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EX-GAUSSIAN MODEL REVEALS PERFORMANCE BIOMARKERS RELATED TO EMOTION-COGNITION INTERACTION DURING PUBLIC SPEAKING ANXIETY

(Model Ex-Gaussian Menghasilkan Biomarker Prestasi Berkaitan dengan Interaksi Emosi-Kognitif Semasa Kebimbangan Pengucapan Awam)

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ABSTRACT

This research is to compare the reaction time (RT) of low public speaking anxiety (LPSA) and high (HPSA) individuals using Ex-Gaussian modelling technique to investigate behavioural abnormalities in individuals with PSA. Despite the fact that one out of every four individuals worldwide experiences PSA, there remains a notable lack of research on this condition. With that, the RT performance biomarker of PSA is still unclear. This study observed the correlation between Ex-Gaussian parameters and the level of trait anxiety in 12 subjects with LPSA and 12 subjects with HPSA in an emotion-cognition Eriksen-Flanker (ECEF) experiment. Results revealed that sigma (σ) value in congruent trials was significantly smaller than incongruent trials. It was found that increased trait anxiety is related to reduced sigma (σ) value in LPSA subjects. Conversely, in HPSA subjects, trait anxiety is positively correlated with sigma. As for mu (μ) and tau (τ), we observed increased mu (μ) and tau (τ) in the incongruent compared to congruent trials across all emotional conditions. All in all, increased sigma (σ), mu (μ) and tau (τ) in the incongruent condition is related to impaired response preparation, decreased efficiency on automatic information processing and impaired cognitive control in HPSA subjects. With this study, Ex-Gaussian model is useful in biomedical engineering because it could successfully unveil RT performance biomarkers of abnormalities during the interaction of emotion and cognition in HPSA individuals.

Keywords: Ex-Gaussian; public speaking anxiety; Eriksen-Flanker; cognition; emotion

ABSTRAK

Kajian ini bertujuan untuk membandingkan masa tindak balas (RT) individu yang mengalami kebimbangan berucap awam rendah (LPSA) dan tinggi (HPSA) menggunakan teknik pemodelan Ex-Gaussian untuk mengkaji abnormaliti tingkah laku dalam individu yang mengalami kebimbangan berucap awam. Walaupun satu dari setiap empat individu di seluruh dunia mengalami kebimbangan berucap awam, masih terdapat kekurangan kajian dalam bidang ini. Oleh itu, biomarker prestasi RT bagi kebimbangan berucap awam masih belum jelas. Kajian ini mengkaji hubungan antara parameter Ex-Gaussian dan tahap kebimbangan berterusan dalam kalangan 12 subjek LPSA dan 12 subjek HPSA dalam satu eksperimen kognitif-emosi Eriksen-Flanker (ECEF). Hasil kajian menunjukkan bahawa nilai sigma (σ) pada ujian selari adalah lebih kecil secara signifikan daripada ujian tidak selari. Didapati bahawa kebimbangan berterusan yang tinggi berkaitan dengan penurunan nilai sigma (σ) dalam subjek LPSA. Sebaliknya, dalam subjek HPSA, kebimbangan berterusan berkaitan secara positif dengan sigma. Bagi mu (μ) dan tau (τ), peningkatan mu (μ) dan tau (τ) diperhatikan dalam ujian tidak selari berbanding dengan ujian selari di semua keadaan emosi. Keseluruhannya, peningkatan sigma (σ), mu (μ), dan tau (τ) dalam keadaan tidak selari berkaitan dengan persediaan tindak balas yang terjejas, penurunan kecekapan pemprosesan maklumat automatik dan kawalan kognitif yang terjejas dalam subjek HPSA. Kajian ini menunjukkan bahawa model Ex-Gaussian

berguna dalam kejuruteraan bioperubatan kerana ia dapat membongkar biomarker prestasi RT untuk abnormaliti semasa interaksi emosi dan kognitif dalam individu HPSA.

Kata kunci: Ex-Gaussian; kecemasan berkempen awam; Eriksen-Flanker; kognisi; emosi.

References

Altman D.G., Gore S.M., Gardner M.J. & Pocock S.J. 1983. Statistical guidelines for contributors to medical journals. *British Medical Journal (Clinical Research Ed.)* **286**(6376): 1489–1493.

Bartholomay E.M. & Houlihan D.D. 2016. Public Speaking Anxiety Scale: Preliminary psychometric data and scale validation. *Personality and Individual Differences* **94**: 211–215.

Bresin K., Robinson M.D., Ode S. & Leth-Steensen C. 2011. Driven, distracted, or both? A performance-based ex-Gaussian analysis of individual differences in anxiety. *Journal of Personality* **79**(5): 875–904.

Duschek S., de Guevara C.M.L., Serrano M.J.F., Montoro C.I., López S.P. & Reyes Del Paso G.A. 2022. Variability of reaction time as a marker of executive function impairments in Fibromyalgia. *Behavioural Neurology* **2022**: 1821684.

Feroz F.S., Ali M.H.M., Ismail A.I., Salman, A.R. & Sahbodin F. 2021a. Event-related potentials reveal impaired emotion-cognition interaction in individuals with public speaking anxiety. *Acta Neuropsychologica* **19**(4): 427–443.

Feroz F.S., Salman A.R., Ali M.H.M., Ismail A.I., Devi S.I. & Subramaniam S.K. 2021b. Attentional bias during public speaking anxiety revealed using event-related potentials. *Indonesian Journal of Electrical Engineering and Computer Science* **24**(1): 253-259.

Gallego A., McHugh L., Villatte M. & Lappalainen R. 2020. Examining the relationship between public speaking anxiety, distress tolerance and psychological flexibility. *Journal of Contextual Behavioral Science* **16**: 128–133.

Galloway-Long H. & Huang-Pollock C. 2018. Using inspection time and ex-Gaussian parameters of reaction time to predict executive functions in children with ADHD. *Intelligence* **69**: 186–194.

Kanske P. & Kotz S.A. 2010. Modulation of early conflict processing: N200 responses to emotional words in a flanker task. *Neuropsychologia* **48**(12): 3661–3664.

Kelsen B.A. 2019. Exploring public speaking anxiety and personal disposition in EFL presentations. *Learning and Individual Differences* **73**: 92–101.

Mandeville M.Y., Ries B.J., Turk C.L., McChargue D.E. & McNeil D.W. 1994. Using a unique cognitive approach - a variation of the Stoop Test - in the identification and the measurement of public speaking anxiety. Presented at the 80th Annual Speech Communication Association Convention. New Orleans. 19-22 November 1994.

Mui M., Ruben R.M., Ricker T.J., Dobryakova E. & Sandry J. 2022. Ex-Gaussian analysis of simple response time as a measure of information processing speed and the relationship with brain morphometry in multiple sclerosis. *Multiple Sclerosis and Related Disorders* **63**: 103890.

Nirjhar E.H., Behzadan A.H. & Chaspari T. 2021. Knowledge- and data-driven models of multimodal trajectories of public speaking anxiety in real and virtual settings. In *Proceedings of the 2021 International Conference on Multimodal Interaction*, pp. 712–716.

Panagiotaropoulou G., Thrapsanioti E., Pappa E., Grigoras C., Mylonas D., Karavasilis E., Velonakis G., Kelekis N. & Smyrnis N. 2019. Hypo-activity of the dorsolateral prefrontal cortex relates to increased reaction time variability in patients with schizophrenia. *NeuroImage: Clinical* **23**: 101853.

Penner-Wilger M., Leth-Steensen C. & LeFevre J.-A. 2002. Decomposing the problem-size effect: A comparison of response time distributions across cultures. *Memory & Cognition* **30**(7): 1160–1167.

Spangler D.P., Cox K.R., Thayer J.F., Brooks J.R. & Friedman B.H. 2021. Interplay between state anxiety, heart rate variability, and cognition: An ex-Gaussian analysis of response times. *International Journal of Psychophysiology* **159**: 60–70.

Thomson P., Johnson K.A., Malpas C.B., Efron D., Sciberras E. & Silk T.J. 2021. Head motion during MRI predicted by out-of-scanner sustained attention performance in attention-deficit/hyperactivity disorder. *Journal of Attention Disorders* **25**(10): 1429–1440.

Vaurio R.G., Simmonds D.J. & Mostofsky S.H. 2009. Increased intra-individual reaction time variability in attention-deficit/hyperactivity disorder across response inhibition tasks with different cognitive demands. *Neuropsychologia* **47**(12): 2389–2396.

Zandbelt B. 2014. exgauss: a MATLAB toolbox for fitting the ex-Gaussian distribution to response time data (Version 2). *figshare*.

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