PROGRAM BOOK

KSBNS 2023

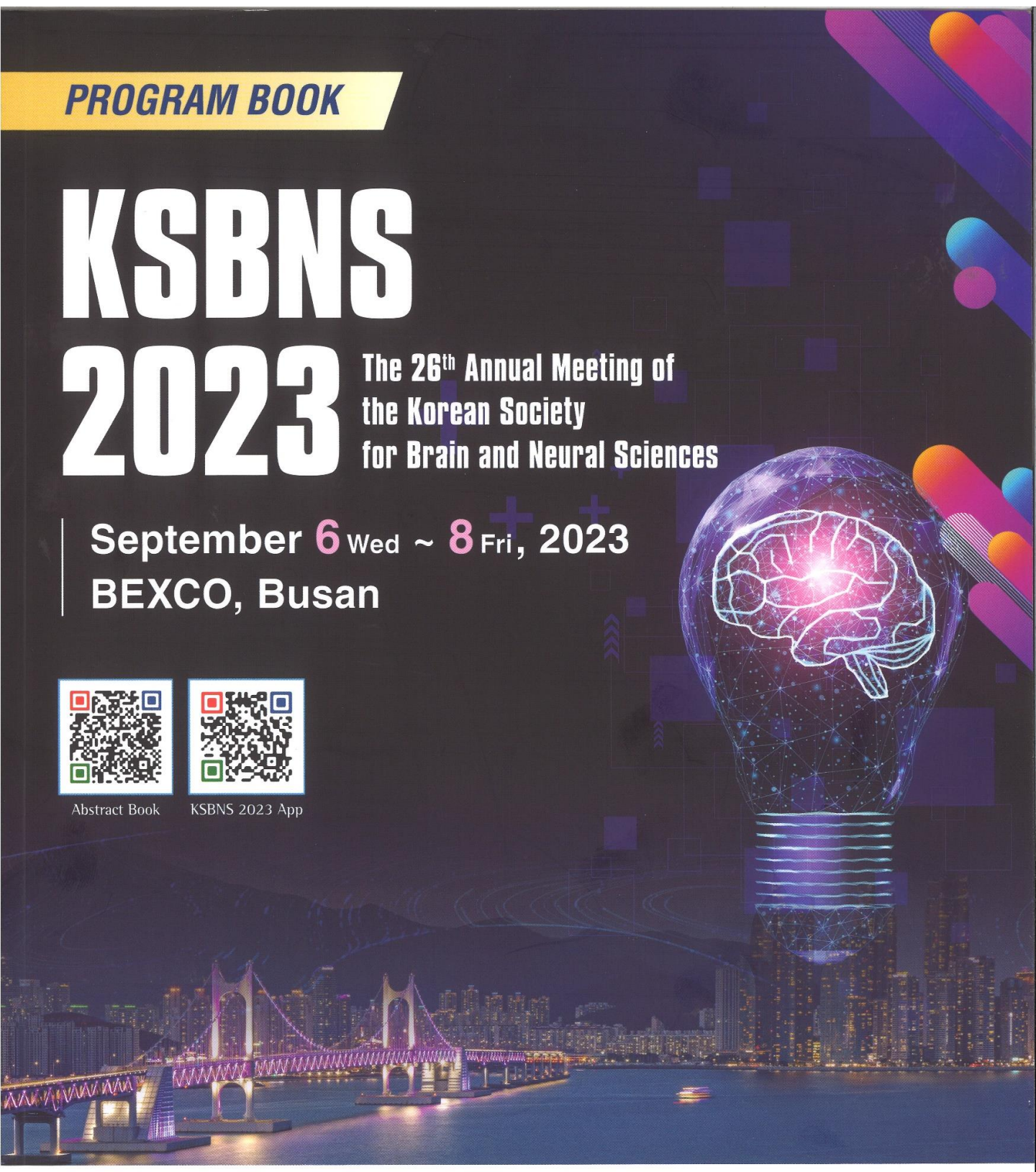
The 26th Annual Meeting of the Korean Society for Brain and Neural Sciences

September 6 Wed ~ 8 Fri, 2023

BEXCO, Busan

Abstract Book

KSBNS 2023 App



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P-381 Cortical thickness of the empathy-related brain regions modulates congruency between the decisions for self and other among adolescents
Junho Bang[1], Sunhae Sul[1], Kiho Sung[2], Yoosik Youm[2]

P-382 Stochastic characterization of navigation strategies in an automated variant of the Barnes maze
Juyoung Lee[1,2], Dahee Jung[1], Sebastien Royer[1,2]

P-383 Attenuated synaptic inhibition in the CA1 neurons induces anti-despair-like behaviors in RalBP1-mutant mice
Sang Ho Yoon[1,2], Woo Seok Song[1,2,3], Yubin Ko[2,3], Young-Sook Kim[2,3], Myoung-Hwan Kim[1,2,3]

P-384 Neural correlates of financial well-being predict real-life positive anticipatory experiences and everyday happiness
Won-Gyo Shin[1], Mina Jyung[2], Incheol Choi[2], Sunhae Sul[1]

P-385 Suppressed sour sensing by sweet taste from PNS to CNS
Jongmin Yoon[1], Chaeri Park[1,2], Myunghwan Choi[1,2]

P-386 Autophagy enhancer small molecule accelerates Aβ clearance and ameliorates neurological deficit
Jinho Kim[1], Myung-Shik Lee[2,3], Keun-A Chang[1]

P-387 Role of inferior colliculus in sound cue-based decision behavior: a pilot study investigating neural circuits in animals' music perception
Chan Hee Kim, Sumin Lee, Se-Young Choi

P-388 Investigating feedback and feedforward representations in the human primary visual cortex through laminar fMRI with spin-echo BOLD
Royoung Kim[1,2], Sohyun Han[3], Won Mok Shim[1,2,4]

P-389 Neuronal growth regulator 1 modulates mouse affective discrimination by regulating adult olfactory neurogenesis
Kwang Hwan Kim[1,4], Sung Joong Lee[2,3,4], Kyungchul Noh[2,4], Jaesung Lee[3], Soojin Lee[5]

P-390 Neural encoding of mean motion direction in mouse primary visual cortex and posterior parietal cortex
Young-Beom Lee, Yee-Joon Kim, Doyun Lee

P-391 Accelerating learning by automatically correcting licking bias in a two-choice delayed match-to-sample task
Jongrok Do[1,2], Doyun Lee[1]

P-392 Cognitive maps for a non-Euclidean environment
Misun Kim

P-393 Intracranial EEG correlates of age-related degeneration in hippocampal spatial mapping and a potential compensatory mechanism in PFC
Sang-Eon Park[1,2], Josh Jacobs[3], Sang Ah Lee[1]

P-394 Differential reactivation of value- and place-dependent information between the intermediate and dorsal hippocampus
Seung-Woo Jin, Inah Lee

P-395 Variations in value and outcome processing across the dorsal, intermediate, and ventral CA1
Miru Yun[1,2], Ji Young Hwang[1,2], Min Whan Jung[1,2]

P-396 Role of different types of cortical projections neurons in value-based action selection
Eun Ju Shin[1,2], Jeongwook Ghim[3], Min Whan Jung[1,2]

P-397 Distinct top-down projections from the posterior parietal cortex mediate behavioral flexibility during auditory reversal learning in mice
Eunji Jung[1,2], Jong-hoon Lee[1], Seung-Hee Lee[1,2]
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P-398 Flexible Multisensory Decision-Making: State-Dependent Gating of Auditory Inputs to Parietal Cortex
Ilsong Choi[1], Seung-Hee Lee[1,2]

Computational Neuroscience / Technology in Neuroscience

P-399 Effect of adult-born immature granule cells on sparsely synchronized rhythms in the hippocampal dentate gyrus
Sang-Yoon Kim, Woochang Lim

Effect of Adult-Born Immature Granule Cells on Sparsely Synchronized Rhythms in The Hippocampal Dentate Gyrus

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We are concerned about the main encoding granule cells (GCs) in the hippocampal dentate gyrus (DG). Young immature GCs (imGCs) appear through adult neurogenesis. In comparison to the mature GCs (mGCs) (born during development), the imGCs show high activation due to lower firing threshold. On the other hand, they receive low excitatory drive from the entorhinal cortex via perforant paths and from the hilar mossy cells with lower connection probability p_C (=20 x %) (x: synaptic connectivity fraction; $0 \le x \le 1$) than the mGCs with the connection probability p_C (=20 %). Thus, the effect of low excitatory innervation (reducing activation degree) for the imGCs counteracts the effect of their high excitability. We consider a spiking neural network for the DG, incorporating both the mGCs and the imGCs. With decreasing x from 1 to 0, we investigate the effect of young adult-born imGCs on the sparsely synchronized rhythms (SSRs) of the GCs (mGCs, imGC, and whole GCs). For each x, population and individual firing behaviors in the SSRs are characterized in terms of the amplitude measure $M_a^{(X)}$ (X=m, im, w for the mGCs, the imGCs, and the whole GCs, respectively) (representing the population synchronization degree) and the random phase-locking degree $L_d^{(X)}$ (characterizing the regularity of individual single-cell discharges), respectively. We also note that, for $0 \le x \le 1$, the mGCs and the imGCs exhibit pattern separation (i.e., a process of transforming similar input patterns into less similar output patterns) and pattern integration (making association between patterns), respectively. Quantitative relationship between SSRs and pattern separation and integration is also discussed.

Keywords : Hippocampal dentate gyrus, Adult neurogenesis, Immature granule cells (GCs), Mature GCs, Sparsely synchronized rhythm, Pattern separation, Pattern integration