

An Indian-Australian research partnership

Project Title:

Project Number

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IITB Department:

Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST one. For more information, see www.iitbmonash.org)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

Define the problem

Cognitive flexibility is a higher-order cognitive skill contributing to the elicitation of goal-directed behaviour and is associated with individual ability to adjust one's behaviour according to a changing environment. In the psychology literature, cognitive flexibility has been theoretically and empirically linked to information processing and response generation skills critical in decision-making. Thus, cognitive flexibility is involved in processing and incorporation of feedback based on accumulated experience, and thereby is associated with the ability of an individual to adapt one's own mental (cognitive) strategies as per the requirement to face new and unexpected situations in the environment.

Similarly, cognitive flexibility enables people to look at any task or problem from multiple viewpoints and this helps them to effectively interpret situational changes in the environment and managing the contradictory demands of the multiple stakeholders.

The developmental neuroscience body of literature associates cognitive flexibility with a range of contributing cognitive processes, including salience detection & attention, working memory, inhibition, and switching. As suggested by Dajani and Uddin (2015), in changing environments, individuals face the task of first identifying how the surroundings have changed; if the previous strategies do not work in the new environment, individuals have to inhibit previous responses and reconfigure a new strategy to attain context-specific goals; Individuals should be able to use existing information and manipulate it in real time to flexibly switch responses from one scenario to another, while retraining the information about the scenarios and their effectiveness in working memory.

Multiple studies demonstrate a crucial role of cognitive flexibility to success both in the classroom settings and in everyday life decision-making. Specifically, high cognitive flexibility is associated with patience, more long-term orientation and risk assessment, decision making in day-to-day life, and thus has a highly significant implication on wellbeing. On the other hand, cognitive inflexibility has been associated with poor ability to cope with the changing demands of the everyday life, poor academic success, difficulties in socialisation, as well as with a range of clinical conditions, including autism spectrum disorder, attention deficit hyperactivity disorder, and obsessive-compulsive disorder (Dajani and Uddin, 2015)

Past research demonstrated the success of cognitive interventions for improving cognitive flexibility for different age groups (Diamond & Lee, 2011; Kueider et al., 2012), including such interventions as aerobic exercise (Young et al., 2015), mindfulness and mediation practices (Moore & Malinowski, 2009).

This study will examine the ways of enhancing cognitive flexibility via interventions built on Yoga-based practices.

Yoga represents an ancient contemplative practice with its history dating back to over 3500 years. It aims to alleviate suffering and promote optimal physical and mental thriving (Cope, 1999; Feuerstein, 2011). Early teachings on Yoga emphasized on developing harmony with nature and maintain cordial personal relationships. Sage Patanjali gave a "eight-limbed" structure to the yogic path and led to Yoga attain its classical form, known as Ashtanga Yoga (Feuerstein, 2013). This Classical Yoga based on its eight-fold path represents a comprehensive and an integrative system. Ashtanga Yoga with a focus on the physical, mental, emotional and spiritual well-being of an individual comprise of the following eight practices:

- Yama: moral codes or ethics with respect to others
- Niyama: self-purification or ethics with respect to self
- Asana: postures
- Pranayama: breath regulation
- Pratyahara: sensory withdrawal
- Dharana: concentration
- Dhyana: meditation
- Samadhi: self-transcendence

We hypothesize a positive impact for Yoga Based Practices on cognitive flexibility. Yoga based practices regulate the activities of the mind field, promoting the equanimity of mind. That, in turn, is likely to result in decentering or psychological distancing from one's thoughts and emotions. Distancing makes psychological and cognitive resources available to reflect on the problem more, and flexibility to look at the problem from multiple perspectives (cognitive flexibility). A Yoga Protocol will include body movement, body tapping, pranayama like Bharstika, Kapalbhathi, Anulom-Vilom, Pran Sadhana (attention to alternate nostrils and nasal passage while breathing), body scan and meditation by

focusing on breath. This protocol takes about 25 minutes to complete.

We will examine the impact of Yoga based practices through psychometric assessment (e.g., International Personality Item Pool, Rumination-Reflection Questionnaire AND/OR the Perseverative Thinking Questionnaire, Non-attachment measure, Mindfulness questionnaire, Depression, anxiety and stress scale), as well as with physiological and neurological data using EEG and the tasks that focus on cognitive flexibility (the Wisconsin Card Sorting Task),

The Wisconsin Card Sort Task (WCST) is used to measure the cognitive flexibility. To be brief, the task requires participants to sort cards under three possible categories, based on characteristics of the images presented on the cards (i.e., colour, shape, and number). Through trial and error learning, participants determine what category they are required to sort the cards. Once participants get 10 correct in a row, the category that participants need to sort is changed to something else, and participants are required to adapt to this change by learning what the new category is. This task reports to present with predictable brain activity, specifically the frontal P2, parietal P3b, and occipital P1 brain event-related potentials, or brain waves (see Nyhaus & Barceló, 2009). Muse 2 EEG device <https://choosemuse.com/muse-2/> will be used for the study.

References

Dajani, D. R., & Uddin, L. Q. (2015). Demystifying cognitive flexibility: implications for clinical and developmental neuroscience. *Trends in Neurosciences*, 38(9), 571-578.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, 333(6045), 959-964.

Feuerstein, Georg. *The Psychology of Yoga*. Shambhala. 2013

Kueider, A. M., Parisi, J. M., Gross, A. L., & Rebok, G. W. (2012). Computerized cognitive training with older adults: a systematic review. *PloS one*, 7(7), e40588.

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and cognition*, 18(1), 176-186.

Nyhaus, E., & Barceló, F. (2009). The Wisconsin card sorting test and the cognitive assessment of pre-frontal executive functions: a critical update, *Brain and Cognition*, 71, 437-451.

Young, J., Angevaren, M., Rusted, J., & Tabet, N. (2015). Aerobic exercise to improve cognitive function in older people without known cognitive impairment. *Cochrane Database of Systematic Reviews*, (4).

Project aims

Define the aims of the project

To study the impact of Yoga Based Practices on Cognitive Flexibility

Expected outcomes

Highlight the expected outcomes of the project

The proposed study is designed to test the immediate and long-term effect of Yoga Based Practices on Cognitive Flexibility which has direct impact on human decision making and wellbeing.

The current study will be useful to unravel the benefits of Yoga at cognitive and emotional level. The findings of the study can be useful to the policy makers as well for strengthening the success of the educational and competence building programs imparted to youth population in India via incorporating Yoga as a part of those programs. As such, the project will be of interest to educators and policy makers.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

This project proposal is being submitted under the theme of Humanities and Social Sciences and the

cluster of HSS, Design, and Management. The tentative steps towards achieving the goals are as follows:

1. Extended literature review and finalization of the survey instruments
2. Ethics committee approval for experiment to test the short term and long term impact of Yoga based practices on cognitive flexibility
3. Pilot study
4. Analysis of the pilot study
5. Recruitment of the participants for main study in control group, experiment group and active control group
6. Conducting the experimental study
7. Analysis
8. Report writing

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

Master Degree in Psychology/ Management / Yoga Science

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

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Apart from a PhD degree in Economics (2005) and a PhD in Information Systems / Risk Management (2010), Dr Kristian Rotaru holds a Graduate Diploma in Psychology (2017) and a Bachelor of Science (with Honours in psychology, 2018), both from Monash University.

Dr Kristian Rotaru is a visiting researcher at the Brain and Mental Health Lab, Monash University (<http://bmh.org.au/people/kris-rotaru>), where he investigates neurocognitive and functional correlates of

addiction, and works on designing and testing interventions for behavioural change.

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Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Psychology