



Course program and reading list

Semester 0 Year 2023

School: Baruch Ivcher School of Psychology

multi-sensory perception and brain plasticity

Lecturer:

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Course No.:	Course Type :	Weekly Hours :	Credit:
3297	Seminar	4	4

Course Requirements :	Group Code :	Language:
Final Paper	230329700	Hebrew

Prerequisites

Prerequisite:

- 8000 - Introduction To Psychology
 - 8014 - Research and Measurement Methods
 - 8910 - Introduction To Statistics A
 - 8911 - Introduction To Statistics B
 - 8924 - Multivariate Statistics A
 - 8925 - Multivariate Statistics B
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 Course Description

In this course, the students will have the opportunity to be part of an international, world leading research team, and will contribute to its body of work by running a study at the

institute. The team consists of researchers from Harvard, MIT, IIT among other institutes worldwide. This year the research will focus on the cutting-edge topics in the field of multisensory perception and explore the transfer of information between senses by technological means and uncovering of hidden connections between the senses. The research will focus on healthy populations, but it will also be possible to work with clinical populations in the areas of hearing impairment, anxiety, and more.

The technologies and experiments we will focus on this year for student projects include:

- Improving hearing through touch
- Improving enjoyment of music through multisensory experiences
- Reducing pain through multisensory integration
- Creating multi-sensory technologies to improve meditation
- Breathing and reducing anxiety
- Improving attention
- The link between the default mode network and emotions/emotional regulation
- Sensory Augmentation (expanding the sensory abilities and creating novel senses) and more.

About the institute, and it's current research:

The institute explores a wide range of questions from the field of brain research and psychology using a variety of research methods and unique technologies. We ask many questions about the capabilities of the brain as a flexible organ, particularly in areas related to the processing of sensory information. Among other things, what is the relationship between the design of the brain before birth and after birth in the different stages of life; Does the brain really stop being flexible after certain critical periods? And if so, to what extent and when? What is the role of human experience throughout life in shaping representations of the external and internal world? and more. The innovative technologies together with the understanding that the information in the world is in fact multi-sensory for the most part place the institute at the forefront of multi-sensory research when questions about brain flexibility also focus on the ability to do sensory integration. In particular, we are investigating the ability to use sensory integration to train the brain in ways that have not yet been seen and to ask questions such as: Is it possible to use innovative technologies to train the brain to decode and represent sensory information, in a way that has so far existed in nature among a few animal species (such as ultrasound or infrared sensing)?

In addition to theoretical research, the institute specializes in the application and development of advanced brain technologies, including sensory substitution devices that allow the hearing impaired to better understand speech in noisy environments, through the use of touch and vibration, and may even help people with normal hearing who are

trying to understand speech in sub-optimal conditions (for example, passing a mask in a noisy environment). Or allow the blind to receive high-resolution visual information through sound. Ranging from general information about distance and shapes to recognizing facial expressions. The institute has unique environments that were created out of the research need and enable virtual or physical multi-sensory experiences. One of them is an innovative space that produces a three-dimensional auditory and visual experience of 360° in space.

The researchers at the institute come from leading institutions in Israel and around the world among them Harvard, MIT and the Italian Institute of Technology (ITT) and diverse backgrounds that include, among others, neuroscience and cognition, computer science, psychology, medicine, visual art and sound engineering. The variety of fields and technologies allow the laboratory to work in a unique way to discover the secrets of the brain, to develop technologies through which the brain can be better understood, as well as to contribute to the quality of life in various fields such as rehabilitation and neuro-wellness. For example, a way to reduce anxiety using three ambisonic sounds, touch and unique use of virtual reality.



Course Goals

Participating in research and experiments conducted in the lab, incorporating methods from the field of brain research and human-brain interfaces. In addition to an in-depth understanding of the scientific background of the topic that the students chose for the seminar. students will gain a familiarity with and acquire skills in several of the following areas (depending on the chosen research topic): multisensory perception, synesthesia (Mixing of senses in which input from one sense causes a conscious experience in two senses or 2 sub-models within a sense), Sensory substitution, functional magnetic imaging and brain plasticity/flexibility. This learning process will take place through the different project phases of forming the hypothesis, preparing the research methods, designing the experiment and running it, to the phase of analyzing the data and writing it up for the seminar.



Grading

Final paper: 60%

Active participation throughout the year: 40%



Reading List

The reading material will be based on the personal research topic of each student.

In addition, reading material for everyone:

Are critical periods reversible in the adult brain? Insights on cortical specializations based on sensory deprivation studies

B Heimler, A Amedi - Neuroscience & Biobehavioral Reviews, 2020 - Elsevier