



Middle East Technical University
Informatics Institute
Health Informatics Program
Neuroscience Track
www.ii.metu.edu.tr



Master of Science with Thesis	Master of Science without Thesis	PhD
3 core courses (9 credits total)	3 core courses (9 credits total)	3 core courses (9 credits total)
5 elective courses (15 credits total)	7 elective courses (21 credits total)	10 elective courses (30 credits total) ¹
1 seminar course (non-credit)	1 seminar course (non-credit)	1 seminar course (non-credit)
M.S. Thesis	Term project (non-credit)	Term project (non-credit)

Deficiency Courses (Preparatory)

For Students graduated from technical departments	For Students graduated from medicine or health related departments
BIS 535/735 Biyoistatistik	BIS 535/735 Biyoistatistik
TEB 501 Tıbbi Terminoloji	MAT 157 Basic Calculus I ²
TEB 502 Tıbbi Bilimlere Giriş	

Core Courses	Background courses 1 for MS, 2 for PhD
MIN 502 Introduction to Medical Informatics	BIO 417 Neurochemistry
BIS 610 Karar Verme Sürecinde İstatistiksel Yöntemler	BIO 409 Introduction to Neurobiology
IS 545 Object Oriented Programming and Data Structures	BIO 462 Biophysics
	BIO 406 Behavioral Neuroscience
Specialization Electives: 2 for MS, 3 for PhD	Free Electives: (1 for MS, 4 for PhD) ⁴
MIN 705 Neuroimaging: Anatomy, Physiology, Function of the Human Brain	BIO 562 Spectroscopy of Biological Molecules and Membranes
MIN xxx³ Electrophysiology: Foundations, Methods, Applications	BIO 705 Protein Structure Function and Stability
MIN xxx³ Computational Neuroscience	CENG 564 Pattern Recognition
BIO 704 Advances in Neuroscience	CENG 574 Statistical Data Analysis
BIO 716 Molecular, Cellular Neurobiology	CENG 576 Numerical methods in optimization
BIO 507 Neurobiology	CENG 561 Artificial Intelligence
COGS 533 Functional Neuroanatomy	CENG 562 Machine Learning
CENG 569 Neurocomputing	CENG 571 Numerical Analysis I
EE 543 Neurocomputers	CENG 555 Object-oriented Database Systems
MIN 702 Eval. Meth. in Health Informatics	IS 566 Image Processing Algorithms
	IS 503 Database Concepts and Applications
	IS 781 Knowledge Repr. and Data Mining
	EE 553 Optimization
	MIN 704 Reasoning under Uncertainty

Associated Laboratories

- **METU-NEURO: Neuroimaging and Cognitive Neuroscience Laboratory**, <http://brain.ii.metu.edu.tr>
PI: Didem Gökçay, didem@ii.metu.edu.tr
- **BEHAVIORAL NEUROSCIENCE LABORATORY**
PI: Ewa Doğru, bioewa@metu.edu.tr
- **BIOPHYSICS LABORATORY**: www.biophysics.metu.edu.tr
PI: Feride Severcan, feride@metu.edu.tr
- **MOLECULAR AND CELLULAR ENDOCRINOLOGY LABORATORY**
PI: Tülin Yanık, tyanik@metu.edu.tr

¹ Up to 5 courses can be waived from the PhD program if the student graduated from a related MS program

² This course will be replaced with a more user-friendly course soon

³ To be opened

⁴ This is a recommended list. Upon consent of advisor, other courses may also be taken

METU-NEURO NEUROIMAGING and COGNITIVE NEUROSCIENCE LABORATORY



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Research activities:

METU-NEURO Cognitive Neuroscience and Neuroimaging Lab is involved in an array of research activities that range from cognitive task design and functional neuroanatomy to structural neuroanatomy. The main area of focus in cognitive research is the interaction between cognition and emotion. Projects in this area are being conducted on healthy people, as well as patient populations with illness such as Parkinson's and Major Depressive Disorder. In the technical projects, the major focus is on improved fMRI signal analysis and advanced shape morphology. The applications of these new methods in the functional domain focus on face perception, emotional conflict resolution, episodic memory and decision making, all of which have been known to have limbic underpinnings. The applications of the newly developed methods in the structural domain focus on the shape, volumetrics and tissue characteristics of specific neuroanatomical structures such as Anterior Cingulate and Heschl's. Strong collaborations are established with several universities nationwide to share data and results. METU-NEURO activities also support two major courses: MIN 705-Neuroimaging and COGS 533- Functional Neuroanatomy. The course materials are supported with data from the lab and homework and hands-on activities are performed in the lab. The laboratory predominantly conducts research on MRI and fMRI data, although recently future plans are being made for international collaborations to participate in the analysis and interpretation of psychophysiology data (SKR, eyeblink).

Recently finished projects in METU:

- Quantitative Analysis of Structural and Functional Magnetic Resonance Images (BAP 2006)

- Localization of Morphological Changes on Prefrontal Cortex in a Population with Major Depression Disorder (Turkish Brain Association and Astra Zeneca 2006)
- Exploration of the Effect of Symmetry in Face Perception through fMRI (BAP 2007)
- TÜDADEN: Development of an Affective and Semantic Norm Database for Turkish words (BAP 2008).

Selected publications:

- Kara, M., Yörübulut, M., **Gökçay, D.**, Özçelik, E., Kaymak, B., Özçakar, L., Tan, A.A., Çetin, A., "Quantification of the Effects of the Transcutaneous Electrical Nerve Stimulation With Functional Magnetic Resonance Imaging: A double-blind Randomized Placebo-controlled Study", ISPRM 2009, Istanbul
- Çiftçioğlu M.U., Akkoyun, E. **Gökçay, D.**, 'Beyin MR Görüntülerinde Korteks-altı Bölgesindeki Bölütlemenin İyileştirilmesi', *Proceedings of 14th National Biomedical Engineering Meeting (Biyomut)*, İzmir, 2009
- **Gökçay D.**, Kılıç A., Say B., 'Emotional Stimuli Based Exclusively on Valence Fail to Enhance Recognition Memory: A Study Across Ages', *International Neuropsychological Society*, 2009, Atlanta
- **Gökçay, D.**, Dövençioğlu, D., "The effect of symmetry perception on attractiveness", *Proceedings of Kognitif Nörobilim 5*, 2008, Marmaris
- **Gökçay, D.**, Başgöze, Z., Dövençioğlu, D., Katircioğlu, K., Kitiş, Ö., Gönül, A.S., 'Volumetric morphology analysis of compartments of the anterior cingulate cortex in major depressive disorder', *Proceedings of 2nd National Pharmacology Congress*, Istanbul, 2007 (2nd poster award)
- D Bowers, K Miller, W Bosch, **D. Gökçay**, O Pedraza, U. Springer, M. Okun, "Faces of Emotion in Parkinson's Disease: Micro-expressivity and Brady-kinesia during Voluntary Facial Expressions", *Journal of the Int. Neuropsychol. Society*, 2006, 12(6), 765-73.
- M.A. Cato, B. Crosson, **D. Gökçay**, D. Soltysik, C. Wierenga, K. Gopinath, N. Himes, H. Belanger, R.M. Bauer, I.S. Fischler, L. Gonzales-Rothi, R.W. Briggs, "Processing Words with Emotional Connotation: An fMRI Study of Time Course and Laterality in Rostral Frontal and Retrosplenial Cortices", *Journal of Cognitive Neuroscience*, 2004, 16(2):167-77.
- **D. Gökçay**, C.M. Mohr, B. Crosson, C.M. Leonard, J.A. Bobholz, "LOFA: Software for Individualized Localization of Functional MRI Activity", *Neuroimage*, 1999, 10 (6):749-755.



fMRI experiment activities

BEHAVIORAL NEUROSCIENCE LABORATORY



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Main Research Areas:

Experimental Brain Research, Psychopharmacology,
Behavioral Sciences

Focus:

Investigation of mnemonic processes.

Selected publications:

Jakubowska-Doğru E., “Modification of avoidance responding by amphetamine and dopamine receptor antagonists.” *Pol. J. Pharmacol.*, 51, 301-309, 1999

Jakubowska-Doğru E., U. Gümüşbaş, F. Kara, “Individual variation in the spatial reference and working memory assessed under allothetic and idiothetic orientation cues in rat.”, *Acta Neurobiol. Exp.* 63: 17-23, 2003

Jakubowska-Doğru E. and U. Gümüşbaş, “Chronic intracerebroventricular NGF administration improves working memory in young adult memory deficient rats.” *Neuroscience Letters* 382:45-50, 2005

Dursun I. and **E. Jakubowska-Doğru**, “Effects of prenatal alcohol exposure on activity, anxiety, and memory in young adult Wistar rats.” At the stage of submission. *Pharmacol Biochem Behav.* 85(2):345-55., 2006

Research Topics:

1. Study on the molecular basis of individual variation in spatial memory among young Wistar rats: Investigation of the differences in AChT, NOS, PKA, and CaMKII α levels in the hippocampus of rats classified as “good” and “poor” learners.

2. *The study of the effects of Pioglitazon and Curcumin on the brain morphology, brain levels of docosaheksaenoic acid and mnemonic processes in cognitively impaired aged mice.
3. *#Studies on the fetal alcohol effects in rats and mice.
4. Elucidation of the mechanisms of morphological and functional recovery in the adulthood after perinatal exposure to ethanol.
5. The effects of chronic ethanol administration on the macromolecular make-up of hippocampal tissue in rat: a FT-IR study.
6. The study on the potential protective effects of the dietary vitamin E on the molecular changes induced in the brain tissue by chronic ethanol intake: a FT-IR study.
7. The effects of gender, age and dopaminergic blockade on the reference and working spatial memory in Wistar rats.
8. Studies on the role of nerve growth factors as a therapeutic tool in the treatment of memory deficits.

*Studies carried out in collaboration with the Dept. of Med. Pharmacology, Gülhane Military Medical Academy, Ankara, Turkey

Studies carried out in collaboration with School of Medicine, Center for Neuroscience, UC Davis University, USA



The experimental techniques used in the brain and behavioral research in the Laboratory for Mnemonic Processes, at METU include several behavioral tasks aided by a computerized video-tracking system (Etho-Vision 3.1, Noldus Technology), Stereotaxic apparatus, Leica DM4000 microscope with digital DM4000 camera and MicroBrightField Stereo-Investigator software enabling stereological investigations.

MOLECULAR BIOPHYSICS LABORATORY



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Main Research Areas: Molecular and Cell Biophysics in Neuroscience and Medical Biophysics

Description of on-going research activities in neuroscience:

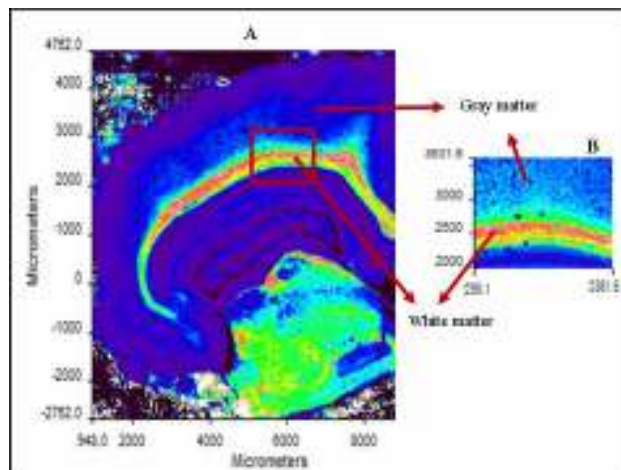
1. Investigation of molecular basis of epilepsy using different epileptic models in rats, such as chemical-induced and genetically modified epilepsy
2. The role antiepileptic drugs in epilepsy treatment
3. Interaction of antiepileptic drugs with model and brain membranes.
4. Investigation of side effects of epilepsy and antiepileptic drugs.
5. Molecular effects of alcohol on rat brain tissues
6. Molecular investigation of sleep deprivation
7. Molecular investigation of the effect of radiation and radioprotectants on rat brain tissues
8. Effect of neurodegenerative diseases on protein secondary structure using neural networks based on FTIR spectroscopy

Research Facilities

In all of these research activities, we mainly use spectroscopic and calorimetric techniques, which include Fourier Transform Infrared (FTIR) Spectroscopy with Attenuated Total Reflectance (ATR) attachment unit and FTIR microscope, Differential Scanning Calorimetry (DSC) and UV-Visible Spectrophotometry. In addition, the laboratory houses an Olympus microscope with a digital camera, HPLC, cryostat, freeze dryer, storage freezers and other small laboratory equipments.

FTIR spectroscopy provides simultaneous monitoring of different biological macromolecules such as lipids, proteins, nucleic acids. We also use FTIR microscopy, which allows us to see the image of heterogeneous tissues such as brain, to study different regions of tissues at molecular level. In addition, Differential Scanning Calorimeter (DSC) and UV/Visible spectrometer are used to support FTIR studies.

Using these techniques, the changes in macromolecular concentration, lipid/protein ratio, saturated / unsaturated lipid ratio, macromolecular structure such as lipid order, nature of hydrogen bonding and protein secondary structure, and the changes of lipid dynamics are determined.



Representative IR spectral map of a coronal serebrum section of control rat brain demonstrating the lipid to protein ratio in A) 25 μm X 25 μm pixel size and B) 6.25 μm X 6.25 μm pixel size (marked region in A)

Selected Recent Publications

Boyar H., Zorlu F., Mut M., **Severcan F.**, "The effects of chronic hypoperfusion on rat cranial bone mineral and organic matrix: A fourier transform infrared spectroscopy study" *Analytical and Bioanalytical Chemistry*, 379 (3), 433-438, 2004.

Toyran N., Zorlu F., Dönmez G., Öge K., **Severcan F.**, "Chronic hypoperfusion alters the content and structure of proteins and lipids of rat brain homogenates: A fourier transform infrared spectroscopy study", *European Biophysics Journal*, 33, 549-554, 2004.

Severcan M., **Severcan F.**, Haris, I.P., "Using artificially generated spectral data to improve protein secondary structure prediction from FTIR spectra of proteins" *Analytical Biochemistry*, 332 (2), 238-244, 2004.

Toyran, N., Zorlu, F., **Severcan, F.**, "Effect of stereotactic radiosurgery on lipids and proteins of normal and hypoperfused rat brain homogenates: A Fourier transform infrared spectroscopy study", *Int. J. Rad. Biol.*, Dec;81(12):911-8, 2005.

Akkas SB, Severcan M, Yilmaz O, **Severcan F.**, "Effects of lipoic acid supplementation o rat brain tissue: An FTIR and neural network study", *Food Chemistry*, 105 (3): 1281-1288, 2007.

Akkas SB, Inci S, Zorlu F, **Severcan F.**, "Melatonin affects the order, dynamics and hydration of brain membrane lipids", *J Mol Struct*, Vol 834-83, 207-215, 2007.

Severcan M., Akkas B., Gorgulu S.T., **Severcan F.**, "Protein Structure Determination of Proteins in Rat Brain Tissues and Membranes using Neural Networks based on FTIR Spectroscopy", *Biophysical Journal*, 94: 1089, 2008.

**MOLECULAR AND CELLULAR
NEUROENDOCRINOLOGY LABORATORY**



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Main Research Areas

Processing, intracellular trafficking, and secretion of neuropeptides and peptide hormones which are related to obesity and neurodegeneration.

Research activities:

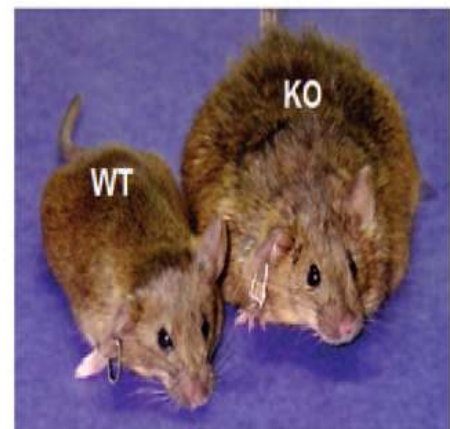
- 1- * Psychotic Disorder(Schizophrenia) and Metabolic Syndrome: Gene expression levels of anorexigenic peptides in Risperidal treatment in psychotic patients.
- 2- **Investigation of the carboxypeptidase E QQ mutation in neurodegeneration.
- 3- Analysis of Carboxypeptidase E human mutations in the Turkish population.
- 4- ***Methylation Status of PPAR-gamma gene in obese patients with Polycystic Ovary Syndrome.

- * Collaboration with the Psychiatry Dept. Gülhane Military Medical Academy, Ankara, Turkey
- ** Collaboration with National Institutes of Health, MA, USA
- *** Collaboration with the Dept. of Endocrinology, Hacettepe Univ.

Selected Publications:

- **Tulin Yanik**, Alicja Woronowicz, Niamh X. Cawley, Joan Marini, Peng Loh. (2009) Low bone density is associated with increased bone turnover in Carboxypeptidase E mice with Cocaine and Amphetamine Regulated Transcript (CART) deficiency. *Submitted to J. of Endo.*

- Niamh X. Cawley, **Tulin Yanik**, Irina Arnaoutova, Hong Lou, Nimesh Patel, and Y. Peng Loh.(2008) Techniques in neuropeptides processing, trafficking, and secretion. Springer protocols: Neurochemistry, *Neuropeptide Techniques* Vol 39, pages 67-96,
- **Tulin Yanik**, Geraldina Dominguez, Michael J. Kuhar, Emanuele Miraglia Del Guidice and Y. Peng Loh. (2006) The Leu34Phe ProCART Mutation leads to CART deficiency: A possible cause for obesity in humans. *Endocrinology*. 147(1):39-43.
- Niamh X. Cawley, Jiechun Zhou, Joanna M. Hill, Daniel Abebe, Sylvie Romboz, **Tulin Yanik**, Ramona M. Rodriguiz, William C. Wetsel, Y. Peng Loh. (2004). The carboxypeptidase E knockout mouse exhibits endocrinological and behavioral deficits. *Endocrinology* 145:5807-19.



Carboxypeptidase E knockout mice