2019

臺灣認知神經科學學會年會暨研討會

Taiwan Society of Cognitive Neuroscience Annual Meeting

26 January (Sat.) 9:00-17:30

地點：國立交通大學博愛校區賢齊館

Venue: Jan Qi Biomedical Engineering Building , National Chiao Tung University.

主辦單位：臺灣認知神經科學學會/國立交通大學生物科技系所

協辦單位：國立中央大學認知神經科學研究所/中央研究院腦磁波儀實驗室/
國立交通大學智慧型藥物與智能生物裝置研究中心/
國立交通大學腦科學研究中心/
IEEE Computational Intelligence Society Taipei Chapter

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大會歡迎詞 Welcome Remarks

各位會員及朋友們：

感謝您撥冗前來參加本年度大會，本年度會議要感謝國立交通大學在人力、行政、財務上的支持，與本會共同主辦此次會議。同時要感謝中央大學團隊協助邀請國際學者，以及中央研究院腦磁波儀實驗室支援大會業務。

臺灣認知神經科學學會至今成立第七年，會員們在腦與心智科學研究領域勤勉不懈，每年都有令人激賞的研究發展，學會希望能夠齊聚在此領域深耕的學者們，共同分享資訊及相互砥礪，讓此研究領域邁向更好的發展。

今年度年會會議的主題為「Real-World Neuroimaging」，邀請到美國加州大學聖地牙哥分校的斯沃茨計算神經科學中心(Swartz Center for Computational Neuroscience)主任 Professor Scott Makeig 親臨臺灣擔任專題講座，Professor Scott Makeig 將以「Imaging human consciousness: knowing, feeling, and willing」為主題，說明當前科學界透過觀察人腦及大腦建模，試圖找出人類透過知覺、感覺及意願與世界產生連結的方式，並分享斯沃茨計算神經科學中心研究團隊目前最新的研究工作。

本次年會規劃了三場主題研討會與一場口頭報告。主題研討會議題包括大腦研究數據分析方法、神經影像學、視覺空間認知等，歡迎各位與會聆聽及交流。

在新年度的初始，能夠再次與國內外各位學界好友們共聚一堂，關注目前各研究領域的進展，是備感溫馨榮耀的事，臺灣認知神經科學學會感謝您的參與及支持。

祝各位身心健康，闔家平安。

臺灣認知神經科學學會 理事長 鄭谷苑敬上

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壁報論文摘要審查委員會 Abstract Review Committee

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會議議程 Conference Agenda

Time / 時間	Events / 活動內容	
Venue/地點:	**Jan Qi Biomedical Engineering Building, National Chiao Tung University. 國立交通大學博愛校區賢齊館**	
9:00~09:20	Registration 報到	
Venue/地點: 9:20~12:00 1 F Conference Hall 國際會議廳		
09:20~09:40	Opening Remarks 開幕致詞	
09:40~10:40	**Keynote speech** **Imaging human consciousness: knowing, feeling, and willing** Professor Scott Makeig Research Scientist & Director, Swartz Center for Computational Neuroscience (SCCN), Institute for Neural Computation, University of California San Diego	
10:40~10:50	Group photo 團體合照	
10:50~11:00	Break 中場休息	
11:00~12:00	Assembly meeting 會員大會	
12:00~13:00	Lunch 午餐 Venue: 3F 301 地點：3 樓 301	
12:30~13:50	Poster presentation 壁報論文 Venue: 3F Entrance Court /地點: 3 樓電梯口	
12:50~13:50	Student Paper Competition 學生優秀論文比賽 Venue: 3F 310 /地點: 3 樓 310	
13:50~15:30	**Symposium A: The Nonlinear Analytical Methods and The Investigation of Cognitive Function with Noninvasive Brain Stimulation 阮啟弘教授主持** Venue: 3F 302 /地點：3 樓 302	**Symposium B: Real-World Neuroimaging and Neuroergonomics 金榮泰教授主持** Venue: 3F 303 /地點: 3 樓 303
15:30~15:40	Coffee break 中場休息	
15:40~17:20	**Symposium C: Visuospatial Cognition 曾祥非教授 主持** Venue: 3F 302 /地點: 3 樓 302	**Oral Presentations 鄭仕坤教授主持** Venue: 3F 303 /地點: 3 樓 303

主題演講 Keynote Speech

Professor Scott Makeig

Research Scientist & Director,
Swartz Center for Computational Neuroscience
Institute for Neural Computation
University of California San Diego, USA
smakeig@ucsd.edu; smakeig@{google,skype}

Imaging human consciousness: knowing, feeling, and willing

Recent interest in scientific understanding of human consciousness has naturally focused on observing and modeling brain processes supporting our behavior and experience. The largest part of experimental work in this direction has focused on (visual) perception, for example using bi-ocular, bi-stable visual patterns, gaze fixity, and selective attention paradigms to vary what is perceived without changing what is visually presented. However, perceptual awareness is only a relatively small, specific aspect of human consciousness. A second, equally important aspect concerns our *feeling* senses and affective cognition, a field that brain imaging experiments have only begun to explore. A third aspect of human consciousness is our sense of agency – our awareness of interacting intentionally with objects and other agents in our environment. My own thinking in these directions was stimulated by a remark by Meher Baba, "*[All humans] have full consciousness of the gross world in all the aspects of knowing, feeling and willing*"[1] . We might use these distinctions to organize our thinking about consciousness as follows: **Knowing**. Under 'knowing' consciousness we might include conscious perception ('[I *know*] I see the keyboard in front of me'), episodic memory ('[I *know*] I spoke with you when I visited Japan last year'), declarative memory ('[I *know*] dogs have four legs'), results of deductive reasoning ('[I *know*] the answer is 7'), etc. Many brain imaging studies have attempted to define macroscopically observable brain processes supporting these forms of conscious 'knowing.' **Feeling**. Under 'feeling' consciousness we might include both physical and emotional affect ('[I *feel*] heat!', '[I *feel*] pain!', '[I *feel*] joy!', '[I *feel*] jealousy!', etc.). Some, though still many fewer, brain

[1] Avatar Meher Baba, Discourses, Vol. 2, 6th ed., p. 141.

imaging studies are exploring observable brain processes supporting this domain of consciousness and cognition. **Willing.** Under 'willing' consciousness we might include both the experience of motor agency ('I am [*willfully*] typing this abstract.') and intention to experience such agency ('I am going to [*willfully*] exercise every day!', etc.). Because of technical constraints, most relevant brain imaging studies have involved imagined or constrained in-scanner movements. For the last decade my colleagues and I at the Swartz Center have been developing a new imaging paradigm that I have termed mobile *brain/body* imaging (MoBI), involving simultaneous recording of mobile high-density scalp EEG during motivated behavior recorded concurrently using body motion tracking, eye gaze tracking, etc. I will give examples of how we have begun to use these methods to study each of the three aspects of human consciousness – but will end by noting the distinct question of whether or not studying our biological nature can lead to full understanding of the nature and origin of consciousness *per* se.

專題研討會議程及摘要　Mini-Symposium Agenda and Abstracts

Symposium A:
The Nonlinear Analytical Methods and The Investigation of Cognitive Function with Noninvasive Brain Stimulation
Organizer: Wei-Kuang Liang (梁偉光)
Moderator: Chi-Hung Juan (阮啟弘)
Venue: 3F 302 /地點：3樓302

NO	Time	Event
A1	**13:50-14:10**	Wei-Kuang Liang (梁偉光), Institute of Cognitive Neuroscience, National Central University ***The introduction of Holo-Hilbert Spectral Analysis (HHSA) and its application***
A2	**14:10-14:30**	I-Hui Hsieh (謝宜蕙), Institute of Cognitive Neuroscience, National Central University ***Processing Auditory Phantom Sounds Using a Nonlinear Analysis Method***
A3	**14:30-14:50**	Kien Trong Nguyen (阮鐘堅), Institute of Cognitive Neuroscience, National Central University ***Unraveling nonlinear electrophysiologic processes in the human visual system with full dimension spectral analysis***
A4	**14:50-15:10**	Trung Van Nguyen (阮文鐘), Institute of Cognitive Neuroscience, National Central University ***Motor inhibitory control as a function of grip force and early neural dynamics revealed with Electrophysiological indices***
A5	**15:10-15:30**	Yi-Chun Tsai (蔡怡君), Institute of Cognitive Neuroscience, National Central University ***The effect of the theta burst TMS revealed in brain oscillations of Treatment-Resistant Depression patients***

Symposium B: ***Real-World Neuroimaging and Neuroergonomics***

Organizer: Jung-Tai King (金榮泰),

Brain Research Center, National Chiao-Tung University

Venue: 3F 303 /地點：3樓303

NO	Time	Event
B1	**13:50-14:10**	Fu-Yin Cherng(程芙茵), Wen-Chieh Lin(林文杰), Department of Computer Science, National Chiao-Tung University, Hsinchu, Taiwan ***Applying Brain-Computer Interfaces to Evaluation of Graphic Icons and Auditory Icons Design***
B2	**14:10-14:30**	Oleksii Komarov and Li-Wei Ko (柯立偉), Institute of Bioinformatics and Systems Biology, National Chiao-Tung University, Hsinchu, Taiwan ***Longitudinal associations of stress, fatigue and sleep quality with EEG dynamics during attention driven classroom activities***
B3	**14:30-14:50**	Jung-Tai King(金榮泰), Cheng, Yu-Feng (鄭宇峰), Chin-Teng Lin(林進燈), Brain Research Center, National Chiao-Tung University, Hsinchu, Taiwan ***Individual Differences of Perceived Embodiment Conflict in Virtual Reality***

Symposium C: *Visuospatial Cognition*

Organizer: Philip Tseng (曾祥非)

Graduate Institute of Mind, Brain, & Consciousness, Taipei Medical University

Venue: Venue: 3F 302 /地點：3樓302

NO	Time	Event
C1	**15:40-16:00**	**Philip Tseng** Graduate Institute of Mind, Brain, & Consciousness, Taipei Medical University ***Differential working memory involvement in egocentric and allocentric navigators in wayfinding***
C2	**16:00-16:20**	**Chun-Yu Lin** Department of Psychology, National Cheng Kung University ***Spatial navigation with paper and mobile maps***
C3	**16:20-16:40**	**Erik Chang** Institute of Cognitive Neuroscience, National Central University ***The interaction between implicit and explicit inhibition in a location-based negative priming paradigm***
C4	**16:40-17:00**	**Chin-An Wang** Research Center for Brain & Consciousness, Shuang-Ho Hospital, Taipei Medical University ***Comparing pupil light response modulation between saccade planning and spatial working memory***
C5	**17:00-17:20**	**Chun-Hao Wang** Institutes of Physical Education, Health, & Leisure Studies, National Cheng Kung University ***The effect of cardiovascular fitness on visuo-spatial orienting***

Symposium A: The Nonlinear Analytical Methods and The Investigation of Cognitive Function with Noninvasive Brain Stimulation

Organizer: Wei-Kuang Liang (梁偉光)
Moderator: Chi-Hung Juan (阮啟弘)

Institute of Cognitive Neuroscience, National Central University
Brain Research Center, National Central University, Taiwan

Synopsis

In order to reveal the complex brain activities, previous analytical methods which based on the additive assumption were not sufficient. The recent introduction of the high dimensional Holo-Hilbert Spectral Analysis (HHSA) by Huang et al., (2016) overcomes the limitations by adding the spectra of amplitude and frequency modulations as new dimensions which includes two-layers Empirical Decomposition Method (EMD). The nonlinear analytical methods were applied to investigate several cognitive functions such as auditory phantom sounds processing and motor inhibitory control in the talk. In addition, we also will show how the visual system processes the envelope of amplitude-modulated stimuli by inducing a steady-state visually evoked potential (SSVEP). Finally, the HHSA was also applied in the clinical field such as investigating the predictor of the TMS treatment in depressed patients. The preliminary results will be shown in the talk.

Talk #1:
Wei-Kuang Liang (梁偉光), Institute of Cognitive Neuroscience, National Central University
The introduction of Holo-Hilbert Spectral Analysis (HHSA) and its application

Talk #2:
I-Hui Hsieh (謝宜蕙), Institute of Cognitive Neuroscience, National Central University
Processing Auditory Phantom Sounds Using a Nonlinear Analysis Method

Talk #3:
Kien Trong Nguyen (阮鐘堅), Institute of Cognitive Neuroscience, National Central University
Unraveling nonlinear electrophysiologic processes in the human visual system with full dimension spectral analysis

Talk #4:
Trung Van Nguyen (阮文鐘), Institute of Cognitive Neuroscience, National Central University
Motor inhibitory control as a function of grip force and early neural dynamics revealed with Electrophysiological indices

Talk #5:
Yi-Chun Tsai (蔡怡君), Institute of Cognitive Neuroscience, National Central University
The effect of the theta burst TMS revealed in brain oscillations of Treatment-Resistant Depression patients

The introduction of Holo-Hilbert Spectral Analysis (HHSA) and its application

Wei-Kuang Liang (梁偉光) [1,2], Norden E. Huang[2,3], Chi-Hung Juan[1, 2]

[1] Institute of Cognitive Neuroscience, National Central University

[2] Brain Research Center, National Central University, Taiwan

[3] Key Laboratory of Data Analysis and Applications, First Institute of Oceanography, SOA, 266061 Qingdao, China.

Abstract

A major and unsolved issue in neuroscience is how neural communications are accomplished and their underlying mechanisms for carrying out certain cognitive functions. Because traditional methods for analysis of time-series data such as Fourier and Wavelet transform assume that the data are linear and stationary, and can be represented by an additive expansion. However, data obtained from real biological systems are most likely to be nonlinear and nonstationary, i.e., the results of multiplicative operations. To understand the complex brain activities, the recently proposed high dimensional Holo-Hilbert Spectral Analysis (HHSA) by Huang et al. (2016) resolves all the nonlinear and nonstationary difficulties of existing spectral analysis methods that were built on an additive expansion of a priori function bases. HHSA employs a two-layer EMD and HHT approach to identify intrinsic amplitude modulation (AM) and frequency modulation (FM) that are often present in nonlinear systems, and represents these nonlinear components by adding new dimensions to the spectral representation. HHSA performs as an excellent tool to quantify the cross-frequency multiplicative operation in a nonlinear signal, thus providing rich information about neural correlates in electrophysiological data (e.g. M/EEG). An example of the application of HHSA on EEG data acquired from a visual working memory task will also be given for this symposium.

Processing Auditory Phantom Sounds Using a Nonlinear Analysis Method

I-Hui Hsieh (謝宜蕙)

Institute of Cognitive Neuroscience, National Central University

Abstract

Pitch perception is a fundamental function of the auditory system and critical aspect of both speech and music perception. Traditional analysis methods in understanding how the human auditory system process pitch has long relied on linearly-based method most prominently the Fourier transform and Wavelet analysis. Animal neurophysiological and human electrophysiological studies have provided clear evidence that the mammalian cochlear mechanism involves many nonlinear properties, thus using linear-based analysis method may be inadequate for auditory analysis. In the current study, we applied a nonstationary and nonlinear approach known as the Ensemble Empirical Decomposition Method (EEMD) to investigate binaural system's acoustical analysis of two-tone complex. Surprisingly, EEMD analysis revealed nonlinear components of combination tones in the extra-aural signal which could not be observed based on linear series of cosines. Using a novel binaural-beat probe tone paradigm, listeners detected which interval contained a larger percept of beat produced by the interaction of nonlinear component and a probe tone. Two-tone complex varied in the extent of its relative frequency and amplitude ratio. The pattern of pitch identification responses was consistent with those predicted from EEMD analysis. Importantly, we showed that the wave travels at a velocity that accurately maps onto the perceived phantom tone frequency. Phase coherence of oscillatory mode dynamics predicted discrimination sensitivity to phantom sounds by listeners. Perceived incidences of phantom tones correlated with magnitude of the Hilbert power spectra of the extra-aural component. Our findings suggest that nonstationary and nonlinear data analysis method may provide a better correlate of auditory pitch perception.

Unraveling nonlinear electrophysiologic processes in the human visual system with full dimension spectral analysis

Kien Trong Nguyen (阮鐘堅)[1], Wei-Kuang Liang[1,2], Victor Lee[1], Wen-Sheng Chang[1], Neil G. Muggleton[1-4], Jia-Rong Yeh[2,5], Norden E. Huang[2,5], Chi-Hung Juan[1, 2]

[1] Institute of Cognitive Neuroscience, National Central University

[2] Brain Research Center, National Central University, Taiwan

[3] Institute of Cognitive Neuroscience, University College London, London, UK

[4] Department of Psychology, Goldsmiths, University of London, London, UK

[5] Key Laboratory of Data Analysis and Applications, First Institute of Oceanography, SOA, 266061 Qingdao, China.

Abstract

Natural sensory signals have nonlinear structures dynamically composed of the carrier frequencies and the variation of the amplitude (envelope). Although the envelope is critical for perception, how the human brain processes such information is still poorly understood. One of the challenges is that conventional analyses have difficulties directly quantifying the envelopes. Here, we investigated how the visual system processes the envelope of amplitude modulated (AM) stimuli by inducing a steady-state visually evoked potential (SSVEP) in the human brain. We used a recently developed method, Holo-Hilbert spectral analysis (HHSA), which would theoretically extract all possible frequencies of evoked responses elicited by the envelope of an AM stimulus, in this case with a 14 Hz carrier and a 2 Hz envelope. Rather than a single point of significant activity, corresponding to 14 Hz carrier and 2 Hz envelope, analysis showed a range of carrier/envelope activity broadly in the 8 to 32 Hz carrier range and 2 to 8 Hz envelope range. Results from dichoptic stimulation showed that the envelope of a stimulus to one eye modulated the response to a sinusoidal flicker to the other eye, illustrating the dominance of the envelope of the stimulus in the electrophysiological response in the SSVEP. The results indicate that the electrophysiological response to AM stimuli is more complex than could be revealed by, for example, Fourier analysis. They also show that the envelope of such signals may dominate visual system activity. These patterns of results may shed new light on how AM may affect perceptual experiences.

Motor inhibitory control as a function of grip force and early neural dynamics revealed with Electrophysiological indices

Trung Van Nguyen (阮文鐘)[1], Che-Yi Hsu[1], Cheng-I Lam[1], Neil G. Muggleton[1-4], Wei-Kuang Liang[1,2], Chi-Hung Juan[1,2]

[1] Institute of Cognitive Neuroscience, National Central University

[2] Brain Research Center, National Central University, Taiwan

[3] Institute of Cognitive Neuroscience, University College London, London, UK

[4] Department of Psychology, Goldsmiths, University of London, London, UK

Abstract

The ability to inhibit a pre-potent motor response to adapt to the sudden change in the environment is an important function of the executive control. Inhibition is suggested to involve attentional capture and motor inhibition processes. However, it is unclear how these two processes can be distinguished using conventional stop signal task. Current study employs a modified stop signal task including an additional continue go trial which shares similar attentional characteristics with the stop trial and requires the participants to respond to it. Therefore, the continue go condition could eliminate the attentional capture effect from motor inhibition. Twenty participants performed the task with EEG recording coupled with force measurement that provides a finer estimate of inhibitory control process. EEG data was analyzed with Event-related mode, an improved ERP analysis method. The results demonstrate that the non-cancelled force and force rate increased as a function of Stop Signal Delay, offering new objective indices for gauging the dynamic inhibitory process. Larger N1 amplitude was observed in successfully stopped trials (SST) than in unsuccessfully stopped trials (USST) but no difference between SST and continue go trials. This pattern of results suggests that N1 component may not only represent the discrimination between the stop and continue signals, but also the inhibition process due to the overlapping and successful inhibitory processes in SST and continue trials. Thus, our study develops alternative indices of motor inhibition by introducing force and force rate measurement, and provides evidence on the importance of N1 in the pure inhibition process.

The effect of the theta burst TMS revealed in brain oscillations of Treatment-Resistant Depression patients

Yi-Chun Tsai (蔡怡君)[1], Cheng-Ta Li[2], Wei-Kuang Liang[1,3], Chi-Hung Juan[1,3]

[1] Institute of Cognitive Neuroscience, National Central University

[2] Psychiatry department, Veterans General Hospital, Taipei, Taiwan

[3] Brain Research Center, National Central University, Taiwan

Abstract

Previous studies have shown the efficacy of theta-burst stimulation (TBS) in treatment-resistant depression (TRD) (Li et al., 2014; Li et al., 2018). However, the mechanisms of variant outcome of TBS treatment are still unclear. This study was conducted to investigate the diversity of the brain oscillations during resting state in TRD patients and the variability between responder and non-responder to the TMS treatment. Currently, we have recruited 46 TRD patients with the recurrent major depressive disorder who were randomly distributed to intermittent TBS group, repetitive TMS group, or sham TBS group. Each participant was involved in ten sessions treatment phase and recorded the resting state electroencephalography (EEG) before and after the treatment phase. The 17-item Hamilton depression rating scales (HDRS-17) and Clinical Global Impression-severity (CGI-S) evaluation were held by psychiatry doctors from Veterans General Hospital at the beginning, the 5th session and at the 12th week after initiation of the TMS treatment. The non-linear analytical method such as Holo-Hilbert spectral analysis (HHSA; Huang et al., 2016) was applied to the resting-state EEG data. This new analytical method provides not only the carrier frequency information but also the amplitude modulation which can represent the complex nonlinear signal more accurate. The preliminary results have shown that in the responder, the brain activities increased in the alpha frequency band in the right frontal area after iTBS while this result didn't show in the non-responder. These results have indicated the individual difference toward the treatment effect in TRD patients. Furthermore, we aim to find biomarkers for the prediction of the treatment effect in TRD patients.

Symposium B: Real-World Neuroimaging and Neuroergonomics

Organizer: Jung-Tai King (金榮泰),

Brain Research Center, National Chiao-Tung University

Synopsis

How to apply the existing brain knowledge to the design of products, processes, and systems is the key aim of neuroergonomic. Moreover, through the neuroscience methods, they can advance the understanding of the relationship between brain function and performance in real-world tasks and designed product usages. With the progress of neuroergonomic, the researcher/designer can improve the human error, productivity, safety and comfort with a specific focus on the interaction between the human and the thing of interest.

In this section, we will present recent works on mobile EEG studies in the field of neurorgonomics and how mobile brain/body imaging methods can provide new insights in the field of neuroergonomics. Next, some ideas and results were shown on applying the neuroscience method to investigate the design effect of the human factor interaction (HCI). Third, a longitudinal experiment was performed to study the fatigue and stress of students in the real world classroom. In the end, we will demonstrate the individual difference on cognitive operations in virtual reality (VR).

Talk #1:

Fu-Yin Cherng(程芙茵), Wen-Chieh Lin(林文杰),

Department of Computer Science, National Chiao-Tung University, Hsinchu, Taiwan

Applying Brain-Computer Interfaces to Evaluation of Graphic Icons and Auditory Icons Design

Talk #2:

Oleksii Komarov and Li-Wei Ko (柯立偉),

Institute of Bioinformatics and Systems Biology, National Chiao-Tung University , Hsinchu, Taiwan

Longitudinal associations of stress, fatigue and sleep quality with EEG dynamics during attention driven classroom activities

Talk #3:

Jung-Tai King(金榮泰), Cheng, Yu-Feng (鄭宇峰), Chin-Teng Lin(林進燈),

Brain Research Center, National Chiao-Tung University, Hsinchu, Taiwan

Individual Differences of Perceived Embodiment Conflict in Virtual Reality

Applying Brain-Computer Interfaces to Evaluation of Graphic Icons and Auditory Icons Design

Fu-Yin Cherng(程芙茵), Wen-Chieh Lin(林文杰)

Department of Computer Science, National Chiao-Tung University Hsinchu, Taiwan

Abstract

The needs and benefits of measuring users' cognitive states are mentioned by more and more previous studies in the field of human-computer interaction (HCI). The problem of information overload also reveals the importance of obtaining nuanced users' cognitive and behavioral performance in the evaluation. Among all the information, we focus on the evaluation of the usability of graphic icons and auditory icons because of their high-frequency appearance in our daily life. The goal of our work is to advance the method of usability testing for graphic icons and auditory icons via obtaining a subtler data of users' cognitive and behavioral performance. In this presentation, we will introduce the EEG-based method we developed for evaluation of graphic icons and auditory icons to provide the direct measures of users' cognitive states. We will also demonstrate how the EEG-based method could generate novel insights and design implications for graphic icons and auditory icons. Moreover, we will explain how the EEG-based method can complement the behavior-based evaluation by triangulating the findings from behavioral results.

Longitudinal Associations of Stress, Fatigue and Sleep Quality with EEG Dynamics during Attention Driven Classroom Activities

Oleksii Komarov and Li-Wei Ko (柯立偉)
Institute of Bioinformatics and Systems Biology
National Chiao-Tung University, Hsinchu, Taiwan

Abstract

Students are a high-risk group for experiencing negative effects of stress and fatigue. According to a survey of college students by American College Health Association more than half of the participants reported long-term problems with stress, tiredness and sleepiness during daytime activities, while 11.4% of them consider themselves being in the state of continuous tremendous stress. Concerns about academic performance, post-graduation plans and highly competitive environment, as well as feeling of social insecurity, financial troubles and pressure from their families are among the reasons that cause emotional vulnerability and mental health problems in students. It has been shown that students which experience mental health issues are likely to drop out of college without obtaining a degree or may experience a nervous breakdown, which is a state characterized by a failure to perform daily life activities and professional duties often accompanied by severe sleep deprivation. Another dangerous phenomenon is suicidal thoughts and behaviors: according to an estimation by a set of survey based studies, suicidal ideations and attempts of university students are within the 8.1–53.0% and 1.0–11.2% ranges respectively. In this longitudinal experiment we introduce the Daily Sampling System as a set of questions about the participants' mood and sleep quality, which can be filled-in within five minutes every morning. The one-year long data collection in a group of graduate school students is combined with electrophysiological data acquisition that takes place while performing a realistic sustained attention task during university lectures. The results demonstrate a significant association between self-evaluated levels of stress and fatigue, daytime sleepiness, sleep quality and duration, as well as correlations of spectral features extracted from tonic electrocortical activations and variations in the attentive state of students during classroom activities.

Individual Differences of Perceived Embodiment Conflict in Virtual Reality

Jung-Tai King(金榮泰), Cheng, Yu-Feng (鄭宇峰), Chin-Teng Lin(林進燈)
Brain Research Center, National Chiao-Tung University, Hsinchu, Taiwan

Abstract

Virtual reality (VR) emerges as a mainstream platform for multiple applications, include entertainment, education and shopping etc. Most studies focus on the immersion improvement and cybersickness reduction. However, what kind of cognitive operation are used in the VR is less well known. Whether users adopt the same real-world processing for VR still needs to be investigated. In this study, a VR touch task with three VR hand styles (realistic, robotic and arrow) was used to explore this question. Participate needed to touch two VR cubes sequentially and visual feedback (color of cube) was changed to red when the cube was reached. The distance between two cubes were manipulated to evoke subjective perceived “error” which could be indexed by ERP indicator, feedback-related negativity (FRN). The individual difference was assessed by behavioral inhibition system (BIS), which corresponds to motivation to avoid aversive outcomes. The results showed that, for participants with high BIS, the amplitude of the FRN correlated with the realism of the virtual hands. These findings suggest that the more realistic the VR representation of the user’s hand is, the more similar real-world cognitive processing is used for the VR.

Symposium C: Visuospatial Cognition

Organizer: Philip Tseng

Graduate Institute of Mind, Brain, & Consciousness, Taipei Medical University

Spatial processing is heavily involved in many aspects of visual cognition, and consequently it can impact a wide range of cognitive processes such as attentional orienting, oculomotor control, working memory, inhibitory control, and even wayfinding capabilities…etc. In this symposium, we try to cover a few exemplars from this diverse area of research. We start with two studies that investigate navigation and wayfinding abilities, and the individual differences behind them, either in the laboratory (Philip Tseng) or real outdoor environment (Chun-Yu Lin). We then move on to two studies that investigate the commonalities in attentional mechanisms either between implicit and explicit inhibition using a spatial negative priming task (Erik Chang), or between saccade planning and visuospatial working memory using pupil light response (Chin-An Wang). Finally, we conclude with a talk on the impact of cardiovascular fitness on visuospatial attentional orienting.

Talk #1:

Philip Tseng,

Graduate Institute of Mind, Brain, & Consciousness, Taipei Medical University

Differential working memory involvement in egocentric and allocentric navigators in wayfinding

Talk #2:

Chun-Yu Lin,

Department of Psychology, National Cheng Kung University

Spatial navigation with paper and mobile maps

Talk #3:

Erik Chang,

Institute of Cognitive Neuroscience, National Central University

The interaction between implicit and explicit inhibition in a location-based negative priming paradigm

Talk #4:

Chin-An Wang,

Research Center for Brain & Consciousness, Shuang-Ho Hospital, Taipei Medical University

Comparing pupil light response modulation between saccade planning and spatial working memory

Talk #5:

Chun-Hao Wang,

Institutes of Physical Education, Health, & Leisure Studies, National Cheng Kung University

The effect of cardiovascular fitness on visuo-spatial orienting

口頭論文摘要 Oral Abstracts

Oral Presentations
Venue: 3F 302 /地點：3樓303
主持人：鄭仕坤教授

NO	Time	Event
T01	15:40-15:55	郭文瑞、李芯如 Institute of Neuroscience, National Yang-Ming University ***Neural representations of Mandarin lexical tone processing Revealed by fMRI and Intracranial EEG***
T02	15:55-16:10	林依禛 Institute of Neuroscience, National Yang-Ming University ***Neural representation of second language proficiency in Mandarin-English late bilinguals***
T03	16:10-16:25	李芯如、郭文瑞 Institute of Neuroscience, National Yang-Ming University ***Catching motivation modulation upon action inhibition***
T04	16:25-16:40	張揚，柯立偉 Institute of Bioinformatics and Systems Biology, National Chung Cheng University, Hsinchu, Taiwan ***Assessing Severities of Attention Deficit Hyperactivity Disorder Symptoms Based on EEG and CPT***
T05	16:40-16:55	Rupesh Kumar Chikara，柯立偉 Institute of Bioinformatics and Systems Biology, National Chung Cheng University, Hsinchu, Taiwan ***Brain Dynamics of Monetary Reward and Punishment in Human Inhibitory Control with Simultaneous fMRI-EEG Study***
T06	16:55-17:10	徐坤宇，吳嫻、段正仁 Institute of Cognitive Neuroscience, National Central University ***Brain Connectivity was Modulated by Sentence Complexity as Revealed by fMRI-ICA in Chinese Relative Clause***

T01

Neural representations of Mandarin lexical tone processing Revealed by fMRI and Intracranial EEG

郭文瑞、李芯如

Abstract

More than 50% of languages in the world are tone languages. Tone languages use pitch patterns to distinguish words. Usage of lexical tone is a common practice in human languages rather than exceptional or deviant. Lexical tone has acoustic and articulatory properties distinct from segment (i.e., vowel or consonant). Lexical tone processing creates neural activity patterns distinct from those for processing segment, including higher activities in the right auditory cortex and the right inferior frontal gyrus. In our previous studies, for example, we demonstrated that phonological processing to implement Mandarin lexical tone for production highly correlates with the right inferior frontal gyrus. However, the picture about how it interplays with other language areas in the left hemisphere remains to be elucidated. In this talk, we would like to present you the results of our recent studies in which we used fMRI and intracranial EEG to pin down the possible connections. From fMRI studies, the results indicated that processing lexical tone elicited strong activations in bilateral frontal cortices extending from premotor down to inferior gyri, pre-SMA, bilateral superior temporal cortices, and left inferior parietal cortex. Among the four Mandarin tones, while behavioral data showed that the participants committed more errors for the third tone processing, imaging results revealed greater activations in left and right inferior frontal cortex, pre-MA, and let inferior parietal cortex. Intracranial EEG recorded from auditory temporal cortices and frontal cortices were compared. Both evoked responses from left auditory temporal cortex and left frontal cortex showed higher activity for lexical tone processing, as compared to the auditory stimuli under another task demand of voice gender judgment. The results were discussed under the framework of neurolinguistics models.

Keywords: lexical tone processing, fMRI, intracranial EEG

T02

Neural representation of second language proficiency in Mandarin-English late bilinguals

林依禛、林發暄、郭文瑞

Abstract

Learning a second language (L2) will result in a tuning of language neural networks for its statistical structure and grammatical properties different from the native language (L1). Proficiency, therefore, is a factor to show how L2 impact processing the networks. This study was set up, first, to demarcate anatomical territory of L1 and L2 for spoken sentence comprehension, and, second, to denote neural effects of L2 proficiency. There were 30 native Mandarin speakers, screened with an online questionnaire, recruited for participation. The participants have similar education history and English learning/usage background except for their L2 proficiency. In terms of L2 proficiency level, there were a moderate-proficiency group (M-group) and a high-proficiency group (H-group) formed for the fMRI experiment respectively. Spoken sentences in three languages were presented in a blocked-design fashion for comprehension, including L1, L2, and an unknown one. Compared to the unknown language, while L1 elicited activations in the temporal pole to the inferior parietal lobule bilaterally, L2 elicited activations in temporal and left frontal cortices. ROI analysis notified a significant interaction between L2 proficiency and language in the pars triangularis of left inferior frontal gyrus (IFGtri). H-group showed higher activation in left IFGtri than M-group for L2 comprehension. No difference was found when listening to L1 sentences. The results suggest that the left IFGtri might be responsible not only for language-related processing but also for higher-level cognitive control during processing L2.

Keywords: Bilingualism, L2 proficiency, spoken sentence comprehension, fMRI, learning

T03

Catching motivation modulation upon action inhibition

李芯如，郭文瑞

Abstract

Extrinsic motivation induced by reward is critical for the vigor and efficiency of goal-directed behavior. A wealth of studies have demonstrated that action inhibition operates in a fast and rather stable fashion within individuals. The question about how inhibitory control proceeds in the context of extrinsic motivation is scientifically intriguing and practically essential and deserves a thorough investigation. In a series of experiments, fMRI and ERP measurement were administered to explore the neural effects of motivation modulation upon action inhibition. For motivation, a prospective momentary reward was included.

In the fMRI experiment, we found that higher motivation leads participants to establish a new balance between fast response and accurate stopping. Their BOLD response revealed that motivation modulates activities in the anterior caudate and pre-SMA and exert its influence by strengthening the connectivity within the stopping neural networks. In the ERP experiment, we found that the motor response of go-trial was speeded up when the participants were motivated. Their electrophysiological response disclosed an interaction between motivation and stop-signal processing. The N2 component showed higher activity for stopping failure than for stopping success. This N2 effect was augmented when motivated, suggesting an enhanced sensitivity for error monitoring.

Taken together, motivation modulates action inhibition by enhancing the sensitivity of its monitoring processes and strengthening connectivity among the stopping network.

Keywords: inhibition, stop-signal task, motivation, fMRI, ERP

T04

Assessing Severities of Attention Deficit Hyperactivity Disorder Symptoms Based on EEG and CPT

張揚、柯立偉、林達雄

Abstract

Introduction

Nowadays, the proportion of school-age children in Taiwan suffering from Attention Deficit Hyperactivity Disorder (ADHD) is about 5~7%. There are 3 main symptoms of ADHD: Inattention, Hyperactivity, and Impulsivity. So far, ADHD assessment method mainly based on DSM-IV handbook diagnosed by doctors and assisted with the description of the patients by his/her parents or teachers. However, it is lack of an objective method to assess whether a child is an ADHD patient. The main purpose of this study is to investigate the features of brain dynamic regarding the severities of ADHD symptoms based on EEG and CPT scores.

Methods

25 potential ADHD children were recruited in this study. First, the child was instructed to perform CPT to acquire the assessment of the severities of different ADHD symptoms, including attention deficit and hyperactivity through the well-established model of CPT. While performing CPT, EEG signals were acquired from wireless EEG equipment simultaneously for further analysis. The CPT is consist of six blocks, hence EEG features including brain regions and power of different frequency bands, and CPT scores of each block were brought into correlation analysis.

Results

Experimental results showed that the power of delta band of C4 channel exhibits the highest correlation with Commission, one of the CPT indexes regarding attention and hyperactivity (r=0.66). Furthermore, the power of all bands of C3 channel was correlated to three indexes of CPT including d', Commission and Variability.

Conclusion

The correlation of CPT scores and EEG features revealed in this study could be indicators of ADHD symptoms and severity. Furthermore, these EEG features acquired from machine learning technique could be an assistive method for doctors while assessing potential ADHD child and the severity of inattention/hyperactivity when the child is performing the cognitive task.

Keywords: ADHD, EEG, CPT, attention

T05

Brain Dynamics of Monetary Reward and Punishment in Human Inhibitory Control with Simultaneous fMRI-EEG Study

Rupesh Kumar Chikara, 柯立偉

Abstract

The stop-signal model has been commonly assumed an approach to parametrically investigate the response inhibition. Reward does not equally encourage everyone, instead it depends on inter individual personality. Therefore, monetary reward is influenced our emotional and motivational cognitive process. The battlefield scenario is a modified stop signal task in which the traditional images for fixation, go, and stop stimuli were replaced with the images of sniper scope, terrorist and hostage, respectively. This scenario mimicked a shootout between the terrorist and the soldiers. In this investigation, participants played the role of a soldier to open fire on the terrorist and to withhold the fire during hostage presence. The scenario is given to participant's stronger motivation and real world experience of response inhibition under reward, punishment and no-feedback conditions. In this study, neural mechanism of response inhibition was investigated under no-feedback, reward and punishment conditions in a battlefield scenario (BFS). The analysis of brain dynamic with high spatial and temporal resolutions were examined through a simultaneous fMRI-EEG recording. The results shown that all conditions induced increased activity in the presupplementary motor area (preSMA) and the right inferior frontal gyrus (rIFG), which have been associated to response inhibition. Additionally, the results demonstrated that higher blood-oxygen-level-dependent (BOLD) activation and synchronization of delta, theta and alpha activities in posterior cingulate gyrus (PCG) of the brain during reward than in the punishment and no-feedback conditions. The PCG has been firmly related to emotional salience. These results provided new insights into the complex neural networks involved in human response inhibition under no-feedback, reward and punishment conditions.

Keywords: Electroencephalography (EEG), Function magnetic resonance imaging (fMRI), Inhibitory control, No-feedback, Reward, Punishment, Emotion, Motivation.

T06

Brain Connectivity was Modulated by Sentence Complexity as Revealed by fMRI-ICA in Chinese Relative Clause

徐坤宇、Denise H. Wu, Jeng-Ren Duann

Abstract

Previous studies investigating the processing of structurally complex sentences in Indo-European languages have generally demonstrated the involvements of the left inferior frontal gyrus (LIFG) and the left superior temporal gyrus (LSTG), which might subserve reordering and storage of linguistic components for successful sentence comprehension, respectively. However, whether and how these brain regions are functionally connected, especially during the Chinese relative clause process, have still not yet been explored before. In the present study with a mixed-trial fMRI design, an independent component analysis combining with the spatial overlapping ratio measure was applied to data analysis. The results showed that (1) The component clusters of LIFG and LSTG supporting sentence comprehension of relative clause in native Chinese readers was consistently identified across participants; (2) Through the Granger causality (GC) analysis, we found that in more complex Chinese subject-extracted relative clause (SRC), the effective connectivity between LIFG and LSTG was significantly bi-directional, while in the less complex ORC, only the forward connection between them was evident; (3) The strength of GC from LIFG to LSTG during reading the SRC, which was argued to be more complex than ORC, was significantly correlated with the individual mean reaction time (RC), meaning that the better the performance in comprehending SRC was, the stronger the effective connectivity from LIFG to LSTG was. These findings not only reveal how the brain activation is modulated by sentence complexity by addressing the functional asymmetry in forward and backward connections between language-related brain regions, but also demonstrate the individual difference in sentence comprehension, especially during reading the sentence with the hierarchical structure. Moreover, such functional asymmetry in comprehending the different types of relative clauses is also consistent with functional architectures implied by theories of perceptual inference in the brain, based on hierarchical generative models.

Keywords: Sentence Complexity, Brain Connectivity, Effective Connectivity, Independent Component Analysis

學生論文獎競賽初選名單　Student Paper Competition

Venue: 3F 310/ 地點：3 樓 310

NO	Paper Title	First Author	Presentation Time
P01	Probing self-representation network in Major Depression Disorder by using resting-state and self-oriented task fMRI.	**Paul Zen Cheng**	**12:55-13:00**
P03	Longitudinal associations of stress, fatigue and sleep quality with EEG dynamics during realistic classroom activities in a group of graduate students.	**Oleksii Komarov**	**13:00-13:05**
P04	The Foreign Language Effect on Social Attitudes: An ERP study of Emotional Processes of Chinese-English Bilinguals.	**陳以琳**	**13:05-13:10**
P08	Dream Lucidity, Executive Functions, and Reality Monitoring: Behavioral and ERP Studies.	**盧慕蓉**	**13:10-13:15**
P14	The organizational processing on test-potentiated learning.	**王忻怡**	**13:15-13:20**
T05	Brain Dynamics of Monetary Reward and Punishment in Human Inhibitory Control with Simultaneous fMRI-EEG Study.	**Rupesh Kumar Chikara**	**13:20-13:25**
T06	Brain Connectivity was Modulated by Sentence Complexity as Revealed by fMRI-ICA in Chinese Relative Clause.	**徐坤宇**	**13:25-13:30**
P19	Source identification for the motor execution, motor imagery and motor observation condition based on independent EEG components.	**Yu-Yu Huang**	**13:30-13:35**
P27	P600 effect of Logographic Orthography on Visual Statistical Learning.	**Andhika Renaldi**	**13:35-13:40**
P31	Dynamic interaction of functional brain connectivity in Convergent and divergent thinking.	**Patil Abhishek Uday**	**13:40-13:45**
P32	Overcome the Boundary of Space and Time: A Combined Virtual Reality and EEG Study of Rubber Hand Illusion.	**黃鈺翔**	**13:45-13:50**

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NO	Paper Title	First Author
P01	Probing self-representation network in Major Depression Disorder by using resting-state and self-oriented task fMRI.	**Paul Zen Cheng**
P02	The relationship between academic stress and brainwave changes in the classroom environment.	**何聰穎**
P03	Longitudinal associations of stress, fatigue and sleep quality with EEG dynamics during realistic classroom activities in a group of graduate students.	**Oleksii Komarov**
P04	The Foreign Language Effect on Social Attitudes: An ERP study of Emotional Processes of Chinese-English Bilinguals.	**陳以琳**
P05	Altered sensory functioning as a broader autism phenotype: Behavioral and neuronal correlates in parents of individuals with autism spectrum disorder (ASD).	**朱翎**
P06	Impacts of Mental Stress on the Implicit and Explicit Motor Learning.	**林美靜**
P07	Voluntary and Involuntary Inhibition in Elderly and Young Adults.	**Condrowati**
P08	Dream Lucidity, Executive Functions, and Reality Monitoring: Behavioral and ERP Studies.	**盧慕蓉**
P09	以行為及 fMRI 方法探討認知地圖與製圖式地圖之空間記憶提取歷程	**黃琬晶**
P10	N2pc and P3 decrement in the visual search with collinear grouping.	**Jingling Li**
P11	A quantitative meta-analysis of fMRI studies of repetition priming.	**李松穆**
P12	Exploring the neural correlates of race perception with Asian and Caucasian morphing faces: an MEG study.	**陳君嫚**
P13	Characterizing the Impact of Aging on Spatial Negative Priming.	**李子伶**
P14	The organizational processing on test-potentiated learning.	**王忻怡**
P15	Emotional Prosody Perception in School-Aged Children with High-Function Autism.	**曹峰銘**
P16	A Novel Algorithm to Improve Accuracy of SSVEP-BCI Using Dipped Sponge Electrode.	**吳佩倫**
P17	Individual differences in wayfinding strategies when using electronic maps.	**Meng-Ting Lin**

NO	Paper Title	First Author
P18	Exploration of eye-movement behaviors during decision on fairness judgment.	**Yu-Wen Shih**
P19	Source identification for the motor execution, motor imagery and motor observation condition based on independent EEG components.	**Yu-Yu Huang**
P20	A direct support for the perceptual expertise hypothesis of FFA: interactive face- and bird-selectivity in bird experts.	**楊念庭**
P21	Time courses of identification of beauty and other attributes in faces.	**董志煒**
P22	Sensitivity to componential regularity in a spatial but not temporal pair only correlated with Chinese proficiency in learners but not in native readers of Chinese.	**Denise Hsien Wu**
P23	Beyond FFA BOLD changes: appropriate expertise training not just drives higher BOLD activities, but also faster BOLD onset and better classifications for Greebles in FFA and many brain regions.	**龔俊嘉**
P24	Not just in FFA: becoming an expert also drives the activity, and changes the pattern, of early visual cortex.	**朱謙恕**
P25	Musicians and non-musicians' different reliance of features in consonance and dissonance perception: from EEG to fMRI.	**Han Shin Jo**
P26	Neuro-rehabilitation of Upper Limb Function in Stroke after Botulinum Toxin Injection.	**Yi-Chen Lu**
P27	P600 effect of Logographic Orthography on Visual Statistical Learning.	**Andhika Renaldi**
P28	The effects of collectivistic and individualistic values on structure of the brain: A cross-cultural voxel-based morphometry study.	**黃植懋**
P29	Age-related and individual differences in brain complexity of resting-state fMRI signals in healthy elderly.	**吳順吉**
P30	Neurobiological basis of love: Insights from fMRI meta-analyses of maternal love and passionate love.	**施宣竹**
P31	Dynamic interaction of functional brain connectivity in Convergent and divergent thinking.	**Patil Abhishek Uday**
P32	Overcome the Boundary of Space and Time: A Combined Virtual Reality and EEG Study of Rubber Hand Illusion.	**黃鈺翔**
P33	MATCHED SPATIAL FILTERS FOR ANALYSIS OF LATE ERP COMPONENTS DURING CONFLICT RESOLUTION.	**Mauro Nascimben**
P34	Is integration of auditory and visual information simultaneous in Chinese?	**王馨敏**

P01

Probing self-representation network in Major Depression Disorder by using resting-state and self-oriented task fMRI

Paul Zen Cheng, Niall Duncan, Tzu-Yu Hsu

1. Graduate Institute of Mind Brain and Consciousness, Taipei Medical University, Taiwan

2. Research Center of Brain and Consciousness, Shuang-Ho Hospital, Taiwan

Abstract

Brooding rumination is a pronounced negative symptom of Major Depressive Disorder (MDD), and characterize repetitive and cyclical negative thoughts in an individual. Up-to-date research on self-rest overlapping and MDD's brain functional connectivity pinpoints altered anterior default mode network (DMN) and salient network (SN) in MDD as two components that are strongly associated with the alteration of subjective self-representation. However, to our knowledge, the relationship between brain network and self-oriented tasks has not been studied to shed light upon active subjective self-representation. To address this question, the neural activities of resting and self-oriented task fMRI were measured on MDD patients and matched controls. On the same scanning day, subjects were also required to fill out two questionnaires, the Ruminative Responses Scales(RSS) and the Beck Depression Index (BDI) to measure ruminating activities and the magnitude of the current depressive state experienced by the subjects respectively. We then compare findings from BDI and RSS with our rsfMRI data to ensure that our results correspond with the current state of MDD connectivity findings. By contrasting two Blood-oxygen-level dependent (BOLD) results from the preference and similarity judgment task, MDD participants show changes in the salient network region which, in turn, affect their task performance. Furthermore, the correlation between the BOLD activities of the color preference task with rsfMRI data supported the altering connectivity representation in anterior DMN and SN. With the investigation of altered connectivity and its active state in the neuronal model of MDD, this study may advance our understanding of the underlying neural mechanisms of self in MDD patients.

Keywords: self, major depressive disorder, functional connectivity, color preference judgement

P02

The relationship between academic stress and brainwave changes in the classroom environment

Cong-Ying He，Li-Wei Ko ; Tzyy-Ping Jung ; Shih-Hua Liu

Abstract

In the era of information explosion in the 21st century, life is full of challenges that may cause anxiety, stress, fear, and fatigue. For students, academic stress often seriously affects students' lives. According to the American College Health Association, in 2006, 32% of the 97,000 students surveyed were affected by academic pressure, resulting in low grades, or poor course integrity. Since most of the past researches are short, well-constrained, and mostly in the laboratory, we are setting up experiments in a real environment, trying to track the student's brain wave in the real classroom environment under the pressure of academics. We enrolled a total of 26 students, each of whom participated in a brain wave collection for a full semester and used the scores in this questionnaire based on the Depression Anxiety Stress Scale 21 (DASS21).Then, the linear regression model and the k-means method were used to separate the different stress and anxiety associations and conditions, and the subjects were divided into two categories that we called "Responders" and "Non-responders". The responders who faced stress and the anxiety increased with the other and the non-responders who did not feel anxious even if they are under stress. The brain wave signals of the two groups are detected and analyzed. The research result shows that under stressed condition, we compared the responders and non-responders' channel based of resting EEG power spectrum. We found differences in brain activity between responder and non-responder group under the stressed condition, where delta and theta bands decreased at right anterior frontal region, alpha decreased at parietal region and occipital region. We also found delta, theta and beta bands increase at temporal region and left temporal region. On the other hand, we observed the beta increase at left and right lateral temporal region.

Keywords: Academic stress; Electroencephalography(EEG); Depression Anxiety Stress Scales 21 ; Responder group; Non-responder group

P03

Longitudinal associations of stress, fatigue and sleep quality with EEG dynamics during realistic classroom activities in a group of graduate students

Oleksii Komarov, Li-Wei Ko

Abstract

Students are a high risk group for experiencing negative effects of stress and fatigue due to high academic load, financial and family problems — in particular in the Asian region, where it is common to be pushed to the limits by competitive stress of academic success at all costs. This may be accompanied by irregular sleep patterns caused by the necessity to trade sleep for studying while dealing with extensive academic assignments such as course projects or preparation to exams. For this study we develop and implement the Daily Sampling System, which is a convenient for research participants way of reporting a set of self-assessed psychometric indices on a daily basis, and examine a semester long variations in fatigue, stress and sleep quality individually for each subject from a group of graduate school students that took part in this experiment. Overall, 2461 daily reports were collected during two academic semesters from 26 subjects (aged 23–27 years) with 81.0±15.9% response ratio. The results indicate significant associations between self-evaluated levels of stress and fatigue, daytime sleepiness, sleep quality and duration. In addition to the longitudinally collected behavioral metrics, we recorded EEG data from the participants in 4–13 experimental sessions per subject that took place during realistic classroom activities: lectures, seminars and exams. The results of the data analysis reveal significant differences in the tonic EEG activities that accompany variations in the attentive states of the participants. This experiment demonstrates the relationship between longitudinal variations in the self-assessed life quality, cognitive state of the participants, which is related to their abilities to perceive the information during classroom activities, and the respective neural mechanisms.

Keywords: students, classroom, sleep, stress, attention

P04

The Foreign Language Effect on Social Attitudes: An ERP study of Emotional Processes of Chinese-English Bilinguals

陳以琳, 鄭谷苑

Abstract

Previous studies revealed that people tended to make more unbiased decision and utilitarian judgments and decisions when problems were presented in a foreign language (FL) rather than in the native language (NL). This “the foreign language effect (FLe)” was repeatedly found in a wide variety of studies in the area of decision-making such as moral judgment and economic paradoxes. The present study aimed to investigate the mechanism of FLe specially the impact of emotion. A priming ERP experiment was conducted to investigate how emotion and language interact with each other to influence Chinese-English bilinguals’ attitudes toward social issues. Participants were randomly assigned to two language groups. They first saw emotion-oriented primes in either Chinese or English, and were then asked to make positive or negative judgments on possibly controversial social issues. N400 and LPP indicated the meaning construction and emotional responses, respectively. Results revealed that participants in English group were less affected by emotion-oriented primes, and therefore, social and personal attitudes were more consist than in Chinese group. N400 was modified by languages and emotion valence of the primes. N400 amplitudes were more negative-going in Chinese than in English. On the other hand, LPP were more pronounced in positive-prime condition than in negative-prime condition. Overall, emotion was more influential in NL than in FL. In line with previous studies, we proposed that emotional connotation was weak in retrieving negative association in FL. Hence, the present study supported that emotion was a key factor of the FLe.

Keywords: The Foreign Language Effect, bilingual, emotion

P05

Altered sensory functioning as a broader autism phenotype: Behavioral and neuronal correlates in parents of individuals with autism spectrum disorder (ASD)

朱翎、陳慧芳、鄭雅薇、范揚騰

Abstract

Atypical responses to a variety of sensory stimuli are common features in ASD; however, relatively little is known about the neurobiological underpinnings of these sensory abnormalities. Although literature have reported that altered sensory functioning may share genetic influences with ASD, the relationship between sensory atypicalities in dyads of children with ASD and their parents has not been fully explored. In this study, we recruited 8 individuals with ASD and 8 of their parents (P-ASD) and assessed their autistic and sensory traits, as well as brain reactivity in response to visual, auditory, and tactile stimuli. Results showed that individuals with ASD and their parents had hyper-responsivity to sensory stimuli and similar levels of agreement were noted between individuals with ASD and their parents on tactile and auditory processing, and autistic traits within the ASD dyads. The fMRI results showed that both ASD and P-ASD had heightened activity in the primary sensory cortices during the sensory fMRI tasks. Conjunction analyses further showed that there are significant neural similarities in sensory reactivity between ASD and P-ASD. These findings provided preliminary evidence that individuals with ASD and their parents share similar sensory features (over-responsivity to sensory stimuli) in both behavioral performance and neural indices, and shed light on genetic susceptibility that may contribute to sensory processing abnormalities associated with ASD.

Keywords: autism spectrum disorder (ASD), broader autism phenotype, sensory reactivity, parent-child dyad, fMRI

P06

Impacts of Mental Stress on the Implicit and Explicit Motor Learning

林美靜、張智宏

Abstract

Mental stress is our brain and body's response to the environmental challenges. However, not many studies have explored how these consequences of mental stress influence motor learning. Here we examined the impacts of stress types (daily/acute) on the mode of learning (implicit/explicit) under different contexts (goal-driven/error-driven motor learning), and the corresponding brain activities with FMRI. There were five sessions: in the first session, all participants (3M/5F, 24.0±3.0yrs) were instructed to operate a smartphone APP to record daily resting heart rate and assess the State-Trait Anxiety Inventory as daily stress. The participants were then labeled as High Stress or Low Stress group based on trait anxiety score. From the second to fifth sessions, participants performed serial reaction time task (SRTT) and visuomotor adaptation task (VAT) as pre-test and post-test for each task. In each session, participants were also tested on their cognitive functions. There was no difference in the physiological fluctuations and cognitive performance between the two groups. Interestingly, for the SRTT, High Stress group in implicit condition performed better than Low Stress group, but not in explicit condition. We also found Low Stress group recruited a more broadly distributed brain regions related to attention-demanding and acute stress manipulation in implicit condition than High Stress group. Moreover, for the VAT, Low Stress group performed better than High Stress group both in implicit and explicit condition, and recruited more brain regions related to acute stress manipulation in implicit condition. Taken together, the current findings indicate that participants with low daily and low acute stress level have better performance both in goal-driven and error-driven motor learning, especially in the explicit condition. However, participants with high daily and high acute stress level have similar performance in both tasks and show little learning, implying that high stress down-regulate both types of motor learning.

Keywords: Mental stress, explicit, implicit, motor learning, serial reaction time task (SRTT), visuomotor adaptation task (VAT)

P07

Voluntary and Involuntary Inhibition in Elderly and Young Adults

Condrowati, Erik Chihhung Chang

Abstract

Inhibition is a core executive function and can be theoretically categorized into voluntary and involuntary types. Whereas voluntary inhibition requires conscious process and active suppression, involuntary inhibition proceeds unconsciously and cannot be actively initiated. The aim of the current study is to assess the difference and relationship between voluntary and involuntary inhibition across age groups (young: 21.3±1.35 yrs, N= 40; elderly: 64.1±3.2 yrs, N= 10). All participants completed inhibitory tasks including voluntary (Stop Signal Task and Go/NoGo Task) and involuntary (Negative Priming (NP) Task and Inhibition of Return (IOR) Task) paradigms. The results revealed that in voluntary inhibition, there was a significant difference in Stop Signal Reaction Time (SSRT) and Go/NoGo performance of elderly and young groups, in which the young group was faster about 40 and 136 ms than the elderly group, respectively. In contrast, the results of involuntary inhibition showed that neither NP nor IOR effects differed between groups. In addition, the results of the correlations across four paradigms show dissociation which indicate SSRT and Go/No not being related to IOR and NP Effect. Therefore, the results suggested that the involuntary inhibition processing might be more flexibility than voluntary inhibition processing because adjustment in control mechanism can be induced in the former. Based on the correlations, the current findings also support the view that voluntary and involuntary inhibitions overlap and may be tapping two distinct mechanisms of action control.

Keywords: inhibitory control, voluntary and involuntary inhibition, groups difference

P08

Dream Lucidity, Executive Functions, and Reality Monitoring: Behavioral and ERP Studies

盧慕蓉、鄭仕坤

Abstract

Dream lucidity refers to the degree to which a dreamer is aware of the difference between the dream context and the real world. It is related to the discrimination between self-generated precepts in a dream and externally derived experiences when being awake, a capacity we consider to resemble the “reality monitoring”. Following the source monitoring framework, the discrimination of the source relies on the heuristic and systematic examination that involves executive control. Executive function should hence play an indispensable role in dream lucidity, but it remains unclear how they relate to each other. This proposal will present two completed experiments to address this issue. The first experiment focused on the relationship between dream lucidity and executive function. Lucidity was compared with the participants’ performance in the executive function task. The data showed that there is a significant correlation ($r=-0.356$, $P<0.05$) between lucidity and the conflict score. The second experiment focused on the relationship between dream lucidity and reality monitoring. Lucidity was compared with the participants’ performance in the reality monitoring task, in which ERPs were recorded during the test phase. The behavioral results showed that participants performed better in both the old/new recognition and the source judgments for the imagined trials than the perceived trials. They also showed more internalization errors than externalization errors. A correlational analysis found the lucidity to be positively correlated with the externalization bias and negatively correlated with the number of internalization errors. Importantly, the “late posterior positivity”, an ERP wave that has been linked to visual imagery, was of greater magnitude for hit trials to the imagined than the perceived objects, and the difference negatively correlated to the number of externalization errors. The results therefore support a close link between dream lucidity, conflict resolution, and the utilization of mental imagery in reality monitoring.

Keywords: dream lucidity, executive function, reality monitoring

P09

以行為及 fMRI 方法探討認知地圖與製圖式地圖之空間記憶提取歷程

黃琬晶、許雅勛、林君昱

Abstract

過去研究發現海馬迴與空間記憶相關，且不同尺寸的空間資訊在海馬迴前後側有表徵差異，但過去並未直接比較認知及製圖式地圖提取機制的異同，也較少以製圖式地圖探討精細及粗略尺寸在海馬迴的表徵差異。本研究使用 Hirshhorn 等人(2012)的地標方位判斷作業，探討使用不同類型的地圖（心中的認知地圖及視覺觀看學習的製圖式地圖），其行為及腦影像表現的情形。結果發現，使用認知地圖比製圖式地圖在旁側海馬迴有更高的活化，支持了認知地圖比製圖式地圖活化較多處理景象腦區的假設；在使用製圖式地圖的情境下，處理精細的空間表徵（方位差異較小的困難題）在右後側海馬迴也呈現較多的活化。此結果提供了大腦對認知地圖及製圖式地圖的處理機制上可能之異同更多的認識。

Keywords: 海馬迴、空間表徵、精細尺寸

P10

N2pc and P3 decrement in the visual search with collinear grouping

Jingling Li, Chia-huei Tseng, Shin Ono, Takumi Miura, and Satoshi Shioiri

Abstract

PURPOSE: The collinear masking effect refers to the visual search difficulty when environmental regularity, especially if items neighboring to a target were aligned (Jingling and Tseng, 2013). The goal of this study was to measure the event-related potential (ERP) of the collinear masking effect.

METHODS: Sixteen participants completed a visual search task while sixteen-channel EEG signals were recorded by Neurofax EEG-9100. The search display was filled with the same vertically- (or horizontally-) oriented bars, except for one distractor column consisting of bars orthogonal to the others. The bars in the distractor column were grouped by collinearity or by similarity, at chance. Participants discriminated the orientation of a tilted target located on a bar at the middle in the distractor column (overlapping) or other columns (non-overlapping). The search display was presented for 100 ms to prevent eye movements. Each participant completed 1440 trials.

RESULTS: Overlapping conditions, regardless of grouping principles, showed a smaller P3 amplitude than non-overlapping conditions, suggesting some decision making processing involved in the search effect. Meanwhile, RTs was slower and N2pc amplitudes were smaller to targets overlapping with collinear distractors than non-overlapping, while no such differences was observed for that with similarity distractors.

CONCLUSIONS: Our results suggested that the search impairment when a target overlapping with a collinear distractor than non-overlapping is caused by suppression due to collinear grouping, in addition to top-down involvement of target setting.

Keywords: Collinear masking effect, Visual search, ERP, perceptual grouping

P11

A quantitative meta-analysis of fMRI studies of repetition priming

李松穆、林君昱

Abstract

Repetition priming is a form of memory, whereby classification or identification performance is improved with stimulus repetition. Many functional magnetic resonance imaging (fMRI) studies have examined the neural correlates of repetition priming. They often found a decreased fMRI activation for repeated stimuli compared to novel stimuli in various brain regions (i.e., repetition suppression, RS). However, some studies found an increased activation during repetition (i.e., repetition enhancement, RE). To clarify which regions exhibit reliable RS or RE across these studies, we conducted a quantitative meta-analysis using coordinate-based activation likelihood estimation. This study included 64 fMRI studies that employed priming tasks, demonstrated behavioral priming and reported the results from whole-brain analyses. Our results from 1114 participants and 732 foci showed that RS was mainly associated with the bilateral inferior frontal gyrus and fusiform gyrus. The results from 485 participants and 183 foci showed that RE was observed in the bilateral precuneus gyrus. Additionally, meta-analyses of subgroups of the collected studies were performed to examine the RS patterns across the different priming tasks (e.g., perceptual and conceptual) and stimulus categories (e.g., word, face and object). In sum, these results provide the key regions showing reliable RS and RE during repetition priming.

Keywords: Repetition priming, fMRI, Meta-analysis, Repetition suppression,
Repetition enhancement

P12

Exploring the neural correlates of race perception with Asian and Caucasian morphing faces: an MEG study

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Sarina Hui-Lin Chien (簡惠玲)

Abstract

Race perception is an automatic process; however, the underlying neural mechanisms are still unclear. We explored the neural mechanisms of race processing, particularly the correlations between race categorization and M170 and M250 components. We recruited 13 Asian participants (mean age: 24.27 ± 2.13). The MEG experiment was conducted with the Elekta Neuromag TRIUX MEG. The face stimuli were five morphing images averaged between an Asian female and a Caucasian female (A0/C100, A25/C75, A50/C50, A75/C25, and A100/C0), and a scrambled face as the control stimulus; the participants passively viewed all six stimuli (100 trials each) presented in random order. We employed three different analyses for the MEG data: the Principal Component Analysis (PCA, finding the components explaining the signal variance), the Time-Frequency Representations (TFRs, calculating the representation of power individually), and the group difference of Event-Related Fields (ERFs, offering the general statistic result). Applying PCA, we found three major components (48% of total signal variance) captured the difference between Asian (A100/C0) and Caucasian (A0/C100) faces: PCA1 shows strong Caucasian preference at M170 (MEG1721, left temporal lobe); PCA2 shows strong Asian preference at M170 and strong Caucasian preference at M250 (MEG2641, right temporal lobe); PCA3 component shows strong Caucasian preference at both M170 and M250 (MEG1723, left temporal lobe). The TFRs of power between 150-200 ms were calculated; the power was stronger in the left prefrontal lobe for Asian faces and in the right temporal lobe for Caucasian faces. Lastly, the group difference between the ERFs of Asian (A100/C0) and Caucasian (A0/C100) faces was significant mainly in prefrontal lobes and right temporal lobe at M170, and in prefrontal lobes and temporal lobes at M250. In sum, our analyses revealed that race categorization seems to correlate with both M170 and M250 components and involve temporal lobes and prefrontal lobes.

Keywords: magnetoencephalography(MEG); face perception; race categorization; morphing face paradigm; other-race effect

P13

Characterizing the Impact of Aging on Spatial Negative Priming

李子伶、張智宏

Abstract

Inhibitory functions are crucial for keeping our behaviors under control, and it is prone to the influence of aging. In the current study, we do three experiments to explore the impact of aging on selective attention inhibition. First, we adopted a location negative priming task where the participant responded to the target of prime and probe. We manipulated the duration between the response to prime and the probe onset between 389, 931, 1463, and 1995ms to explore the evolution of NP effect across time and also compared age difference in the time course of NP. Second, we combined Go/No-go task with LNP task where if the participant saw a yellow target in the prime, the participant didn't respond and vice versa. Third, we combined Go/No-go task with LNP task in the prime and probe with EEG recording. We found that no matter for the young group or elderly group, the temporal decay function of NP had stable NP effect across RSIs. However, we found that delayed maximal significant NP effect in the elderly relative to the young group. For the second experiment, NP effect of Go was much larger than No-go one in the younger group. However, for the elders, the NP effect increased with adding Go/no-go task but not significantly. For the ERP experiment, the behavioral data showed that the NP effect of No-go was larger than Go one in younger and elderly group. And, we also found that N1 amplitude of No-go prime is smaller than Go one in younger and elderly group. To summarize, we found that selective attention inhibition was not age-related deficit and contrast to with higher attention Go prime condition, the NP performance of lower attention (No-go prime condition) was better in the elderly group.

Keywords: Aging, selective attention, inhibition, negative priming

P14

The organizational processing on test-potentiated learning.

王忻怡、鄭仕坤

Abstract

Test-potentiated learning effect, testing benefit retention by potentiating subsequent learning or encoding, might come from the organizational processing of the materials after test. To examine this hypothesis, the types of materials were manipulated among the experiments. Experiment 1 employed unrelated words & categorized words as the study materials. The results showed higher recall rates for the groups that received repeated testing before restudy than for other groups. However, the test-potentiated learning effect didn't show the different degrees between unrelated words conditions and categorized words conditions. These results indicated that the participants might still involve organizational processing when learned randomly categorized words. The categorized words were presented in the order in Experiment 2. However, the recall rates of the repeated testing and restudy group were still significantly better than other groups. Also, The ARC scores of the two groups who have received repeated testing were significantly higher in the final test compare to the repeated test. Experiment 3 employed a similar procedure of Experiment 1 & 2, during which ERPs were recorded at the initial/final study. The pre-frontal subsequent memory effect(SME) was only found in the final study phase after repeated testing, reflecting that item-specific processing may involve in the encoding. The frontal & parietal SME was found in both the initial & final study phase, but a significant interaction between condition (received testing or not) and SME was only observed in the final study phase after repeated testing, revealing that repeated testing indeed affect subsequent learning. Also, the item-specific processing and relational processing may involve in subsequent encoding to varying degrees. In summary, our behavioral results replicate test-potentiated learning effect but do not fully support the hypothesis. Neural physiological results might suggest that item-specific processing and relational processing involve in the subsequent encoding.

Keywords: test-potentiated learning, organizational processing, event-related potentials

P15

Emotional Prosody Perception in School-Aged Children with High-Function Autism

曹峰銘, 許維欽，劉惠美

Abstract

Despite normal verbal intelligence, children with high-functioning autism (HFA) experience the difficulty in perceiving emotional prosody, one component of pragmatic language. However, it remains unclear whether the perceptual deficit in children with HFA is only restrict to emotional prosody or associate with pragmatic impairments. Lexical tones, phonetic units of tonal language, have similar acoustic features (e.g., pitch variation) with emotional prosody. This study aimed to characterize brain activation patterns associated with emotional prosody and social communication processing in children with HFA. School-age children with HFA (n = 10, 8-12 years of age) and typically-developing (TD, n =11) children, matched with chronological age and general intelligence, participated in this fMRI study. The fMRI tasks were two paired experimental blocks comparing random vs. fixed target syllable positions on emotional prosody and lexical tones: Emotion (random) vs. Emotion (fixed), and Tone (random) vs. Tone (fixed). Same speech stimuli of both experimental blocks were used in fMRI trials and children judged whether emotional prosody or lexical tone in a trial were the same or different. Results revealed that group difference between HFA and TD groups for emotional prosody vs. lexical tone perception was the elevated activity in HFA children at bilateral posterior cingulate cortex (PCC). Stronger brain activity (BOLD signal change）during emotional prosody processing was negatively related to prosody recognition accuracy, but positively associated with severity of communicative impairment in children. The results showed that hyperactive PCC was the neural process associated with less accurate emotional prosody recognition and impaired social communicative functions in HFA children.

Keywords: Emotional prosody perception, autism

P16

A Novel Algorithm to Improve Accuracy of SSVEP-BCI Using Dipped Sponge Electrode

吳佩倫、柯立偉、張揚

Abstract

Brain computer interface (BCI), which allows people to control external devices through their brain waves, can be applied to more and more realms nowadays. It has become a new trend in these years since its novelty and convenience. There are many kinds of technology that can used to recognize multiple brain waves. Among these brain signals, steady state visually evoked potential (SSVEP) is a kind of signal that evoked by visually stimuli. This kind of visually signal is easily to generate and observe, meanwhile having excellent signal-to-noise ratio (SNR) quality. However, the application of electrodes that used to acquire the SSVEP signal is a major problem when it comes to the signal quality, and the system accuracy also need to be ameliorated. In this study, we proposed a novel moisture retention sponge electrode and an innovative differentiable power algorithm to improve the accuracy of SSVEP-based BCI systems. Two experiments were implemented to see the effect of four different kinds of electrodes and the accuracy of three various algorithms. The impedance experiment indicated that the proposed sponge electrode exhibited lower impedance compared with metal electrodes, when they were placed at areas covered with hair; it also suggested that sponge electrodes could be an adoptable appliance for EEG measurement equipment. In the other experiment, the proposed differentiable power algorithm could successfully demonstrate higher accuracy than the others' by focusing on the target power and extracting features from the signal. In conclusion, both innovative findings could strengthen the performance of BCIs, and make it more practical in the real-world applications.

Keywords: SSVEP, BCI, differentiable power

P17

Individual differences in wayfinding strategies when using electronic maps

Meng-Ting Lin, Chun-Yu Lin

Abstract

Wayfinding is the ability to find a way to a particular destination or location. As the information and communication technologies improve, electronic maps have been used to assist wayfinding behavior, especially for finding unfamiliar routes. Previous studies have examined how functions and interface on the electronic map system influence people's wayfinding performance. However, people's interactive strategies with electronic maps during wayfinding are still unclear. In this study, participants had to reach three real-world target locations using a smartphone with the Google Map app. The participants were instructed to use the electronic map as the same way as how they usually use it in their real lives and speak out loud about where they were looking at and what they were thinking about when finding the targets. The results showed that subjects use map for two main purposes: where am I? or where to go? Based on which purpose they wanted to achieve mainly, they focused on different spatial and map's information and use different strategies to interact with the map (e.g., rotate the map or the body). The further classification of the subject's strategies and future directions were also discussed in the present study.

Keywords: Wayfinding, navigation assistant, Electronic map, Google Map app, Individual difference, strategy

P18

Exploration of eye-movement behaviors during decision on fairness judgment

Yu-Wen Shih, Zih Yun Yan, Makayla Chen, Denise Wu

Abstract

Previous neuroimaging research from our lab has revealed a frontal-parietal network, as well as the insula, to be associated with making satisfying judgment on the distribution of monetary reward. Specifically, higher brain activation in the parietal areas, including the inferior parietal cortex and BA40, was identified when participants made the satisfying judgment compared to the activation associated with a simple control task. The activation in the parietal areas has been attributed to the processing of stimulus saliency. However, it is also possible that such activation actually reflected more eye movements. To verify this possibility, participants were asked to perform the same satisfying judgment on the distribution of monetary reward and control tasks while their eye movements were simultaneously tracked. Preliminary analyses indicated that fixation durations did not differ between the control and judgement tasks. On the other hand, the total number of fixations was significantly greater in the judgment than the control task. Based on the eye-tracking data, we could not rule out the possibility that the observed parietal activation in our previous study was due to eye movements. Further research would be needed to determine whether decision making on fairness perception, independent of eye movements, also involves the parietal regions.

Keywords: decision-making, eye-tracking methodology, fairness perception

P19

Source identification for the motor execution, motor imagery and motor observation condition based on independent EEG components

Yu-Yu Huang, Jeng-Ren, Duann

Abstract

Recently, brain computer interface (BCI) has been built as a communication channel between the brain and an external device. Among the modalities to establish such a BCI communication channel, the motor imagery (MI) EEG is one of the most frequently used features. As compared to the motor execution (ME) and motor observation (MO) conditions, MI also shares the same event-related de-synchronization (ERD) EEG response mainly in the alpha and beta frequency bands, called my-suppression. The source brain areas that generate such mu-suppression components for the three different motor conditions have thus been hypothesized co-localized in the past. However, such a co-localization hypothesis has long been controversial given the divergent neuroimaging evidence available in the recent years. Hence, this study was to test if the source of the three motor conditions were co-located using an EEG dataset acquired during the participants performing the three motor conditions in a randomized order in same EEG runs. Two different independent component analysis (ICA) strategies were used: One was applied to the EEG data of the three motor conditions combined and the other was applied to the EEG data of the three conditions separate. Twelve right-handed, healthy participants participated in the experiment. The separate ICA results showed that the source location if the ME condition was more toward the dorsal surface than the source location of the MI condition ($p<0.05$, by both t-test and binomial test). The source location of the MO condition was significantly anterior to the source location of the combined condition ($p<0.05$, binomial test). In sum, our results may indicate that the sources of the three motor conditions might not be co-located, with the ME condition had its source localized more anterior toward the primary motor cortex and the MI condition more posterior toward the primary sensory and parietal cortex.

Keywords: BCI, motor imagery

P20

A direct support for the perceptual expertise hypothesis of FFA: interactive face- and bird-selectivity in bird experts.

楊念庭、龔俊嘉

Abstract

One of the unsolved debates in the prolonged exchanges between face specificity and perceptual expertise hypothesis of FFA (e.g., Gauthier et al., 2007; 2017; Kanwisher et al., 2017) has been on whether the BOLD activities in FFA for objects of correlate with their behavioral expertise. While early studies found positive evidence (Gauthier et al., 2000; Xu, 2015), later replications by other labs didn't (Grill-Spector et al., 2004; Rhodes et al., 2004; Moore et al., 2006). Until today, the reason behind these disparate expertise-FFA correlation results remain unsolved. In this study, we recruit bird experts, and look from the opposite side of the expertise-FFA correlation: whether there is an adaptation-like negative correlation between face selectivity (faces vs. objects) and bird expertise in FFA. 16 Taiwanese birders and 17 American birds were both evaluated with behavioral expertise index, and later scanned with fMRI tasks, including FFA localizers (Taiwan only), passive viewing and 1-back identity tasks of 4 conditions: Asian faces, familiar birds, unfamiliar birds, and objects. While the localizer-defined rFFA showed insignificant FFA-expertise correlations (r14=.3, p=.3), consistent with much of the majority of previously mentioned literature, the face selectivity (faces vs. objects) shows significant negative correlation (r14 = -606, p=.022). In other words, the default face-responsive fusiform area, when sandwiched between blocks of objects of expertise, could become face un-responsive! Complementary whole-brain correlations with "birds vs. objects" and "faces vs. objects" contrasts (N=33) also showed adjacent but distinctive rFG regions for both positive and negative expertise-correlated regions, not only rapport to the ROI analysis results, but also explains that when focusing on the suboptimal bird stimuli in the default face-selective FFA, the brain-behavior correlation might be sub-optimal. Taken together, these results once again support the Flexible mid-Fusiform Area (FFA, Tarr and Gauthier, 2000) under various task.

Keywords: rFFA, Adaptation effect, Bird experts

P21

Time courses of identification of beauty and other attributes in faces

董志煒, Makayla Chen, Ya-Ting Hsu, Denise Wu

Abstract

Human's ability to appreciate beauty might have evolutionary value. Previous research has shown that facial beauty is perceived unconsciously even before face identity is recognized. Such findings are in a sharp contrast with our previous results showing that aesthetics in Chinese calligraphy was perceived relatively late. To verify whether aesthetics in faces is indeed perceived early during face recognition when investigated with the experimental paradigm that we employed with Chinese calligraphy, participants were asked to make aesthetic, color, gender, or emotion judgment on faces, which appeared for six different durations between a forward and a backward mask. Participants' accuracy of the judgment on the different attributes indicated that aesthetics, as well as color and gender, of faces was identified better than guessing as early as 17 ms. When the presentation duration was 33 ms, all the four attributes were identified better than guessing. Interestingly, the identification of facial beauty had an error rate of about 17% even when the presentation duration was 100 ms, long enough to view the face clearly. This finding might be due to the subjectivity of aesthetics judgment. In summary, we confirmed the rapid perception of beauty expressed in faces, which together with the findings from Chinese calligraphy is evidence for at least partly separate mechanisms underlying aesthetics appreciation in different domains.

Keywords: facial beauty

P22

Sensitivity to componential regularity in a spatial but not temporal pair only correlated with Chinese proficiency in learners but not in native readers of Chinese

Denise Hsien Wu, Andhika Renaldi, Xingye Chen, Yu-Huei Lien

Abstract

Previous research from our lab has explored whether sensitivity to temporal and spatial componential regularity that resembles characteristics of alphabetic and logographic orthographies, respectively, was associated with reading experience of these two kinds of orthographies. For this purpose, we developed novel tests of visual statistical learning (SL) in which two nonverbal shapes were presented in sequential (temporal) or simultaneous (spatial) pairs. In the study phase, each shape always appeared in a specific position in the temporal or spatial pair, while the other shape in the same pair was not specific or unique. In the test phase, each shape encountered in the study phase was paired with a novel shape that was not encountered before. We found that the individual difference of foreigners who were learning Chinese exhibited correlation between the sensitivity to Chinese orthography, measured in a lexical decision task, and the accuracy in the componential spatial but not the temporal SL test. In the present study, native readers of Chinese were recruited, so that their performance could be compared with the previous findings. The present results showed that the correlation between the sensitivity to Chinese orthography and to spatial componential regularity was not significant. Based on our previous and present findings, it is suggested that SL contributes to literacy acquisition in learners of Chinese but not to word recognition in proficient readers. Future research is needed to determine whether such findings can be generalized to other orthographies.

Keywords: spatial and temporal statistical learning, logographic orthography, alphabetic orthography, literacy, reading experience

P23

Beyond FFA BOLD changes: appropriate expertise training not just drives higher BOLD activities, but also faster BOLD onset and better classifications for Greebles in FFA and many brain regions

Chun-Chia Kung, Chien-Shu Chu, Yi Lin, Hsnshin Jo, and Kuo Liu

Abstract

Previous discussions about the role of FFA in face and/or expertise processing focused on whether Greebles are face-like (e.g., Brants et al., 2011 JOCN). But in our previous work (Liu et al., 2017 OHBM), however, we have identified that it was more likely due to the appropriate training, than on the stimulus category per se (e.g., symmetry of Greebles), that caused the FFA activity increases. In this study, we report a companion jittered er-fMRI experiment where the subjects did the same delayed verification task that they were kept trained on in the during- and after-training scan sessions. Our hypothesis is that, while the correct trial RTs for Greeble verifications became faster, their FFA BOLD responses should also rise earlier, and that earlier rise should also predict earlier and higher classification after training.

With previous reported training protocols and fMRI results (Liu et al., 2017), where 16 participants underwent two different Greeble training regimes (8 for each Gauthier97 and Gauthier98, respectively) and scanned during (in the middle of), and soon after training, we first plotted the average FFA time courses and noted that it did rise earlier in Gauthier97, but not in Gauthier98, after training (and later confirmed with estimates of BOLD rising time via BOLD latency mapping), suggesting the earlier rise even before the appearance of Greeble pictures. In addition, MVPA classifications, either ROI-based or whole-brain searchlight mapping, for during- vs. after-training Greebles also reveal that these early rises help classify Greebles significantly, in response to the trained task requirements: earlier rise (Gauthier97) recruited temporal and prefrontal areas in the earlier time frame (3-8s after trial onset), whereas Gauthier98 showed classification successes much later (5-15s) and persisted comparatively in ventral temporal areas. Taken together, these results both exemplify the effect of expertise training beyond single ROI and single dimension.

Keywords: Greeble training, jittered er-fMRI, average time courses, bold latency mapping, MVPA, searchlight.

P24

Not just in FFA: becoming an expert also drives the activity, and changes the pattern, of early visual cortex

朱謙恕，楊念庭,劉闊,龔俊嘉

Abstract

In this fMRI study, we aim to investigate Greeble training effect, especially in early visual areas, in participants who were trained to recognize Greebles with either Gauthier97 (or Gauthier and Tarr, 1997) or Gauthier98 (or Gauthier et al., 1998) paradigm. A retinotopic mapping procedure was used to delineate early visual areas (V1, V2, V3, V4, and/or V3a). Then, these ROI masks were applied to the passive viewing task of faces, objects, and Greebles, both before and after training and in both Gauthier97 and Gauthier98, to evaluate respective BOLD changes in V1 to V4 ROIs associated with Greeble training. We compare brain activity by both univariate and multivariate analysis, which show quite different pictures: while univariate analysis (both ROI time course comparisons and GLM contrasts) showed no significant BOLD changes across early visual area (and no difference across both Gauthier97 and 98); multivariate analyses, including both ROI-MVPA and whole-brain searchlight, present significant classification (Greebles_before vs. _after) accuracies across V1-V4 ROIs (via ROI-MVPA), and wide-spread training effects across many brain regions (including parietal and prefrontal regions, via MVP searchlight), once again across both training paradigms. To further verify that whether early visual area would be recruited by automatic attention, the bird expertise fMRI study in Yang et al. was also analyzed with retinotopic procedure, and was found that in passive viewing task (but not in 1-back identity), subject's behavioral expertise also predict the involvement of early visual cortex.Taken together, these results suggest that while FFAs have been ‘sharpened' by Greeble training; multivariate analyses reveal wide-spread changes in both visual and associative areas. In addition, early visual cortex could also be predicated by expertise-driven attention, consistent with Harel et al. (2010).

Keywords: Greeble training,

P25

Musicians and non-musicians' different reliance of features in consonance and dissonance perception: from EEG to fMRI

Han Shin Jo, Tsung-Hao Hsieh, Wei-Che Chien, Sheng-Fu Liang, Chun-Chia Kung

Abstract

Musicians, learning complex motor and auditory skills from early age, has been demonstrated the behavior, anatomical and functional brain plasticity by musical training. In the present study, 15 musicians and 12 non-musicians were measured in event-related potential (ERP) with electroencephalography (EEG) and scanned in jittered design functional magnetic resonance imaging (fMRI) separately, participants judged musical consonance/dissonance at various frequency intervals (50 ~ 500 Hz), orthogonally selected from across the "pitch interval" and "roughness" spectrum. The functional adaptations of hierarchical auditory brain networks may be corresponded with different reliance of western music theory and psychoacoustic between musicians and non-musicians. Behavioral results were shown that while musicians relied upon pitch intervals (between perfect fifths and tritone, with 76%±14), non-musicians performed around at chance. In the ERPs analysis, components revealed corresponding N1 (~100 ms) and P2 (200~250 ms) amplitude differences in the FC4 and Fz channels for the "tritone vs. perfect fifth" comparison in musicians, and F3, F4, FC3, FC4, Fz, FCz, Cz, and CPz electrodes for the "roughness vs. nonroughness" comparison in non-musicians. In the fMRI, the bilateral Heschl's gyrus (HG) was revealed by ANOVA group comparisons for both "pitch interval" and "roughness" dimensions. Specifically, increased activity in left primary auditory cortex (PAC) was found in pitch interval contrast (perfect fifth > tritone) for musician, meanwhile, dorsal anterior cingulate cortex (dACC) and left PAC were revealed in roughness dimension (nonrough > rough) for non-musician. More interestingly, MVPA searchlight analyses revealed the bilateral Inferior frontal gyrus (IFG) in musician (more pattern information in the right IFG), and supplementary motor area (SMA) in non-musician for pitch interval (perfect fifth vs. tritone) classification. Taken together, these results demonstrate the common role of PAC in consonance perception, and suggest different cognitive domains subserving the detection of consonance/dissonance frequency ratio, or differences between musician and non-musician.

Keywords: fMRI, EEG, Musician, Pitch interval, Roughness

P26

Neuro-rehabilitation of Upper Limb Function in Stroke after Botulinum Toxin Injection

Yi-Chen Lu, Yu-Chun Ho, Kuang-Ting Cheng, Chia-Wei Lin, Li-Wei Ko

Abstract

Neuro-rehabilitation is aiming to aid recovery the nervous injury from either the central nervous system or the peripheral nervous system. The main neural mechanism of the injury is still unknown and attractive for many researchers devote to investigate the neural plasticity. Take Stroke as an example, stroke patients often experience muscle spasticity affecting upper limb function or gait performance, which will be seriously affected their daily life quality. So far, there were still no comprehensive treatment strategy which can integrate brain and peripheral system to enhance neural plasticity and improve motor functional performance. Botulinum toxin (BTX) treatment can relieve spasticity after stroke, “likely acting at several hierarchical levels of the motor system” (Kanovsky, 2013). The goal of this study is to investigate the brain dynamics associate with the improvement of training upper limb function after BTX treatment. Fifteen stroke patients in different damage level performed flexion and extension of elbow before and after BTX injection. Each patient will take around one hour to perform two sessions. We use Neuroscan System to record 32-channel electroencephalography (EEG) signals, and then decode EEG signals to investigate brain neural network changes after receiving BTX treatment. We intend to observe the brain dynamics of the patients’ motor cortex in comparison with the BTX injection or not for evaluating their upper limbs training performance. Brain activity changes reveal the recovery efficacy to inspire stroke patients perform the rehabilitation task with the BTX treatment, which will provide a points of view toward treatment of stroke patients. EEG signals can not only be a potential assessment in stroke patients, but also be used as a feature to develop a new rehabilitation treatment approaches.

Keywords: Neuro-rehabilitation, Stroke, EEG signal, upper limb function

P27

P600 effect of Logographic Orthography on Visual Statistical Learning

Andhika Renaldi, Yu-Huei Lien, Yi-Lin Chen, Denise Hsien Wu

Abstract

Statistical learning (SL) is the ability to detect regularity in the environment. Although previous research has shown that participants were sensitive to componential spatial regularity that resembles characteristics of logographic orthography, whether this sensitivity is reflected in neuronal correlates is unexplored. In the present study, we modified the temporal and spatial componential visual SL (C-VSL) tests to be employed with simultaneous EEG recording. In the study phase of the C-VSL tests, the majority of the trials were standard trials in which each nonverbal shape appeared in a specific position of a temporal or spatial pair while the other shape in the same pair was not specific or unique. On the other hand, in the deviant pairs each shape appeared in the opposite position from the standard ones. In the test phase, each shape encountered in the study phase was paired with a novel shape that was not encountered before, and participants' SL ability was measured by familiarity judgment and recognition. The preliminary results in the test phase revealed comparable behavioral performance to that observed in our previous study with the C-VSL tests. The neurophysiological results in the study phase showed a P600 effect when comparing the standard and deviant trials, particularly in the central anterior region, in both the temporal and spatial C-VSL tests. Such results suggested that learning componential regularity could happen in a short time. Further data collection and analysis is needed to determine whether other neurophysiological components would also reflect the process and individual difference of SL.

Keywords: spatial and temporal statistical learning, logographic orthography, alphabetic orthography, P600, ERP

P28

The effects of collectivistic and individualistic values on structure of the brain: A cross-cultural voxel-based morphometry study

Chih-Mao Huang, Robert Doole, Changwei Wu, Hsu-Wen Huang, Yi-Ping Chao

Abstract

Converging behavioral and functional neuroimaging evidence indicates that East Asian and Western individuals have different biases for processing information that may stem from contrasting cultural values. East Asians appear to be more sensitive to contextual information (i.e., holistic processing style) shaped by the collectivistic/interdependent culture. In contrasts, Westerners have a tendency to process focal and salient objects of the environment (i.e., analytic processing style) due to their individualistic/independent representation. In this cross-cultural MRI study, we used voxel-based morphometry (VBM) to investigate the structural brain differences of collectivistic and individualistic biases in East Asian and Western participants. Each participant's degree of endorsement of individualistic and collectivistic values was assessed by their self-report on the Singelis Self-construal Scale (SCS). Taiwanese rated higher SCS scores than Westerners in collectivistic value and Westerners rated higher SCS scores than Taiwanese in individualistic value (Taiwanese: -7.0; Westerners: 8.4; $p<0.001$). Using a voxel-wise threshold of family-wise error (FWE) $p< 0.01$, VBM results showed that Western group showed larger regional gray matter volume in the bilateral superior and inferior frontal gyrus, left parahippocampal gyrus, and subcortical regions, whereas Taiwanese had larger regional gray matter volume in the left inferior temporal gyrus (Brodmann Area 37). The results remained robust after controlling individual variations in language acquisition (i.e., monolingual, bilingual, or multilingual speakers).These findings are consistent with previous neuroimaging studies and provide evidence for the brain structural basis of individual differences in cultural values.

P29

Age-related and individual differences in brain complexity of resting-state fMRI signals in healthy elderly

吳順吉,Guan-Yen Chen, Pei-Shan Ho, Ya-Wen Fang, Ovid J.L. Tzeng, Hsu-Wen Huang, Chih-Mao Huang

Abstract

Entropy-based complexity of neural signal characterizes intrinsic function of the human brain.

In this resting-state functional magnetic resonance imaging (rs-fMRI) study, we employed multiscale entropy (MSE) analysis to examine age-related and individual differences in the complexity of intrinsic network, brain function and cognition. Specifically, the MSE of blood oxygen level-dependent (BOLD) signals of rs-fMRI data from 90 prior-selected regions-of-interest (ROIs) were estimated in 28 young and 65 healthy older adults. The results showed that healthy older adults exhibited significant reduction in MSE of BOLD signals in fronto-parietal network but increase in MSE of BOLD signals in thalamus, indicating a higher degree of complexity in the aging brain with reduced information transfer between cortical and subcortical regions. Moreover, the MSE of BOLD signals in high-functioning older adults appear to be similar with the MSE of BOLD signals in the default mode and salience networks found in young adults, suggesting a preserved intrinsic network for individuals who age better than others. Our findings provide supportive evidence that complexity of brain activity is declined across the lifespan and associated with the individual variations in neurocognitive performance in the healthy older adults.

P30

Neurobiological basis of love: Insights from fMRI meta-analyses of maternal love and passionate love

施宣竹, 黃植懋

Abstract

Previous neurobiological studies of attachment in mammals suggest that the attachment behaviors between individuals are associated with the neural networks related to dopaminergic and oxytocinergic pathways. In this study, we examine whether functional neuroimaging studies of attachment behaviors in human demonstrate similar neural networks that have a closely linked biological function of crucial evolutionary importance. Specifically, we perform a quantitative meta-analysis of functional magnetic resonance imaging (fMRI) studies by using activation likelihood estimation (ALE) approach to investigate the common and distinct neural substrates of maternal love and passionate love in human when individuals viewed their own infants and partners, respectively. Twelve published fMRI studies related to maternal love and nine published studies related to passionate love were included. The meta-analytic results showed that both types of love appeared to associate with functional activations in bilateral ventral tegmental area and right thalamus, indicating the highly rewarding experience for both maternal love and passionate love. However, maternal love showed greater activation in bilateral putamen, bilateral thalamus, left substantia nigra, left amygdala, right medial temporal gyrus and right superior frontal gyrus compared to passionate love, suggesting a greater neural effort for cognitive-emotional regulation of attachment behavior in maternal love. Our findings suggest that the processing of maternal and passionate love involve the affective and motivational regulation associated with dopaminergic systems, which provide neuroimaging evidence to support the notion that maternal love and passionate love share a common evolutionary origin and neurobiological functions in neural level.

P31

Dynamic interaction of functional brain connectivity in Convergent and divergent thinking

Patil Abhishek Uday, Deepa Madathil, Ovid Jyh-Lang Tzeng, Hsu-Wen Huang, Chih-Mao Huang

Abstract

Creativity is defined as a cognitive process which involves generation of useful and novel ideas which can be used to solve problems. Such cognitive processes can be defined by two components: convergent thinking (i.e. collecting various thoughts and ideas to find the best solution for a particular problem) and divergent thinking (i.e. defining multiple solutions to solve a particular problem). Meta-analytic studies of functional magnetic resonance imaging (fMRI) data focusing on a variety of creativity tasks, have demonstrated that divergent and convergent thinking are associated with differential frontal and parieto-temporal activations that may reflect diverse processes of creative thinking. In this fMRI study, we investigated whether convergent and divergent thinking involve distinct patterns of functional brain connectivity by applying the psycho-physiological interactions (PPIs) approach. Twenty-five healthy participants performed the Chinese-word remote Associates task (CAT) to characterize the convergent thinking process and the Alternative Uses Tasks (AUT) for divergent thinking process. The whole brain analysis revealed that CAT showed activations in the left fronto-parietal region whereas AUT had activations in the bilateral cortical regions of the brain. In the PPI analysis, the hippocampus was connected positively to the superior and inferior frontal gyrus, insula, precuneus, superior parietal lobule and a few temporal region stipulating retrieval and selection of the semantic memory whereas in the AUT, the hippocampus showed positive modulation towards superior and middle frontal gyrus, cerebellum and posterior parietal lobule indicating combinatory thought process in the participants relating to remote concepts. Our results suggest the differential and distributed functional connectivity brain patterns associated to convergent and divergent creativity.

P32

Overcome the Boundary of Space and Time: A Combined Virtual Reality and EEG Study of Rubber Hand Illusion

黃鈺翔, Tzu-Yu Hsu, Chih-Mao Huang

Abstract

The rubber hand illusion (RHI) is a misperception derived from artificial multisensory stimulation. With different stimulating strategies, researchers reported various cognitive processes involved in the perceptional integration phenomenon. Most studies compared the outcome based on pre-defined conditions (e.g. synchronous vs. asynchronous), whereas we did not preconceive the result simply by the preset stimulation but assumed that there is a spectrum of the illusion intensity corresponded to different stimulation circumstances. Furthermore, we investigated into the subjective feeling and brain dynamics during the stimulation. In this study, we conducted a combined virtual reality (VR) and electroencephalography (EEG) experiment to explore RHI which induced the illusion by visual-motor stimulation from the participants' voluntary hand movements. The participants kept moving their hand while gazing at a VR hand model reproducing the same movements through a head mounted display (HMD). Manipulating the location (space) and the synchrony (time) of the hand model in VR, we had the participants report the timing of the beginning of illusion and the illusion fully emerged moment while there was inconsistence of sensory inputs. The behavior result showed that the illusion could be induced almost immediately in the condition with no or little inconsistence. Moreover, in medium or high inconsistence conditions, in spite of spending more time, most participants could still obtain the illusion in a gradual progress. The event-related potentials (ERPs) results revealed that the average amplitude at the prefrontal area differed along with the degree of illusion. Our findings suggest that the flexibility of our body scheme could be further extended under more realistic stimulation, and the amount of neural resourced alters when dealing with different levels of inconsistent stimulation.

P33

MATCHED SPATIAL FILTERS FOR ANALYSIS OF LATE ERP COMPONENTS DURING CONFLICT RESOLUTION

Mauro Nascimben, Chih-Mao Huang, Hsu-Wen Huang

Abstract

In this event-related brain potentials (ERPs) study, we investigated the resolution of conflict by using the modified version of size-congruity comparison, a Stroop-like task in which numerical value and physical size were varied independently under task-relevant and -irrelevant conditions. The electrophysiological results demonstrated that the incongruent condition elicited greater parietal-distributed P300 than the incongruent condition for both numerical and physical comparison tasks. We further investigate the consistency of the congruency responses over all scalp electrodes to take into account the distribution of activity across the sensor array.

Matched-spatial filtering was applied over the time interval between 300 and 700ms. This technique is used to create spatial filters based on the difference between two conditions. By projecting the trial onto the corresponding spatial filters, surrogate single trials are created in which multi-sensor activity is reduced to one time series which exposes experimental effects. If the congruency effect appears in two or more non-contiguous regions, with potentially opposite signs this technique allow us to retrieve the full scale effect. Moreover we don't have to intentionally select a "region of interest" treating equally all its channels even though some may carry much more signal than others.

Analysis of variance shows significant changes over spatially filtered signals in incongruent and congruent conditions. Three time intervals were analyzed further, and signals were superimposed in each time window to exclude influence of previous ERP. No significant difference was found for physical task after 500ms while numerical task showed more sustained differences between "congruent" and "incongruent" over time, maybe reflecting a prolonged cognitive workload. Reaction times portray a similar pattern.

Overall, we presented a method that reduces multi-variate time series data to a single time course by projecting the data onto a single vector that is chosen so as to reveal a given experimental effect. We found that spatially filtered signals retain the characteristics previously described in literature over single channels ERP "congruent" vs "incongruent" between 300 and 650ms. A longer-lasting difference demonstrated in the numerical task than in the physical task is compatible with the distinctive cognitive workload for resolving task relevant conflicts.

P34

Is integration of auditory and visual information simultaneous in Chinese?

王馨敏、陳嬴宇

Abstract

In the transparent alphabetic languages, the degree of automaticity of letter-sound associations has been investigated using the cross-modal MMN paradigm. In this paradigm, the MMN to speech sounds presented alone was compared with the MMN to speech sounds accompanied by letters. Besides, SOA between letter and speech sound presentation was manipulated in order to investigate the temporal time window of letter-sound integration processing. It was found that adult readers showed cross-modal enhancement of the MMN amplitude when letter and speech sound were presented simultaneously (SOA=0), suggesting early and automatic letter-sound integration. Compared to adults, 11-year-olds also showed enhancement of MMN amplitude but requires an extra 200 ms (SOA=200), indicating letter-sound integration processing continues to develop even after 4 years of reading instruction.

Chinese differs from alphabetic languages. To date, it is still less clear whether integration of auditory and visual information is simultaneous in Chinese. The current study aimed to shed light on this issue. Using the same cross-modal MMN paradigm described above, a character was presented simultaneously with a lexical tone, or with either a 100ms SOA or 200ms SOA. We found that MMN was enhanced when the character and the lexical tone were presented with 200ms SOA. These results are interestingly similar to those found in 11-year-old children in the transparent alphabetic languages, suggesting integration of auditory and visual information is not simultaneously in Chinese even in experienced adult readers. These findings highlight differences between fundamental reading processes across different writing systems.

地圖及路線指引 Map & Directions

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(1) 由新竹火車站出發，經民族路(約 190 公尺處)，搭乘市區公車**藍 1 區間車**，至**學園商場站或新竹高商站**下車， 步行至校內。(參考新竹市公車藍 1 區間車時刻表)

(2) 由新竹火車站出發，搭乘 2 路公車至**交大博愛校區**(參考新竹市 2 路公車時刻表)

B. **搭高鐵：**搭乘台灣高鐵於「新竹站」下車後，專搭公車至交通大學博愛校區。(參考新竹市公車藍 1 區間、2 路公車時刻表)

C. **自行開車：**中山高速公路 93.5 公里(95A)新竹交流道→光復路右轉→清華大學→光復路與學府路交叉口(左轉)→學府路口與博愛街交叉口(右轉)→交通大學博愛校區

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依據國立交通大學優惠計次汽車停車識別證，入校參加研討會活動，可享單日停車一趟 50 元。
如有需要開車入校者，請向報到櫃台購買停車優惠券。

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