brain imaging unit, and are applied to relevant areas in the cortex; and either stimulate or inhibit them.

5.4. Human psychopharmacology unit: Using self-administration methods in human samples, this unit, which is undergoing its preliminary and preparatory stages, aims to examine the effects of different medications on brain functions related to addiction in patients in highly controlled experimental conditions.



Along with the mentioned four major units, computational modelling research unit, unit for studies of transcultural difference, and service provision units such as statistical services, management of research affairs, design of data banks, etc. are active in the lab as well.

6. Executive Research Projects of the Lab for Next Year

6.1. Neurocognitive Assessment

1. Design and completion of a battery for the assessment of different aspects of craving in individuals dependent on various types of opiates and methamphetamine.

2. Design and execution of a Persian battery for comprehensive cognitive assessments under the web, based on the unit's experience in the recent four years (in case of sufficient financial supply):

- A series of computerised neurocognitive tests with centralized information bank in the center (10 tests in the first phase).

- Piloting the system by opiate dependent patients under treatment in the center.

- The possibility of provision and expansion of services to all researchers and clinicians in the field of neurosciences.

- Next phase by the end of the Iranian year 1390; holding educational workshops and creating the possibility of using the system throughout the country.

Table 2. Software and MRI processing facilities at the lab's brain imaging unit

a. Neuroimaging Softwares:
1. CIVET 1.1.7
2. SPM 8
3. FSL 4
4. Freesurfer

b. Structural Imaging Facilities:
1. Corticometry
2. Voxel based Morphometry (VBM)
3. Brain Volumetry

c. Functional Imaging Facilities:
1. Block design fMRI
2. Model-free fMRI analysis
3. Brain connectivity
4. Brain parcellization

3. Provision of assessment services to registered research projects in the center.

4. Publication of previous studies in the field of task development.

6.2. Functional and Structural Brain Imaging

1. Development of two research line in the field of functional imaging:

- Launch of the pipleline for assessment of brain areas involved in drug craving in patients abusing heroin (specific task and method of analysis).

- Assessment of possibilities for designing the launch of system for the assessment of brain areas involved in craving in patients abusing methamphetamine (specific task and method of analysis).

2. Execution of two research projects in the field of functional imaging:

- Assessment of the effect of one-month abstinence on the activity of different cerebral areas related to craving in patients dependent on heroin.

- Assessment of the effect of maintenance treatment with methadone on the activity of different brain areas related to craving.

3. Executing a research project in the field of structural imaging:

- Assessment of structural injury in the brain of patients abusing heroin in relation to neropsychological functions.

4. Provision of research and educational services to other research centers as well as projects approved by the center.

6.3. Non Invasive Brain Stimulation

1. Installation and launch of fMRI-guided rTMS system.

2. Installation and application of quantitative surface EMG and analyzing its data.

3. Installation and application of transcranial direct current stimulation or tDCS.

Table 3. Different divisions of brain stimulation unit

a. TMS (Transcranial Magnetic Stimulation)
1- Single Pulse TMS
2- Paired Pules TMS
3- Repetitive TMS
4- Brain Navigated TMS

b. tDCS (Transcranial Direct Current Stimulation)

c. NFB (Neurofeedback)

d. sEMG (Superficial Electro Myo Graphy)

4. Installation and launch of a base for executing preliminary research on Neuro and Bio Feedback.

5. Installation, launch and calibration of system for determining speed of neural transmission between different brain areas and their effect on each other using Paired TMS.

6. Execution of two therapeutic research projects using the above systems:

- Assessment of possibilities for craving control using electrical stimulation of specific brain areas in amphetamine users.

Table 4. Approved and granted research projects related to the neurocognitive lab of the National Center for Addiction Studies.

	Project Title
1	Assessment of cognitive aspects of riskful decision making before and after the course of methadone maintenance treatment in comparison with the normal group
2	Determining the validity and reliability of Farsi versions of Eysenck, Barret, Dickman, and Zuckerman questionnaires in establishing riskful and impulsive behaviour in opiate abusers and normal individuals
3	Provision of visual test for the assessment of drug craving and assessment of its efficiency in different groups of opiate addicts
4	Assessment and comparison of degree of disorder in social cognition of opioid addicts in comparison with the normal group using the Farsi version of computerized tests for Theory of Mind assessment through the eyes (Cohen's eyes test) and Facial emotional expression test
5	Determining and comparing the results of Finger Tapping Task in opioid chronic users with the normal group, and the effect of maintenance treatment course with methadone on its results
6	Assessment of relationship between indexes of impulsivity and riskful behaviour, and craving severity in opiate addicts
7	Comparison of brain regions involved in craving process and their activation before and after Methadone Maintenance Treatment MMT and Buprenorphine Maintenance Treatment BMT using functional brain imaging fMRI in IV heroin addicts-a pilot study
8	Determining cognitive infrastructures involved in addiction in opioid female addicts compared to normal peers
9	Assessment and comparison of degree of disorder in general and selective attention in addicts to smokable heroin and smokable cannabis in comparison with normal individuals, using Paced Visual Serial Additive Task PVSAT and Stroop test
10	Determining and comparison of cortical thickness in different brain areas in three groups of addicts to smokable opium, IV heroin, and smokable heroin (crack) compared to the control group using digital analysis of MRI images and with relationship to results of neuropsychological assessment
11	Assessment of cognitive disorders related to executive function and attention in opioid addicts under long-term treatment with methadone and its relationship with the dosage of methadone
12	Cognitive modelling of addictive behaviour based on computerized tests for behaviour assessment and valid questionnaires in the control group and addicts
13	Assessment of relationship between HIV infection and impulsive riskful behaviour in homeless IV substance abusers
14	Assessment of relationship of motor impulsiveness measured with go-no go test and dependency to opiate substances
15	Multi-center qualitative study of different aspects of addiction in female addicts in Tehran
16	Assessment of impulsive behaviour and riskful decision making in HIV positive and negative addicts
17	Assessment and comparison of brain areas involved in cue-induced craving before and after one month abstinence: using functional brain imaging in smokable abusers of crack heroin
18	Production and evaluation of visual test of induced craving in methamphetamine abusers
19	Validation of questionnaires for the assessment of sudden and periodic craving in abusers of various substances (heroin, opium and methamphetamine)
20	Assessment of different aspects of addiction in female addicts residing in the city of Tehran in a qualitative-quantitative study

- Assessment of possibilities for craving control using non invasive brain stimulation of specific brain areas in heroin users.

7. Holding educational workshops for brain stimulation and issuance of license in cooperation with ministry of health.

8. Provision of educational content related to brain stimulation for specialists active in fields of neuroscience as well as the general public.

6.4. Computational Modelling

1. Execution of a cognitive modelling project using cognitive tasks in addicted patients trying to define and extract new cognitive concepts and models for risk taking and impulsive-compulsive behavior.

2. Execution of a computational modelling project on prediction of the successful dosage of medication in methadone detoxification, long-term detoxification with opium tincture and maintenance treatment with methadone.

6.5. Human psychopharmacology

1. Designing different divisions of the unit and carrying out basic feasibility study and the provision of financial plan.

2. Launch of system for drug self administration to examine the reinforcing effect of amphetamine in human samples.

3. Attempting to reach agreements and supply budgets necessary for the launch of the unit.

7. Conclusion

INCAS neurocognitive lab is an active research subsystem in the country, which pursues particular goals in addiction science particularly and clinical neuroscience generally with more nationally oriented approaches. Interaction with policy makers in the fields of prevention and treatment of addiction in upper hierarchies, and collaboration with researchers and clinicians in the field of addiction medicine in lower hierarchies, with the aim of executing projects proportional to the country's requirements and guaranteeing the quality and effectiveness of the studies' findings, are continually being carried out. Education of specialized human resources in research in the field of addiction and maintaining specialized and young human force inside the country, avoiding "brain drain", is also among the basic goals of establishing the lab and continuing its activity.

On the verge of its fifth year, the lab endeavours to further expand and deepen its activities. However, these endeavours require supporting budget and backing to be sustained in the form of a coordinated and organized system. Indeed, the execution of an expansive and goal oriented scientific activity in the form of a system, will demand higher costs than that of a few independent and isolated projects with no particular long term plan. Unfortunately however, in the pyramid of research in the country, no place has been considered for these research microsystems and their costs. This limitation has posed major challenges to the continuation of activities in this lab as well as other similar units. We hope that with the persistent support of authorities and policy makers, the path for the knowledge and treatment of addiction in the country and the region gets more even, so that taking it becomes feasible for researchers active in the country.

NEUROSCIENCE

Research Fellows and Lab Technicians of the Neurocognitive Laboratory in INCAS. From the right side: Leila Jahromi, Mohammad Mazaheri, Amir Dezfouli, Hosein Tabatabaei, Pedarm Rezaei, Habib Ganjgahi, Mehdi Ghaffari, Ali Ansarinia, Alireza Tavoosi, Emran Mohammad Razaghi (INCAS Director), Mohammad Ebrahimi, Hamed Ekhtiari (Lab Director), Alireza Rezvanifar, Anahita Khorrami, Mohammad Mohammadi, Mehri Nouri, Moahammad Jamshidi, Sobhan Rezaee.

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Sanchez, D., & King-Toler, E. (2007). Addressing disparities consultation and outreach strategies for university settings. *Consulting Psychology Journal: Practice and Research*, 59(4), 286-295. doi:10.1037/1065- 9293.59.4.286

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