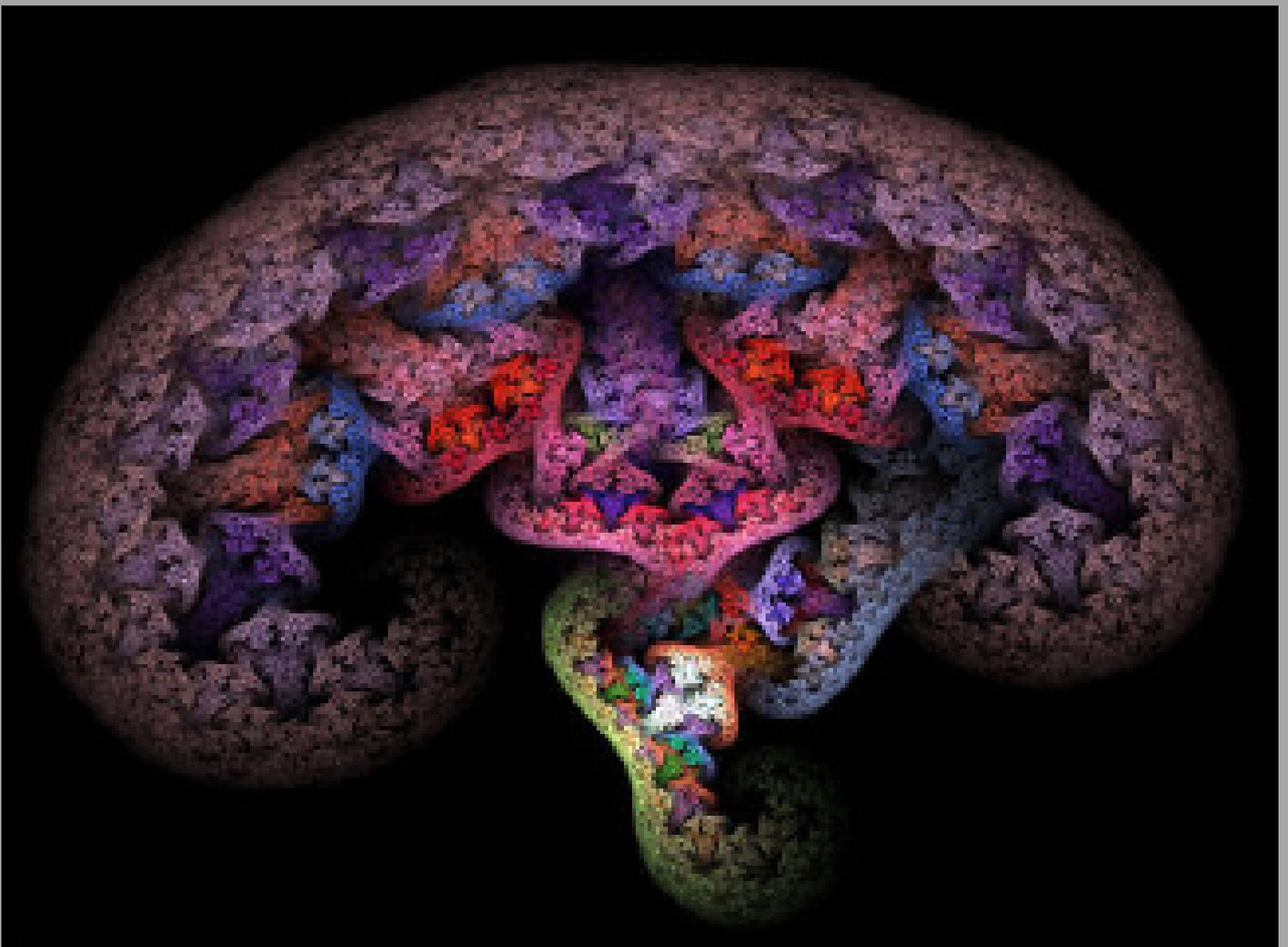


PSYCHOLOGY AND COGNITIVE SCIENCES

Open Journal 

August, 2015 • Volume 1, Issue 1



Editor-in-Chief : Donald M. Hilty, MD

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Volume 1 : Issue 1

Article Ref. #: 1000PCSOJ1e001

Article History:

Received: April 27th, 2015

Accepted: April 27th, 2015

Published: April 28th, 2015

Citation:

Hilty DM. Advancing science, clinical care and education: shall we update engel's biopsychosocial model to a Bio-psycho-socio-cultural model? *Psychol Cogn Sci Open J*. 2015; 1(1): e1-e6.

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Advancing Science, Clinical Care and Education: Shall we Update Engel's Biopsychosocial Model to a Bio-Psycho-Socio-Cultural Model?

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ABBREVIATIONS: BPS: Biopsychosocial; TRP: Tryptophan; DSM-III: Diagnostic, Statistical Manual Third Edition; OCF: Outline for Cultural Formulation; APA: American Psychiatric Association; CFI: Cultural Formulation Interview; BPSC: Bio-psycho-socio-cultural.

OVERVIEW

Psychology and Cognitive Sciences attempts to lead, organize and contribute to the study of mind and intelligence, including memory, emotions, conceptual development and decision-making. It therefore draws on the fields of psychology, philosophy, neuroscience, mathematics, computer science and linguistics. The primary scope, accordingly, involves human behavior, cognition, emotions, and intelligence. As we move forward with this scope, we have the option to narrow or expand it, based on the evolution of the fields, readers' preferences, and in how much we want to entertain applications of this work. In the latter case, one potential secondary scope is how we apply this science to other areas of science, to training and education paradigms, or even clinical populations – this may occur *via* rich, contextualized narratives that capitalize on qualitative methodology to generate hypotheses that can be further explored. Natural extensions to this primary scope are bio and health informatics, but perhaps education and training of workforce and the next generation of scientists would be suitable, too. This editorial on the Biopsychosocial Model - an update suggested on it - shows the primary and potential secondary scopes of the *Journal*.

MODELS, THEORIES AND APPROACHES: THE CASE OF THE BIOPSYCHOSOCIAL MODEL

Engel's article on the Biopsychosocial (BPS) Model in medicine¹ and the follow-up clinical application of the Model was rooted in the attempt to "educate a truly scientific physician ... closer to reality". Its roots summarize a long movement over time related to the Flexner report on standards for medical education and practice.^{2,3} The Model also attempted to shift clinicians from a purely "Biomedical Model" to one that had more of a systems approach and included contributions from behavioural science, cognitive science, neurobiology, medical sociology and health psychology.^{4,5} One of the limitations of the biomedical approach was separation of the mind from the body, with most focus on the latter. Those who posited psychosomatic medicine as an integrative approach linked the *psyche* (mind) and *soma* (body), but not in a comprehensive way.

The systems theory of biology was used by Engel to move beyond a reductionist approach, in which the hierarchy represents and organized dynamic whole with distinctive properties and characteristics (e.g. cell). The figures depicted a continuum from biosphere to subatomic particle/molecule. The focus, accordingly, was the person and the two-person system (doctor and patient) not the disease. The case example of Mr. G. in a subsequent paper (Engel,

1980) included the biomedical *and* the psychological and interpersonal aspects. Psychiatry in the 1970s was evolving quickly, but it was burdened by competing psychoanalytic and biomedical potential directions of the field. In a way, the Model was a compromise of views, and Engel believed that, “*How physicians approach patients and the problems they present is much influenced by the conceptual Model around which their knowledge is organized*” (Engel, 1980). Therefore, this Model is an approach to patient care.

Engel believed the Model enhanced collaboration, communication and complementarity among the various health professions, and he urged educators to develop curricula based on this Model. It has helped with “bedside manner” more than advancing social scientific knowledge on the central practices of diagnosing and treating patients.⁶ As still new specialties evolve, the Model is a main theoretical foundation for many undergraduate medical education institutions.⁷ In a survey of the 118 US medical schools (1997-1999), 41% indicated that they provide teaching on topics related to the BPS Model (e.g. psychosocial factors 80-93%, cardiovascular 83%, doctor – patient communication 98%) and on average, BPS topics amounted to 10% of all the curricula.⁸ Obstacles were limited resources, resistance by students and faculty, and lack of continuity of courses.

The integration of the BPS Model into clinical medicine has been less, but partially successful, related to integrated care Models in pain clinics and medical-psychiatric units in the US. In psychosomatic units in Germany, as well as in departments of internal medicine, BPS assessment instruments have been used in standard cases (e.g. the Intermed method).⁷ At the Medical School, University of Berne, a program trained residents in integrated BPS internal medicine for patient care.⁹ Follow-up at 5-28 years has shown that these residents now working as general practitioners and general internists still practice the integrated approach, demonstrate higher skill in diagnosing psychophysiological disorders, and work at lower costs than the physicians controls.¹⁰ A BPS curriculum is in place at all of the five Swiss medical schools, with 360 hours spaced over 3 years.⁷

Is the BPS Model Really a Model?

Models are absolutely fundamental to the progress of science, but it is surprising when we realize just how little of the philosophical work on defining what a Model is or what it does, has percolated through to the scientific literature.¹¹ The main definition of a Model is usually a simplified representation or description of a system or complex entity, especially one designed to facilitate calculations and predictions. Two definitions of “Models” are commonly referred to, the first being modest, as a Model is the practical means of matching a theory to reality. A theory is a broad, general statement, while the Model of the theory is the actualization of the theory, the truncated theory at work or its work under an assumption as to how things are. Generally, a theory is testable from a purely scientific point-of-view and a Model is not. Nonetheless, some testing of the BPS Model is occurring (e.g. dementia).¹²

Limitations, problems and weaknesses of the BPS Model have been more recently argued that while it has heuristic value, it is as if “anything goes” with this Model.¹³ They have questioned if it is a Model, since Models maybe specific (e.g. hypotheses) components of a paradigm or broader like a paradigm itself.¹³ Indeed, the authors place the Model in even broader context, by going back to the work of Adolf Meyer, Roy Grinker, and the Diagnostic, Statistical Manual Third Edition (DSM-III) and Thomas Kuhn.¹⁴⁻¹⁶ This contextualization also highlights the competing points-of-view – including Darwinian, pragmatism, integrationism, and pluralism – and cautions against biological dogmatism as recent advances in neurosciences and genomics could shift any Model out of balance, or as some complained in the past, shifting the BPS Model for one example to the “bio-Bio-social Model.” One conclusion was that the “pluralistic approach can allow us to avoid the vagaries of eclecticism and rise beyond the simple-minded dogmas that have been, and continue to be, the bane of true progress in this complex discipline”.¹³

SHOULD THE MODEL BE UPDATED, CHANGED OR WHAT?

A new Model? The Bio-psycho-socio-cultural (BPSC) Model has been suggested, with an expanded definition and delineation of culture and diversity components.^{17,18} Culture itself and its elements now include race, ethnicity, spirituality, religion, sexual preference, gender identity, geography (urban, rural, global), special populations (e.g. incarcerated) and language;^{19,20} others add socioeconomics, education and other parameters. Emergence of culture as central to care is not new,²¹ but its central role in facilitating patient-centered care is new to many.¹⁸ It is well known that ethnic minorities face barriers to mental healthcare globally. Care is patient-centered when we ask patients to explain their illness/suffering, why they think it is occurring, how their social group understands/explains it, standard/alternative approaches to care, and how their culture affects the doctor-patient relationship. The Outline for Cultural Formulation (OCF),²² Cultural Formulation Interview²³ and the CFI Supplementary Modules²⁴ help clinicians with questions to ask about, and more broadly, gain perspective on the complexities involved.

An updated Model? There are many new findings in neuroscience, genomics/genetics, and developmental psychology/biology.¹⁷ Updates on the BPS Model may include biological concepts like the stress – diathesis Model, which suggests that a biological-

ly driven (genetic) predisposition interacting with environmental factors produces an individual's phenotype. A detailed integrated Biopsychosocial/psychobiological Model might explain how such factors interact to lead to major mental illnesses like depression²⁵ and schizophrenia.²⁶ Traditionally, the hypothalamic-pituitary-adrenal (HPA) axis activation in response to environmental stress (often chronic) is discussed. Slices of new science explain depression resulting from Interferon (IFN- α therapy for hepatitis C, which increases the activity of Indoleamine 2, 3-dioxygenase (IDO; a Tryptophan (TRP)-catabolizing enzyme) which presumably depletes TRP.²⁷ Early diagnosis and intervention studies related to psychosis in children and adolescents are a meaningful advance.²⁸

Psychology and Cognitive Sciences – what can we emphasize or contribute? Some of the top discoveries since 2000 in science directly relate to the Journal's scope and some of these are worthy of being incorporated in a new Model:

- 2001: The first draft of the human genome
- 2003: The Poincaré Conjecture (Perelman) a theorem about the characterization of the 3-sphere, which is the hypersphere that bounds the unit ball in four-dimensional space, which states that every simply connected, closed 3-manifold is homeomorphic to the 3-sphere
- 2006: Shinya Yamanaka generates first induced pluripotent stem cells
- 2010: J. Craig Venter Institute creates the first synthetic genome for a bacterial cell
- 2012: Higgs boson discovery at CERN, an elementary particle in the Standard Model of particle physics. It allows scientists to explore the Higgs field – a fundamental field first suspected to exist in the 1960s that unlike the more familiar electromagnetic field cannot be “turned off”, but instead takes a non-zero constant value almost everywhere.
- 2012: Photonic molecules are discovered at MIT
- 2014: Exotic hadrons are discovered at the LHCb (subatomic particles composed of quarks and gluons, but which do not fit into the usual scheme of hadrons. While bound by the strong interaction they are not predicted by the simple quark Model)

A shifted or differentially weighted Model? A Model with a *shifted* emphasis would be the findings from dynamic non-linear systems, which apply to networks of a large quantity of densely interconnected elements – or complex systems like the mind or the brain. Vulnerability or predisposition to imbalance may arise between activating and inhibiting interactions, (between some cognitions and emotions at a mental level, and between certain neuronal groups at a cerebral level).²⁹ A Model with *additional* emphasis would be the Biopsychosocial-spiritual (BPSS) Model showing extrinsic and intrinsic factors that influence behavioural responses requiring clinical attention. Collectively, these factors provide a more holistic approach to the assessment of patterns, trends, and dynamic reciprocity between issues (e.g. pain and treatment methods).³⁰

WHAT DO WE DO WITH SUCH A 'MODEL' TODAY?

The BPSC Model is a step toward culturally competent care – based on linguistic, cultural *and* racial concordance – which seems fitting in terms of patient-centered care (IOM) and clinician/learner-centered education for clinical care. By the year 2050, minorities will constitute 54% of the US. population; by 2023, one-half of all children will be minority group members.^{31,32} Such care facilitates patient and provider satisfaction and is associated with better patient adherence to treatment and higher patient and provider satisfaction.³³⁻³⁷ Overall, perhaps we are adding more Psychosociocultural (PSC) perspective to medicine and more biological perspective to the social sciences; some of our fields may benefit from input from both.

Another issue is that language barriers alone are associated with lower rates of patient satisfaction, poor care delivery,^{38,39} and less trust in their providers.⁴⁰ The use of professional interpreters is associated with improved clinical care and patient satisfaction more than is use of ad hoc interpreters,⁴¹ but overall, the presence of a third person (i.e., an interpreter) in a confidential relationship changes things. It influences both transference and countertransference between individuals involved, with unavoidable consequences on a doctor-patient relationship.⁴² Mistakes in interpretation (omissions, distorted questions, additions) occur frequently when staff and nurses (reliability, missed contexts), family (patient and their views) and other non-trained interpreters are used.⁴³⁻⁴⁵

The concordance for culturally competent care is rarely possible, but videoconferencing and other e-mental health options may help.⁴⁶⁻⁴⁸ The use of a non-primary, shared language (e.g. a third language shared by both patient and clinician when neither's primary language can be used), is advocated in some parts of the world, like Europe. This is not often available, either, in developing or third world countries⁴⁹ and e-health (e.g. web and Internet-based) options are being explored across the world. Globally, Africa, the Middle East, and Latin America are the fastest growing populations in terms of Internet usage.⁵⁰⁻⁵¹ In the United States, as of January of 2014, 90% of adults have a cell phone and 58% have a Smartphone.⁵²

CONCLUSIONS

Psychology and Cognitive Sciences expertise draws on the fields of psychology, philosophy, neuroscience, mathematics, computer science and linguistics. There are many applications of this science to other walks of life – from other areas of science, to training and education, clinical populations and still others. A new Biopsychosociocultural Model exemplifies this application, capitalizing on the *Journal's* primary and potential secondary scopes.

REFERENCES

- Engel GL. The Need for a New Medical Model: A Challenge for Biomedicine. *Science*. 1977; 196(4286): 129-136. doi: [10.1126/science.847460](https://doi.org/10.1126/science.847460)
- Flexner A. Medical Education in the United States and Canada: A Report of the Carnegie Foundation of the Advancement of Teaching. Bulletin 4. Boston, MA, USA: Updyke; 1910.
- Engel GL. Biomedicine's Failure to Achieve Flexnerian Standards of Education. *J Med Educ*. 1978; 53: 387-392.
- Engel GL. A Unified Concept of Health and Disease. *Perspect Biol Med*. 1960; 3: 459-485. doi: [10.1353/pbm.1960.0020](https://doi.org/10.1353/pbm.1960.0020)
- Engel GL. The Biopsychosocial Model and the Education of Health Professionals. *Ann NY Acad Sci*. 1978; 21; 310: 169-187.
- Wasserman JA. On Art and Science: An Epistemic Framework for Integrating Social Science and Clinical Medicine. *J Med Philos*. 2014; 39: 279-303. doi: [10.1093/jmp/jhu015](https://doi.org/10.1093/jmp/jhu015)
- Adler RH. Engel's Biopsychosocial Model is Still Relevant Today. *J Psychosom Res*. 2009; 67(6): 607-611. doi: [10.1016/j.jpsychores.2009.08.008](https://doi.org/10.1016/j.jpsychores.2009.08.008)
- Waldstein SR, Neumann SA, Drossman DA, et al. Teaching Psychosomatic (Biopsychosocial) Medicine in United States Medical Schools: Survey Findings. *Psychosom Med*. 2001; 63: 335-343.
- Adler RH. Five- To Twenty-Eight Years Follow-Up of 99 Residents Trained in Biopsychosocial Internal Medicine. *Psychother Psychosom*. 2008; 77: 126-127.
- Adler RH, Minder CE. Clinical Competence of Biopsychosocially Trained Physicians And Controls. *Swiss Med Wkly*. 2012; 142: w13649. doi: [10.4414/smw.2012.13649](https://doi.org/10.4414/smw.2012.13649)
- McLaren N. A Critical Review of the Biopsychosocial Model. *Aust N Z J Psychiatry*. 1998; 32: 86-92. doi: [10.3109/00048679809062712](https://doi.org/10.3109/00048679809062712)
- Clare L, Nelis SM, Martyr A, et al. The Influence of Psychological, Social and Contextual Factors on the Expression and Measurement of Awareness in Early-Stage Dementia: Testing A Biopsychosocial Model. *Int J Geriatr Psychiatry*. 2012; 27(2): 167-177. doi: [10.1002/gps.2705](https://doi.org/10.1002/gps.2705)
- Ghaemi SN. Paradigms of psychiatry: eclectic and its discontents. *Curr Opin Psychiatry*. 2006; 19: 619-624. doi: [10.1097/01.yco.0000245751.98749.52](https://doi.org/10.1097/01.yco.0000245751.98749.52)
- Kuhn T. The Structure of Scientific Revolutions. Chicago, ILL, USA: University of Chicago Press; 1962 [1996].
- Grinker RR Sr. In Memory of Ludwig von Bertalanffy's Contribution to Psychiatry. *Behav Sci*. 1976; 21: 207-208. doi: [10.1002/bs.3830210402](https://doi.org/10.1002/bs.3830210402)
- Ghaemi SN. The Concepts of Psychiatry: A Pluralistic Approach to The Mind and Mental Illness. Baltimore, MD, USA: Johns Hopkins University Press; 2003.

17. Hilty DM, Ton H, Lu F, et al. Revising Engel's Biopsychosocial Model to the Biopsychosocialcultural Model? Suggestions and Implications. Keystone, CO, USA: American Directors of Medical Student Education in Psychiatry; 2014A.
18. Hilty DM. Educational Reform: Engel's Biopsychosocial Model for Medical Student Education. Keystone, CO, USA: American Directors of Medical Student Education in Psychiatry; 2014B.
19. Lu F. Cultural Issues in DSM-5: A Roadmap. Chicago, ILL, USA: AAP Bulletin; 2013.
20. Lim RF, Lu F. Culture and psychiatric education. *Academic Psychiatry*. 2008; 32: 269-271.
21. Office of the Surgeon General (US); Center for Mental Health Services (US); National Institute of Mental Health (US). Mental Health: Culture, Race, and Ethnicity: A Supplement to Mental Health: A Report of the Surgeon General. Rockville (MD): Substance Abuse and Mental Health Services Administration (US); 2001 Aug. Chapter 4 Mental Health Care for American Indians and Alaska Natives. Website: <http://www.ncbi.nlm.nih.gov/books/NBK44242/> Accessed April 1, 2015.
22. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Text Revision, 4th Edition, Outline for Cultural Formulation. Washington, DC, USA: American Psychiatric Publishing; 2000.
23. American Psychiatric Association, Cultural Formulation Interview Supplementary Modules, 2013. Website: http://www.multiculturalmentalhealth.ca/wp-content/uploads/2013/10/2013_DSM5_CFI_InformantVersion.pdf Accessed April 1, 2015.
24. APA Cultural Formulation Interview, 2013. Patient Version. Website: <http://www.dsm5.org/Pages/Feedback-Form.aspx> and Informant Version, at: http://www.multiculturalmentalhealth.ca/wp-content/uploads/2013/10/2013_DSM5_CFI_InformantVersion.pdf Accessed April 1, 2015.
25. Plotsky PM, Owens MJ, Nemeroff CB. Psychoneuroendocrinology of Depression. Hypothalamic-pituitary-adrenal Axis. *Psychiatr Clin North Am*. 1998; 21(2): 293-307. doi: [10.1016/S0193-953X\(05\)70006-X](https://doi.org/10.1016/S0193-953X(05)70006-X)
26. Zubin J, Spring B. Vulnerability – a New View of Schizophrenia. *J Abnorm Psychol*. 1977; 86: 103-126. doi: [10.1037/0021-843X.86.2.103](https://doi.org/10.1037/0021-843X.86.2.103)
27. Baranyi A1, Meinitzer A, Stepan A, et al. A Biopsychosocial Model of Interferon-Alpha-Induced Depression in Patients With Chronic Hepatitis C Infection. *Psychother Psychosom*. 2013; 82(5): 332-340.
28. Shoemaker EZ, Tully LM, Niendam TA, et al. The Next Big Thing in Child and Adolescent Psychiatry: Interventions to Prevent and Intervene Early in Psychiatric Illnesses. *Psychiatric Clinics of North America*. In Press.
29. Garcia-Toro M, Aguirre I. Biopsychosocial Model in Depression Revisited. *Med Hypotheses*. 2007; 68(3): 683-691. doi:[10.1016/j.mehy.2006.02.049](https://doi.org/10.1016/j.mehy.2006.02.049)
30. Matteliano D, St Marie BJ, Oliver J, et al. Adherence monitoring with chronic opioid therapy for persistent pain: a biopsychosocial-spiritual approach to mitigate risk. *Pain Manag Nurs*. 2014; 15(1): 391-405. doi: [10.1016/j.pmn.2012.08.008](https://doi.org/10.1016/j.pmn.2012.08.008)
31. Shrestha LB, Heisler EJ. The Changing Demographic Profile of the United States. Washington, DC, Congressional Research Service; 2011. Website: <http://fas.org/sgp/crs/misc/RL32701.pdf> Accessed April 1, 2015.
32. United States Census Bureau. An Older and More Diverse Nation by Midcentury [press release]. 2008. Website: <http://www.census.gov/newsroom/releases/archives/population/cb08-123.html> Accessed February 28, 2015.
33. Freeman GK, Rai H, Walker JJ, et al. Non-English Speakers Consulting With the GP in Their Own Language: A Cross-Sectional Survey. *Br J Gen Pract*. 2002; 52: 36-38.
34. Pochhammer F. Language barriers in Vienna hospitals. *Ethn Health*. 2000; 5: 113-119.
35. Saha S, Komaromy M, Koepsell TD, et al. Patient-physician Racial Concordance and the Perceived Quality and Use of Health

- Care. *Arch Intern Med.* 1999; 159: 997-1004. doi: [10.1001/archinte.159.9.997](https://doi.org/10.1001/archinte.159.9.997)
36. Brown S. *Language Barriers in Access to Health Care.* Ottawa, Ontario, Canada: Health Canada; 2001.
37. Perez-Stable EJ. Language Access and Latino Health Care Disparities. *Med Care.* 2007; 45: 1009-1011.
38. Carrasquillo O, Orav EJ, Brennan TA, et al. Impact of Language Barriers on Patient Satisfaction in an Emergency Department. *J Gen Intern Med.* 1999; 14: 82-87.
39. Sarver J, Baker DW. Effect of Language Barriers on Follow-Up Appointments after an Emergency Department Visit. *J Gen Intern Med.* 2000; 15(4): 256-264. doi: [10.1111/j.1525-1497.2000.06469.x](https://doi.org/10.1111/j.1525-1497.2000.06469.x)
40. Mutchler JE, Bacigalupe G, Coppin A, Gottlieb A. Language Barriers Surrounding Medication Use Among Older Latinos. *J Cross Cult Gerontol.* 2007; 22: 101-114.
41. Karliner LS, Jacobs EA, Chen AH, et al. Do Professional Interpreters Improve Clinical Care for Patients With Limited English Proficiency? A Systematic Review of the Literature. *Health Services Health Serv Res.* 2007; 42(2): 727-754. doi: [10.1111/j.1475-6773.2006.00629.x](https://doi.org/10.1111/j.1475-6773.2006.00629.x)
42. Spiegel JP. Cultural Aspects of Transference and Counter transference Revisited. *J Am Acad Psychoanal.* 1976; 4: 447-467.
43. Brua C. Role-blurring and Ethical Grey Zones Associated with Lay Interpreters: Three Case Studies. *Communication Med.* 2008; 5(1): 73.
44. Brooks TR. Pitfalls in Communication with Hispanic and African-American Patients: Do Translators Help or Harm? *J Nat Med Asso.* 1992; 84(11): 941.
45. Elderkin-Thompson V, Silver RC, Waitzkin H. When Nurses Double as Interpreters: A Study of Spanish-Speaking Patients in a US Primary Care Setting. *Soc Sci Med.* 2001; 52: 1343-1358. doi: [10.1016/S0277-9536\(00\)00234-3](https://doi.org/10.1016/S0277-9536(00)00234-3)
46. Mucic D, Hilty DM, Yellowlees PM. Telemental Health For Cross Cultural Populations World Wide. In Mucic D, Hilty DM, eds. *Key Issues in e-Mental Health.* Basel, Switzerland: Karger Publishing; In Press.
47. Yellowlees P.M., D.M. Hilty, Mucic D. Global/World Wide Telehealth: International Perspectives of Telepsychiatry and the Future. In: Mucic D, Hilty DM, eds. *Key Issues in e-Mental Health.* Basel, Switzerland: Karger Publishing; In Press.
48. Hilty DM, Ferrer D, Callahan EJ, et al. The Effectiveness of Telemental Health: A 2013 Review. *Tel J e-Health.* 2013; 19(6): 444-454. doi: [10.1089/tmj.2013.0075](https://doi.org/10.1089/tmj.2013.0075)
49. Riddick S. Improving Access for Limited English-Speaking Consumers: A Review of Strategies in Health Care Settings. *J Health Care Poor Underserved.* 1998; 8: S40-S61. doi: [10.1353/hpu.2010.0672](https://doi.org/10.1353/hpu.2010.0672)
50. Internet World Stats. Internet Users in the World-Distribution by World Regions, 2011A. At: <http://www.internetworldstats.com/stats.htm> Accessed April 1, 2015.
51. Internet World Stats. United States of America: Internet Usage and Broadband Usage Report, 2011B. Website: <http://www.internetworldstats.com/am/us.htm> Accessed February 28, 2015.
52. PEW Research Center, Internet Survey, 2013. Website: http://www.pewinternet.org/~media/Files/Reports/PIP_HealthOnline.pdf or smart phone information available at: <http://www.pewinternet.org/data-trend/mobile/cell-phone-and-smartphone-ownership-demographics/> Accessed April 1, 2015.

Research

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Volume 1 : Issue 1

Article Ref. #: 1000PCSOJ1101

Article History:

Received: December 5th, 2014

Accepted: February 3rd, 2015

Published: February 5th, 2015

Citation:

Koval SR, Todman McW. Induced boredom constrains mindfulness: an online demonstration. *Psychol Cogn Sci Open J*. 2015; 1(1): 1-9.

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Induced Boredom Constrains Mindfulness: An Online Demonstration

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ABSTRACT

Background: Boredom and mindfulness have long been considered to be incompatible psychological states. The latter state has been associated with a variety of psychological benefits, whereas the former has tended to be associated with far less positive outcomes and conditions, such as substance abuse and Attention-Deficit/Hyperactivity Disorder (ADHD).

Method: In an effort to empirically validate the presumed inverse relationship between state boredom and state mindfulness, an online sample (n=95) was recruited via Amazon's Mechanical Turk web-based service and randomly assigned to either an online Vowel Cancellation task condition or an online Reading Task condition (control). An online assessment of state mindfulness was conducted immediately following the assigned task.

Results: As predicted, the boredom-induced individuals were found to report significantly lower levels of mindfulness than participants in the control group. Moreover, even though the entire study was conducted over the internet and involved no face-to-face contact with the study personnel, the online boredom induction procedure appeared to perform as intended. This was confirmed by the results on the standard manipulation check, the significantly higher scores of the boredom-induced individuals on the Multidimensional State Boredom Scale (MSBS),¹ and the significantly higher dropout rate in the boredom induction condition.

Conclusions: This is the first study that the authors are aware of that has been able to provide empirical evidence of a dynamic, inverse relationship between the psychological states of boredom and mindfulness. It is also the first study to report the successful induction of boredom using an online methodology. The clinical and methodological implications are discussed.

KEYWORDS: Boredom; Mindfulness; Online boredom induction.

INTRODUCTION

The concept of mindfulness was codified in the 3rd century BC by Buddhist scholars and meditation teachers. These Theravada Abhidhamma texts define it as, "presence of mind, attentiveness to the present."² More contemporary attempts to characterize mindfulness have provided somewhat more elaborate descriptions but ultimately differ more in terms of emphasis than on substance. For example, Lazar describes mindfulness as a meditative state in which there is an active "exploration of the distractions to concentration, such as sensations, thoughts and feelings,"³ a definition that is not too different from those⁴ who describe mindfulness as open, receptive, undivided awareness and attention to internal and external experience in the present moment.

Minor definitional differences notwithstanding, there is now a substantial body of evidence to suggest that mindfulness is associated with a host of beneficial physical and psychological effects, including measurable reductions in levels of anxiety, depression and even subjective pain.⁵ As a consequence, there has been a corresponding interest among clinicians and researchers in the therapeutic potential of mindfulness in the promotion of psychological

and physical well-being.

Interest in boredom has also increased over the last several years, especially with respect to its growing list of associated liabilities. Indeed, it has not gone unnoticed that boredom, both a trait and state, appears to be the antithesis of mindfulness. Whereas, mindfulness is known to promote subjective wellbeing and to mitigate a number of negative states, boredom and the propensity to become bored appear to promote the opposite. Moreover, in contrast to the definition of mindfulness, many of the definitions of boredom describe a state in which distractions to concentration are not only unrecognized, they are in fact deliberately and effortfully resisted at the cost of increasing levels of subjective distress.^{6,7-9}

Despite this apparent inverted relationship between the conceptual and empirical corollaries of mindfulness and boredom there has been a surprising lack of interest in empirically examining the presumed relationship between the two. This is unfortunate, especially since the capacity for mindfulness through training and practice can be enhanced in most individuals, thus raising the possibility that mindfulness training might also increase the capacity to cope with boredom and by extension forestall some of its attendant negative consequences. The current study was an attempt to address this oversight using a web-based platform to examine the relationship between state mindfulness and induced boredom in an online sample of participants. Importantly, we are unaware of any reports in the literature of previous attempts to induce boredom in participants in an online study. Thus an additional and secondary goal of the study was to examine the utility and effectiveness of a novel and potentially far more efficient approach to the induction of boredom states.

CORRELATES OF BOREDOM

Though long ignored, research of the last twenty years suggests that boredom and the propensity to become bored are associated with a number of social and psychological problems. For example, boredom proneness has been positively associated with measures of hopelessness,¹⁰ loneliness,¹⁰ hostility and anger,¹¹ anxiety,¹² somatization complaints¹³ decreased sexual satisfaction¹⁴ poorly developed interpersonal relationships,¹⁵ impulsiveness,¹⁶ lowered motivational orientation,¹⁰ lowered academic achievement,¹⁷⁻²⁰ poor performance in the workplace,^{21,22} job dissatisfaction^{21,22} increased levels of alcohol abuse,^{23,24} overeating,²⁵ pathological gambling,²⁶ drug use,¹⁹ psychotic symptoms,⁷⁻⁹ physical symptoms,¹¹ and depression.^{10,12,27}

Less clear, however, is the reason why boredom has proven to be such a powerful predictor of psychosocial dysfunction. One plausible explanation that has been frequently put forward is that attentional failure is a defining and necessary feature of the experience of boredom,²⁸⁻³¹ and it is this loss of attentional control that is at the core of many of the problems that have been found to be associated with boredom prone individuals.

ATTENTIONAL THEORIES OF BOREDOM

Attentional theories of boredom suggest that a disruption of attentional regulation is at the root of the experience of boredom.²⁸⁻³¹ Eastwood et al. for example, have proposed that boredom depends on three conditions: (1) An inability to successfully engage attention with internal or external environments in a sufficiently stimulating way; (2) awareness of that failure of attention, and; (3) the attribution of the aversive experience to the external environment. Todman^{7,9} has also emphasized the important role of attentional dyscontrol, but has argued that a more precise characterization must give prominence to the feelings of attentional constraint that are invariably experienced when the impulse to shift attention is persistently frustrated by an external or internal injunction that prohibits the desired shift.

It also seems that the attentional options matter when trying to cope with boredom. Even when the individual does not feel an obligation to remain attentive to an uninteresting task or stimulus, feelings of attentional constraint might obtain if the alternative attentional targets available to the individual are experienced as unappealing or unrewarding. In a compelling demonstration of this point, Critcher and Gilovich³² conducted a series of studies in which they manipulated the content of the mind-wanderings of the study participants and found that they were significantly more likely to report boredom with an ongoing task when their daydreams were about negative events, than when their minds wandered to positive or rewarding narratives. This finding underscores not only the importance of the broadened notion of attentional constraint but also the contention that boredom is an evolutionarily prepared signal that indicates that valuable attentional resources are being squandered on an activity or environment in which the potential for positive reinforcement has been depleted below a certain threshold.^{7,9} In short, for the feelings of boredom to be reduced or avoided, it is necessary that the shift in attention be directed to an alternative source of reinforcement that is construed as being potentially more positive in nature; something that can be accomplished by one of two strategies: (1) Changing the actual environment to one that is richer in potential positive reinforcement or; (2) Engaging the same environment differently in order to expose hitherto undiscovered sources of reinforcement. If this conjecture is accurate, then it makes sense that an experiential strategy that is described as being a mode of positively engaging the environment (i.e., mindfulness) is probably a desirable resource to have at ones disposal.

MINDFULNESS AND BOREDOM

Although the need for further research on the apparent association between the constructs of boredom and mindfulness has been proposed by a number of researchers,^{33,34} we have been able to identify only two such studies in a review of the recent literature. In the earlier of the two studies, Trunnell, et al³⁵ measured the effects of a mindfulness training class for college students registered for recreation and leisure classes such as kayaking, camping, and back packing skills. The authors reported

finding a greater decrease in boredom in the experimental group, which received a 10-minute mindfulness didactic, followed by 15-minutes of guided meditation, than in the control group, which received no mindfulness training. However, the authors did not measure boredom directly. Instead, they inferred its existence on the basis of a discriminant function analysis of the participants' responses on a modified version of Russell and McAuley's Causal Dimension Scale,³⁶ which contained a list 14 positive and 14 negative affects but made no reference to boredom. The authors conjectured that the constellation of affects contained in the predictive function could be reasonably construed as boredom.

In the second and more recent study, using two psychometrically valid measures—the Mindfulness Attention Awareness Scale (MAAS)⁴ and the Boredom Proneness Scale (BPS)³⁷, LePera found that the traits of boredom proneness (the propensity to become bored) and mindfulness are negatively correlated³⁸. However, the study focused exclusively on traits, rather than the actual states of boredom and mindfulness. Thus it remains unclear whether feelings of boredom can actually be mitigated by a state of mindfulness and *vice versa*. In order to more directly address this relationship, the present study examined the question of whether individuals subjected to a boring task would show lower state mindfulness scores compared to individuals in a control task.

METHODS

Participants

One hundred and sixteen participants were recruited from Amazon Mechanical Turk, a web based recruitment interface, to participate in “online research on the influence of different types of visual stimuli on learning styles.” Participants were compensated with a payment of 60 cents. While Mechanical Turk is largely considered to be a reliable and, in many ways, an advantageous source of data for social science research, precautionary exclusion criteria have been recommended to ensure the quality of data.³⁹ In the present study, data was excluded from analyses if the participant finished the study unusually quickly (time < 20 mins, n=1), took an unusually long amount of time to complete the study (time > 80 mins, n=3), or failed to correctly answer any of the four validation items¹ that were hidden among the scales and demographic questionnaire (validation score < 26, n=17).

¹The validation items included prompts such as “are you using the internet right now?” and “what is 3+3?” which were scaled in such a way as to blend in with the items around them. A validation composite score was based on the four items with a maximum of 28 and a minimum of 4.

After these exclusions (n=21), ninety-five participants (53 female, 42 male) were included in the analyses. The mean age was 38.9 years (SD=12.62). The majority of the participants were “Non-Hispanic White/Euro American” (44%, n=42), “Asian/Asian American or Pacific Islander” (41%, n=39), and “Black/African-American” (5%, n=4). Seventy-two percent were employed (n=68), and seventy-nine percent had attained an associates degree or higher (n=69). See table 1, for a detailed summary of the sample characteristics.

Characteristic	N (%)	Mean (SD)
Age		38.89 (12.62)
Gender		
Male	42(44.2)	
Female	53(55.8)	
Ethnicity/Race		
Non-Hispanic White/Euro-American/Caucasian	42(44.2)	
Black/African-American/Afro Caribbean	4(4.2)	
Asian/Asian-American or Pacific Islander	39(41.1)	
Latino/a, Hispanic-American, Chicano/a	2(2.1)	
Native American/Alaskan Native	1(1.1)	
Middle Eastern/Arab American	2(2.1)	
Multi-Racial/Multi Ethnic	2(2.1)	
Other/ Prefer not to say	3(3.2)	
Marital Status		
Single/dating casually	30(31)	
Dating seriously/not living together	1(1)	
Living with partner but not married	10(11)	
Married or in marriage relationship	54(57)	
Number of children		1.02(1.25)
Sexual Orientation		
Heterosexual	85(90)	
Gay/Lesbian	3(3)	
Bisexual	2(2)	
Queer	1(1)	
Transgender	4(4)	
Highest Level of Education		
High school diploma/GED	9(10)	
BA/BS	22(67)	
Some college	17(18)	
Associates degree	7(7)	
BA/BS	32(34)	
Some graduate school	3(3)	
MA/MBA/JD	22(23)	
PhD/MD	5 (5)	

Are you currently a student?			Atheist	11(11.6)	
No	81(85.3)		Spiritual	5(5.3)	
Part-time	8(8.4)		Other	7(7.4)	
Full-time	6(6.3)		No response	18(55)	
Annual Household Income			Do you meditate or practice mindfulness?		
\$0 – \$20,000	25(26.3)		No/never	32(33.7)	
\$20,000 – \$30,000	19(20)		I've tried it and liked it	12(12.6)	
\$30,000 – \$50,000	20(21.1)		I've tried it and didn't like it	6 (6.3)	
\$50,000 – \$100,000	18(18.9)		I practice sometimes	26(27.4)	
\$100,000 – \$150,000	9(9.5)		I practice about once a week or more	9 (9.5)	
50,000 – \$200,000	1(1)		I practice every day or nearly every day	10(10.5)	
Prefer not to say	3(3.2)		Political Orientation		
Country of Origin			Liberal	32(33.7)	
USA	41(43.2)		Moderate	46(48.6)	
India	34(35.8)		Conservative	17(17.9)	
UK	3(3.2)		Current Health Status		
Canada	3(3.2)		Excellent	21(22.1)	
Ethiopia	1(1.1)		Good	56(58.9)	
Jordan	1(1.1)		Fair	17(17.9)	
Peru	1(1.1)		Poor	1(1.1)	
South Korea	1(1.1)		In my child hood I grew up with		
Brazil	1(1.1)		Two biological parents	76 (80)	
Vietnam	1(1.1)		A single biological parent	8 (8.4)	
Trinidad and Tobago	1(1.1)		One biological parent and one step parent	6 (6.3)	
Primary/Native Language			In shared custody between two parents	2 (2.1)	
English	59(62.1)		Two adoptive parents	2 (2.1)	
Other than English	18(18.9)		Under the care of relatives	1 (1.1)	
Bi-lingual	18(18.9)		Culture values communicating emotions?		
How serious are you about faith/spirituality?			Yes	50 (52.6)	
Not at all	16(16.8)		No	30 (31.6)	
Somewhat	26(27.4)		I don't know	15 (15.8)	
Quite	22(23.2)		Currently live in		
Very	31(32.6)		My home city	32 (33.7)	
Religious Tradition			My home state	25 (26.3)	
Christian	26(27.4)		My home country	33 (34.7)	
Catholic	12(12.6)		Not my home country	5 (5.3)	
Protestant	3(3.2)				
Mormon/Latter Day Saints	1(1.1)				
Muslim	3(3.2)				
Hindu	20(21.1)				
Agnostic	6(6.3)				

Table 1: Sample characteristics

Because Mechanical Turk is a web-based platform, the sample constituted a multinational population, with 50 percent living outside the United States ($n=48$), and most of those individuals residing in India (36%, $n=34$). Also of note, thirty-two percent reported that they practiced mindfulness-like activities “sometimes,” “once a week,” or “almost every day.”

MATERIALS

The Vowel Cancellation Task (VCT) was used to induce boredom. The VCT, which has been used extensively in the laboratory of the second author to rapidly induce feelings of boredom, is conceptually similar to vigilance tasks that require the participants to maintain attention on uninteresting stimuli for a sustained period of time. On the VCT, participants are presented with a moderately interesting short story² about 20 pages in length. The story is divided into 16 roughly equal sections and each section is followed by a text box in which participants are instructed to record the number of vowels counted (i.e., cancelled) in that section. The task lasts 15 minutes after which a researcher notifies the subject that the task is over. When the task is presented on a computer, as was the case in the present study, the task ends automatically after 15 minutes. Because the current study utilized a computer-based presentation mode, an “incorrect total” warning was added to the VCT protocol, which appeared whenever a participant entered an erroneous vowel count, something that is not possible with the paper and pencil version of the VCT. It was thought that this addendum would increase attendance to the already boring task and therefore increase boredom even further. Participants in the control condition simply read the short story for 15 minutes.

As a manipulation check participants were asked to indicate on a likert-type scale ranging from 1 (not at all) to 5 (extremely) the degree to which they would describe the task that they performed (i.e., reading or vowel cancellation) as being anxiety-provoking, amusing, boring, tedious, or enjoyable, and also the degree to which they currently felt anxious, amused, bored, annoyed or joyful. The expectation was that in comparison to participants in the control condition, participants in the vowel cancellation condition would be more likely to describe the task as being boring and/or tedious and to describe themselves as being bored.

The State Mindfulness Scale (SMS):⁴⁰ was used in the present study to assess state mindfulness. It operationalizes mindfulness defined as a meta cognitive state that is characterized by what one is paying attention to (body sensations and mental events occurring in the present moment) and how one is paying attention (deliberately in the present, with awareness, sensitivity, intimacy with subjective experience, and curiosity). The scale consists of 21 items to which respondents indicate how well each statement describes what they just experienced

by utilizing a likert-type scale ranging from 1 (not at all) to 5 (very well). Total scores range from 21 to 105 with higher scores indicating a greater degree of state mindfulness. The internal consistency coefficient reported was $\alpha=.95$.

The Boredom Proneness Scale (BPS):¹⁰ is a 28-item questionnaire that measures an individual’s susceptibility to the experience of boredom. Sample items include “Much of the time I just sit around doing nothing,” and “When I was young, I was often in monotonous and tire some situations.” Responses are scored on a 7-point Likert scale ranging from “strongly disagree” (1) to “strongly agree” (7). Responses are summed to form a boredom proneness score ranging from 28 to 196, with higher scores indicating a higher susceptibility to the experience of boredom. The BPS is considered to be a trait measure and to be psychometrically sound ($\alpha=.79$, test-retest correlation=.83).

The Multidimensional State Boredom Scale (MSBS):¹ is a 29-item questionnaire that measures the current experience of boredom. Sample items include “Time is moving very slowly” and “I seem to be forced to do things that have no value to me.” Responses are scored on a 7-point Likert like scale ranging from “strongly disagree” (1) to “strongly agree” (7). The MSBS assesses boredom across five dimensions (i.e. attention, disengagement, agitation, dysphoria, and sense of time passing). Responses are summed to produce a total score ranging from 29 to 203 with higher scores indicating a higher level of state boredom. The scale is internally consistent, $\alpha=.95$. The internal consistency of each factor ranges from .80 to .92.

Demographics Questionnaire: A demographics questionnaire was administered, which asked about age, sex, race/ethnicity, relationship status, sexual orientation, gender identity, education, country of origin, religious identification, and other common demographic categories. Also included was an item, “Do you meditate or practice mindfulness?” This item was included because of the likelihood that meditation experience might affect response patterns to the primary measures. For example, the validity of the experiment would be strengthened if meditation exposure were positively related to state mindfulness. Response options were, “No/never,” “I’ve tried it and liked it,” “I’ve tried it and didn’t like it,” “I practice sometimes,” “I practice about once a week or more,” “I practice every day or nearly every day.”

PROCEDURE

The posting on Amazon Mechanical Turk included a link to the study, which was built using Qualtrics software for web-based data collection. After formally consenting to participate in the study, participants were randomly assigned, using the Qualtrics randomization feature, to either the Vowel Cancellation Task ($n=46$) or the Reading Task ($n=49$). Based on pilot data, which suggested that the drop-out rate would be substantially higher during the VCT than during the less aversive Reading Task, the randomization feature was set to assign participants to the VCT at a rate roughly twice that of the rate of assignment to

²Dahl R. Beware of the Dog. In: Over to you: Ten Stories of Flyers and Flying. New York, NY: Reynal and Hitchcock; 1946.

the control condition, thus ensuring a relatively equal number of study completers in both conditions.

In both conditions, participants were instructed to set aside distractions, give their full attention to the focal task, and try to be as accurate as possible while working quickly. The duration of the task was not specified, which likely accounts for drop-out rates across both conditions, as most dropouts occurred during this task phase.

After 15 minutes of working on the assigned task, all participants were automatically advanced to the questionnaire section of the study. The manipulation check was administered immediately after completion of the induction or reading task. Next, the MSBS and the SMS were administered and the order of presentation was counterbalanced, followed by the BPS and the demographics questionnaire. Lastly, participants were debriefed and the purpose of the study explained. Compensation was delayed because each participant's work had to be formally "approved" within the Mechanical Turk system but for no more than 72 hours.

RESULTS

The SMS, MSBS and BPS all showed good to excellent internal consistency ($\alpha = .81-.96$) and each alpha was within 2 hundredths of a point of the respective scale's published alpha coefficients. Despite the small sample, the within group distributions for the SMS, MSBS, and BPS did not violate the assumption of normality, even when the data was factored by gender. Independent sample T-tests confirmed that neither boredom proneness nor any demographic variables significantly differed across conditions.

A comparison of the mean scores of the experimental and control group on each item of the manipulation check confirmed that participants in the vowel cancellation condition were significantly more annoyed and enjoyed themselves less. Moreover, participants in the vowel cancellation condition rated the

vowel counting task as significantly more anxiety-provoking, more boring, more tedious and less enjoyable, compared to the control group's ratings of the reading task. In other words, the boredom task accomplished what it was intended to do; which was to affect an aversive state characterized by feelings of boredom, tedium and annoyance attributed to the focal task (Table 2).

As predicted, participants in the boredom condition ($M=105.7, SD=32.3$) also scored significantly higher on the MSBS than their counterparts in the control condition ($M=90.4, SD=32.9$), $t(93)=2.295, p=.024$, and dropped out at significantly higher rates (roughly 45% more frequently) than participants in the control condition (Tables 3 and 4). Together with the manipulation check results, these findings are similar to the results that have been observed with the VCT in laboratory settings and suggest that with the proper safeguards the online version of the VCT might be viable option for studies involving boredom induction.

T-tests were used to analyze group differences with regard to state mindfulness. Effect size is reported with Cohen's d. Compared with controls participants in the boredom condition ($M=64.02, SD=21.18$) scored significantly lower on the SMS than their counterparts ($M=72.02, SD=16.96$), supporting the main hypothesis that state boredom constrains the experience of state mindfulness, $t(86.119) = -2.024, p=.044, d=.418$ (Table 3).

In the sample as a whole, and also consistent with the study predictions, self-reported meditation exposure was found to be correlated with SMS scores, $r(93) = .271, p=.008$. Moreover, participants who reported that they practiced meditation "weekly" or "almost every day" displayed higher SMS scores ($M=73.30, SD=17.06$) compared those who practiced "sometimes," had only "tried" meditation, or had never practiced ($M=63.30, SD=20.32$), $t(93) = 2.643, p=.010, d=.543$. Also, the BPS was correlated with the MSBS, $r(74) = .683, p<.001$, a finding that is in line with the results that have been reported in the construct validation studies of the MSBS.¹

Items	Condition						t
	Vowel Cancellation Task (boredom)			Reading Task (control)			
	Mean	SD	N	Mean	SD	N	
I am anxious	3.07	1.25	46	2.61	1.22	49	ns
I am amused	2.09	1.28	46	2.24	1.28	49	ns
I am bored	2.30	1.36	46	1.82	1.17	49	ns
I am enjoying myself	2.41	1.39	46	3.06	1.07	49	-2.53*
I am annoyed	2.89	1.35	46	1.96	1.22	49	3.52***
The task is anxiety-provoking	3.22	1.21	46	2.71	1.14	49	2.09*
The task is amusing	2.04	1.26	46	2.20	1.29	49	ns
The task is boring	2.65	1.42	46	1.78	1.23	49	3.21*
The task is enjoyable	2.26	1.41	46	3.08	1.15	49	-3.12*
The task is tedious	3.65	1.43	46	2.35	1.18	49	4.85***

Note. * = $p < .05$, *** = $p < .001$.

Table 2: Means and Standard Deviations for Manipulation Check items by Experimental Condition.

Items	Condition			Condition			t
	Boredom Induction Task			Reading Task (control)			
	Mean	SD	N	Mean	SD	N	
MSBS	105.74	32.29	46	90.39	32.86	49	2.30*
SMS	64.02	21.18	46	72.02	16.96	49	2.02*

Note. * = $p < .05$, *** = $p < .001$.

Table 3: Means and Standard deviations for the Multidimensional State Boredom Scale and the State Mindfulness Scale by Experimental Condition.

	Condition		
	Vowel Cancellation Task (boredom)	Reading Task (control)	Total
Total Recruited	268	132	400
Drop-out¹	212	72	284
Drop-out rate	79.1%	54.5%	71%
Excluded due to time or reliability²	10	11	21
Sample used for analysis	46	49	95

¹Dropout refers to participants who discontinued participation before completing the reading task or the vowel counting exercise.

²Participants were excluded if they took longer than 80 minutes or less than 20 minutes to complete the survey, or if they failed to correctly answer more than one of four validation items ("What does 3+3 = ?").

Table 4: Participants Recruited, Drop-out Rates and Exclusions Due to Time or Reliability by Experimental Condition.

SUMMARY AND DISCUSSION

As predicted, the boredom-induction manipulation had a moderate but significant effect on self-reported state mindfulness, thus supporting the central hypothesis of the study, which is that state boredom constrains the capacity to experience mindfulness. This finding also extends the findings from the earlier study,³⁶ which focused exclusively on the trait forms of boredom (boredom proneness) and mindfulness. By demonstrating that the state forms of the two constructs have a similarly inverse relationship, the present study provides further support for the widely held notion that one of the important potential benefits of mindfulness training is an enhancement in the capacity to cope with boredom. It is also consistent with the growing evidence that mindfulness-based interventions may be particularly effective in high risk populations in which boredom, distractibility and impulsiveness are especially prominent - the most obvious example being individuals diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD).^{41,42}

Basic support for the effectiveness of the electronic on-line version of Vowel Cancellation Task was provided by the manipulation check items, the MSBS, which showed a significant elevation in boredom following the vowel cancellation task, and the differential drop-out rates across groups. However, replication is needed before any firm conclusions can be made about the soundness of the approach, despite its apparent promise.

The differential drop-out rates across conditions is consistent with previous research that supports the association of boredom with decreased vigilance and sustained attention,^{43,28} and is also consistent with the conceptualization of boredom as

a cue to reallocate attentional resources toward more rewarding activity.⁸ Apparently, in this case, the VCT was experienced as being boring enough to send substantially more participants in search of something else to do, while the participants in the Reading Task were more likely to maintain their interest.

One question that remains is whether participants in the boredom condition were more likely to drop out because they were initially or temperamentally more mindful, thus biasing the results. Unfortunately, however, due to the constraints of the study design it was not possible to address this question by directly comparing the levels of mindfulness among completers vs. dropouts. In addition to the fact that the study did not include a measure of trait mindfulness, all of the dropouts in the current study occurred during the VCT or reading task, and thus before the administration of the outcome measures. However, there are good reasons to believe that it is unlikely that the results are attributable to higher rates of attrition among individuals with higher mindfulness scores. For example, findings from earlier research on the impact of mindfulness on the capacity to sustain attention and persist on aversive tasks suggests that mindful participants would be expected to be less, not more, likely to dropout from tasks like the VCT.⁴⁴ Furthermore, as previously mentioned, Lepera³⁸ was able to show in her study that individuals with higher levels of trait mindfulness tend to be less susceptible to boredom, and thus less likely to discontinue intrinsically boring tasks like the VCT.

Finally, although the present study establishes support for state boredom's dampening effect on the experience of mindfulness, it does not address the more clinically relevant question of whether induced mindfulness inoculates against or mitigates

feelings of boredom. Clearly this is a direction that future studies should pursue. For example, previous studies interested in the effects of mindfulness have induced mindfulness using a 15-minute guided meditation.⁴⁵ Utilizing such a methodology would not only address the important question of whether the relationship between states of boredom and mindfulness are truly bidirectional and symmetrical, but also whether it is possible to deliver mindfulness training in an online format.

REFERENCES

- Fahlman SA, Mercer-Lynn KB, Flora DB, Eastwood JD. Development and validation of the multidimensional state boredom scale. *Assessment*. 2013; 20: 68-85. doi: [10.1177/1073191111421303](https://doi.org/10.1177/1073191111421303)
- Bohdi B. A Comprehensive Manual of Abhidhamma: The AbhidhammatthaSangaha (Vipassana Meditation and the Buddha's Teachings) Sri Lanka: Pariyatti Publishing; Buddhist Publication Society. 2012; 86.
- Lazar SW. Mindfulness and Psychotherapy. In: Germer Ck, Siegel RD, Fulton PR. Mindfulness Research. 1st ed. Newyork, NY, USA: Guilford Press; 2005; 220.
- Brown KW, Ryan RM. Perils and promise in defining and measuring mindfulness: Observations from experience. *Clinical Psychology: Science and Practice*. 2004; 11(3): 242-248.
- Kabat-Zinn J, Hanh TN. Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. Random House LLC. 2009.
- Mikulas WL, Vodanovich SJ. The essence of boredom. *The Psychological Record*. 1993.
- Todman M. Boredom in Schizoaffective Disorder and other Psychotic Conditions. In: Yip K. Schizoaffective Disorders: International Perspectives on Understanding, Intervention and Rehabilitation. New York: Nova Science Publications; 2003.
- Todman M. Psychopathology and Boredom: A Neglected Association. In: Fanti KA. Psychological Science: Research, Theory and Future Directions. Athens: ATINER press; 2007.
- Todman M. The dimensions of state boredom: Frequency, duration, unpleasantness, consequences and causal attributions. *Educational Research International*. 2013; 1(1): 32-40.
- Farmer R, Sundberg ND. Boredom proneness--the development and correlates of a new scale. *Journal of personality assessment*. 1986; 50(1): 4-17. doi: [10.1207/s15327752jpa5001_2](https://doi.org/10.1207/s15327752jpa5001_2)
- Rupp DE, Vodanovich SJ. The role of boredom proneness in self-reported anger and aggression. *Journal of Social Behaviour and Personality*. 1997; 12(4): 925-936.
- Gordon A, Wilkinson R, McGown, A, Jovanoska S. The psychometric properties of the Boredom Proneness Scale: An examination of its validity. *Psychological Studies*. 1997; 42: 85-97.
- Sommers J, Vodanovich SJ. Boredom proneness: Its relationship to psychological-and physical-health symptoms. *Journal of clinical psychology*. 2000; 56(1): 149-155. doi: [10.1002/\(SICI\)1097-4679\(200001\)56:1<149::AID-JCLP14>3.0.CO;2-Y](https://doi.org/10.1002/(SICI)1097-4679(200001)56:1<149::AID-JCLP14>3.0.CO;2-Y)
- Watt JD, Ewing JE. Toward the development and validation of a measure of sexual boredom. *The Journal of Sex Research*. 1996; 33: 57-66.
- Watt JD, Vodanovich SJ. Boredom proneness and psychosocial development. *The Journal of psychology*. 1999; 133(3): 303-314.
- Watt JD, Vodanovich SJ. Relationship between boredom proneness and impulsivity. *Psychological reports*. 1992; 70(3): 688-690. doi: [10.2466/pr0.1992.70.3.688](https://doi.org/10.2466/pr0.1992.70.3.688)
- Lehr E, Todman M. Boredom and Boredom Proneness in Children: Implications for Academic and Social Adjustment. In: Todman M. Self-Regulation and Social Competence: Psychological Studies in Identity, Achievement and Work-Family Dynamics. Athens: ATNIER Press; 2009; 79-90.
- Maroldo GK. Shyness, boredom, and grade point average among college students. *Psychological Reports*. 1986; 59(2): 395-398. doi: [10.2466/pr0.1986.59.2.395](https://doi.org/10.2466/pr0.1986.59.2.395)
- Paulson MJ, Coombs RH, Richardson MA. School performance, academic aspirations, and drug use among children and adolescents. *Journal of drug education*. 1990; 20(4): 289-303.
- Robinson WP. Boredom at school. *British Journal of Educational Psychology*. 1975; 45(2): 141-152.
- Fisher CD. Boredom at work: A neglected concept. *Human Relations*. 1993; 46(3): 395-417.
- O'Hanlon JF. Boredom: Practical consequences and a theory. *Actapsychologica*. 1981; 49(1): 53-82. doi: [10.1016/0001-6918-\(81\)90033-0](https://doi.org/10.1016/0001-6918-(81)90033-0)
- Krotava I, Todman M. Boredom Severity, Depression and Alcohol Consumption in Belarus. *Journal of Psychology and Behavioral Science*. 2014; 2(1): 73-83.
- Patrick ME, Schulenberg JE. How trajectories of reasons for alcohol use relate to trajectories of binge drinking: National panel data spanning late adolescence to early adulthood. *Developmental psychology*. 2011; 47(2): 311. doi: [10.1037/a0021939](https://doi.org/10.1037/a0021939)
- Wilson GD. Eating style, obesity and health. *Personality and*

- Individual Differences*. 1986; 7(2): 215-224. doi: [10.1016/0191-8869\(86\)90058-9](https://doi.org/10.1016/0191-8869(86)90058-9)
26. Blaszczynski A, McConaghy N, Frankova A. Boredom proneness in pathological gambling. *Psychological Reports*. 1990; 67(1): 35-42. doi: [10.2466/pr0.1990.67.1.35](https://doi.org/10.2466/pr0.1990.67.1.35)
27. Vodanovich SJ. Psychometric measures of boredom: A review of the literature. *The Journal of psychology*. 2003; 137(6): 569-595. doi: [10.1080/00223980309600636](https://doi.org/10.1080/00223980309600636)
28. Eastwood JD, Frischen A, Fenske MJ, Smilek D. The Unengaged Mind Defining Boredom in Terms of Attention. *Perspectives on Psychological Science*. 2012; 7(5): 482-495.
29. Fisher CD. Boredom at work: A neglected concept. *Human Relations*. 1993; 46(3): 395-417.
30. Hamilton JA. Attention, personality, and the self-regulation of mood: Absorbing interest and boredom. *Progress in experimental personality research*. 1981; 10(28): 1-315.
31. Harris MB. Correlates and Characteristics of Boredom Prone-ness and Boredom. *Journal of Applied Social Psychology*. 2000; 30(3): 576-598. doi: [10.1111/j.1559-1816.2000.tb02497.x](https://doi.org/10.1111/j.1559-1816.2000.tb02497.x)
32. Critcher CR, Gilovich T. Inferring attitudes from mind wan-dering. *Personality and Social Psychology Bulletin*. 2010; 36(9): 1255-1266. doi: [10.1177/0146167210375434](https://doi.org/10.1177/0146167210375434)
33. Martin M, Sadlo G, Stew G. The phenomenon of boredom. *Qualitative Research in Psychology*. 2006; 3(3): 193-211. doi: [10.1191/1478088706qrp066oa](https://doi.org/10.1191/1478088706qrp066oa)
34. Baer RA, Fischer S, Huss DB. Mindfulness and acceptance in the treatment of disordered eating. *Journal of rational-emo-tive and cognitive-behavior therapy*. 2005; 23(4): 281-300. doi: [10.1007/s10942-005-0015-9](https://doi.org/10.1007/s10942-005-0015-9)
35. Trunnell EP, White F, Cederquist J, Braza J. Optimizing an Out-door Experience for Experiential Learning by Decreasing Bore-dom through Mindfulness Training. *Journal of Experiential Edu-cation*. 1996; 19(1): 43-49. doi: [10.1177/105382599601900109](https://doi.org/10.1177/105382599601900109)
36. Russell D, McAuley E. Causal attributions, causal dimen-sions, and affective reactions to success and failure. *Journal of Personality and Social Psychology*. 1986; 50: 1174-1185.
37. Farmer R, Sundberg ND. Boredom proneness--the develop-ment and correlates of a new scale. *Journal of personality assess-ment*. 1986; 50(1): 4-17. doi: [10.1207/s15327752jpa5001_2](https://doi.org/10.1207/s15327752jpa5001_2)
38. LePera N. The relationships between boredom proneness, mindfulness, anxiety, depression, and substance use. *The New School Psychology Bulletin*. 2011; 8(2).
39. Buhrmester M, Kwang T, Gosling SD. Amazon's Mechan-ical Turk a new source of inexpensive, yet high-quality, data?. *Perspectives on Psychological Science*. 2011; 6(1): 3-5.
40. Tanay G, Bernstein A. State Mindfulness Scale (SMS): De-velopment and initial validation. *Psychological assessment*. 2013; 25(4): 1286. doi: [10.1037/a0034044](https://doi.org/10.1037/a0034044)
41. Edel M, Holter, T, Wassink K, Juckel G. A comparison of mindfulness-based group training and skills group training in adults. *Journal of Attention Disorders (online pre-publication edition)*. 2014. doi: [10.1177/1087054714551635](https://doi.org/10.1177/1087054714551635)
42. Zylowska L, Ackerman D, Yang M, et al. Mindfulness medi-tation training in adults and adolescents with ADHD: A feasibil-ity study. *Journal of Attention Disorders*. 11(6): 737-774. doi: [10.1177/1087054707308502](https://doi.org/10.1177/1087054707308502)
43. Thomson DR, Besner D, Smilek D. A Resource-Control Ac-count of Sustained Attention Evidence From Mind-Wandering and Vigilance Paradigms. *Perspectives on Psychological Sci-ence*. 2015; 10(1): 82-96. doi: [10.1177/1745691614556681](https://doi.org/10.1177/1745691614556681)
44. Semple RJ. Does mindfulness meditation enhance attention? A randomized controlled trial. *Mindfulness*. 2010; 1(2): 121-130. doi: [10.1007/s12671-010-0017-2](https://doi.org/10.1007/s12671-010-0017-2)
45. Lau MA, Bishop SR, Segal ZV, et al. The Toronto mindful-ness scale: Development and validation. *Journal of clinical psy-chology*. 2006; 62(12): 1445-1467. doi: [10.1002/jclp.20326](https://doi.org/10.1002/jclp.20326)

Opinion

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Volume 1 : Issue 1

Article Ref. #: 1000PCSOJ1102

Article History:

Received: February 9th, 2015

Accepted: April 7th, 2015

Published: April 8th, 2015

Citation:

Ramírez JM. Practical suggestions for preventing conflicts through a better understanding of culture and differences: tips, anecdotes, and the impact of public events. *Psychol Cogn Sci Open J*. 2015; 1(1): 10-14.

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Practical Suggestions for Preventing Conflicts through a Better Understanding of Culture and Differences: Tips, Anecdotes, and the Impact of Public Events

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ABSTRACT

One of the best strategies of working with conflict is its prevention. Several practical suggestions on how we can know our neighbors better and have a personal engagement in dialogue between people of different cultures are shared in this paper with the hope of achieving world peace through little steps in the elimination of conflicts and prevention of violence. These tips include interchange of information about our respective cultures, use of the internet and other technical mass media, travelling and living together, mastering other languages, ecumenical approaches to others' religions, etc.

INTRODUCTION

The ambiguity and complexity of the notion of conflict and our lack of understanding of its nature often leads to inadequate and inappropriate reactions to it. In other words, a better understanding of it will pave the way to non-coercitive solutions and give rise to the possibility of dialogue in its stead.¹

Conflict is a ubiquitous phenomenon,^{2,3} which can be found at all levels of life, from the intrapersonal one, within our own organism, where immune reactions may lead to illnesses and conflicting inner desires often show up as a lack of harmony, to international relations between world powers, where the protagonists aim in finding substantive negotiated solutions to both technical and political issues in order to avoid wars, such as the recent agreement on Iran Nuclear Talks,⁴ passing through many other intermediate levels –interpersonal, social, and so on. A proactive and supportive attitude in finding the best positive space for solutions to conflict is offered at all scientific levels, from the most diverse disciplines: psychobiology, psychiatry,⁵ sociology, law (conflict resolution is its *raison d'être*), policy science, etc.⁶

The main purpose of the present article is to offer a pragmatic approach, based on personal experiences in cross-cultural research,⁷⁻¹⁰ by sharing some tips, anecdotes, and the eventual impact on public events. Hopefully some of these personal hints might serve professionals and other readers interested in promoting a better dialogue between different cultures thus going a little way towards solving conflicts, preventing violence, and achieving peace through tolerance. A few of these more practical initiatives that we can personally undertake are mentioned below.

Travelling

*“El andar tierras y comunicar con diversas gentes
hace a los hombres discretos”*

(Traversing countries and communicating with different people, makes human beings tactful and discreet)
(Miguel de Cervantes)

Learning about the cultures, customs and religions of our neighbours helps us to understand them better. Encouraging ourselves and others to take the opportunity to cross borders in order to engage, learn from, and listen to how various ethnic groups negotiate and translate their histories, differences, and voices within and across an over-arching polity.

When people visit other countries, the frame of reference of their stories or experiences are often statements in relation to their own customs. “The physical theory of relativity is a very useful example of the danger of thought-habits closing our minds to new truths. We all of us tend to judge problems from one particular stand point – the one determined by our own conditions of life. We are inhabitants of our own particular country, with a particular religion and moral tradition, and we are inclined to forget how many of our judgements are simply relative to this single standpoint and are not absolute. It is only when we begin to study comparative religions and comparative codes of morals that we begin to see to what extent our own opinions about right and wrong and about other matters are not based on scientific truths (for these are true for all persons under all conditions), but are judgements whose truth is relative to the particular view or ‘truth’ from which they were made. By accustoming our minds to comparative studies and by forming the habit of trying to look at problems in a manner which discounts our own point of view, we can to some extent escape from this relativity”¹¹ We must remember this relativity in our point of view.

In this context, fostering visits by young people to foreign countries is an essential element in the effort to strengthen mutual understanding among different civilizations, because these ‘well travelled’ youth later might hold leading positions in their own countries: government, university, law practices, non-profit organizations, art, culture.

After travelling around the world, I have realized that the essential truths human beings have worried about are practically the same in all cultures: love, life, survival, death, after-life. Had I previously felt some nationalism or xenophobia in the deepest of my being, it has completely disappeared. Nowadays, I feel myself to be a real citizen of the world. I try to follow what Confucius taught: “The superior man is universal and not partisan. The mean man is a partisan and not universal.”¹²

Interchange of Cultural Videos, as a Less Expensive Alternative

A less expensive way to promote tolerance and knowledge of other cultures is watching documental movies about them. A good example of it may be the World Video Exchange Programme carried out by UNESCO. It consists of the interchange of 15 minutes videos on the life of adolescents and how they see their own countries. This project has only started in the most economically developed societies where technology is available. In the West and in Japan there are already palm size video-cameras at a quite reasonable price being used by youngsters (remember the phenomenon of the *tamagotchi*), which could be easily used for this purpose. Given globalization, this idea will soon spread around the world, for instance through I-phones and the like. Wait and see!

Impact of ‘Visible Catastrophes’ on Public Perception

People of a certain age remember what were they doing at the very moment of the first landing on the moon. We also have witnessed catastrophes directly through television. I remember the tragedy of the Heysel Stadium, in Brussels (1985), immediately before the final match of the soccer Europe Cup, where 39 spectators died. I also have in mind the American attacks against Baghdad, during the Gulf war, or the Russians against Grosznik, in Chechnya; or the long scene of the killing of a Palestinian young boy, close to his father who was asking the Israeli troops to stop shooting. But what happened on September 11, 2001 was certainly the most spectacular and horrible example. We will never forget those frightful images of smoke, fire, explosions, people jumping from windows, running towards nowhere, with their eyes full of terror, a collapse of the very symbols of economic and military power in America. This was partially due to the immediate presence of mass media, serving as a terrible, large scale mirror image of what unfortunately was already the experience of many other recent mass killing outside the developed world – whether accidental as in Bhopal, natural-disasters as in Guatemala or India, or planned as in Rwanda, Tibet, Sudan, ISIS and related.

This impact of ‘visible catastrophes’ on public perception can also be used in a constructive way to eliminate conflict through understanding its roots in human behaviour, as suggested by Robert Hinde (personal communication). The continuous media coverage of the attack on the World Trade Center towers has brought a large portion of people to a state of acute empathy with the victims. When that kind of things happens, the concept of solidarity gets a new meaning. We all then become the ‘victim’ and want to overthrow the ‘enemy’.

Mastering Several Languages

One of the main tools necessary for a ‘dialogue inter civilizations’ is the mastering of foreign languages. The capacity

of speaking and reading in several languages is clearly a good achievement, because it allows us not only to understand what other people think, but also how they think, which is even more important. For instance, I think in the language which I speak in each specific moment. And I feel myself German when I listen to Beethoven or to a Schubert's *Lieder*; Italian when I read *I Promessi Sposi* or *La Divina Commedia*; Danish when I speak with my Scandinavian wife; or English when I write this paper. And I never have the impression that through this I am being unfaithful to Spain, nor more importantly to my own I, but the contrary.

I found an article on the Internet, written by Rajeev Srinivassan, a South Indian whose maternal language was Malayalam, the language of the state of Kerala. "As a person completely bilingual in English and Malayalam – he was writing, I can say with certainty that, for me, that Malayalam is the language of the heart and English is the language of the head."¹³ The maternal language is related to history, culture, literature, and identity. And the *lingua franca* helps to communicate with a wider world. This is a big advantage for the 'flying Dutchman', the 'wandering Jew' or anyone living out of a suitcase: if they are going to be travelling around, they are obliged to manage in at least one language other than their own.

But it is not easy, indeed, to manage in several languages. I have personally experienced the difficulty of translating from one language to another. Books of mine, first published in English, have been translated into my mother tongue by somebody else; I was not able to do it myself. There is usually significant damage done to in the process of translating from one language to another. For instance, some languages seem to me better suited for one culture, and seem to falter when asked to communicate another person's world view. There are a number of *faux amis* that can provoke many an embarrassing misunderstanding: if you compliment a Frenchman for being 'candid', he will unhappily understand *naïve*; if you compliment a Spaniard for being 'versatile', he will take to mean 'volatile' or an inconsistent *veleta*, a 'fickle' person. I always remember the perplexed face of my old South African auntie when, wanting to compliment her for her cheerfulness, enthusiasm and energy, I told her that she was 'juvenile', *juvenil* as we would have said as a compliment in Spanish. Equally, as a joke, I do also remember when several Spanish youngsters – me included – travelling through Italy asked practically every waiter for butter – *burro* in Italian, not because we wanted it, but just because such a word was one of the biggest insults in our own language: stupid! This was really a juvenile behaviour, far from the lovely joyfulness of my dearest auntie.

I have also read some anecdotes about the embarrassment of some sellers of Japanese cars, due to the different meanings or 'sounds' in different languages. A splendid model of sportive Toyota was presented in the Saloon de l'Automobil, in Paris, with its technical abbreviation: 'MR2'. It elicited quite unexpected burlesque smiles when its name was announced in French: it sounded very similar to a well known but not desired expression: *merde!* A similar thing occurred when Mitsubishi

tried to introduce a jeep into the Spanish market with a name equally unacceptable in that language: *Pajero* is a word that in my language is associated with a vulgar term for the individual who masturbates. I try to remember they changed its name into *Montero*. The habit of using words with several meanings not clearly distinguished therefore may lead us into much erroneous thinking and embarrassing misunderstandings.

An encouragement for the learning of foreign languages through a variety of activities, such as theatre plays, *karaoke*, or films in original version with subtitles, may also contribute to a better understanding and tolerance among people of different linguistic and cultural origin.

Good Living Together

A practical aspect in constructing peace demands the co-operation of all participating parties, in a similar way to genes which work together within an organism, instead of fighting for their own survival and spreading.¹⁴

A macro-policy against discrimination orchestrated by the government is not enough. Small-scale initiatives by ordinary people are also necessary, and perhaps even more effective. Each individual has to do his/her bit to foster good relations with people from other cultures. Sharing is a way of keeping the peace with potentially hostile neighbours.

My own country may be mentioned as a historical pioneer in the dialogue between civilizations. Centuries ago, during the medieval period, when wars were ubiquitous in Europe, Spain (simultaneously known as *Iberia*, *Sefarad*, and *Al Andalus*) had people from 'the three cultures' happily living together for centuries. Muslims, Christians and Jews were sharing a common life. For example, in the 10th century, the Caliph of Cordova, Abderraman III, the Emir of ALL the believers, had a Jew, Hasday ben Xaprut, as prime minister and the Christian Archbishop of Seville as ambassador. Spain was very prosperous during that time. Unfortunately this acceptance broke down. But we still can learn from it.

In many other countries, people from different cultures and ethnic groups for the most part co-exist quite peacefully, in a way inconceivable a couple of generations ago, when most whites probably would have disapproved of intercultural marriages, so common and uncontroversial today, even among royalties.

Another specific example of activities in this direction is the positive communal relations fostered by the Muslim Jewish Forum in England to bring the two communities together, as it was in traditional communities during old times. For instance, at Stamford Hill, a poor North London suburb, where 20.000 Hassidic Jews and a similar amount of Muslims live, more unites both communities than divides them: Kosher cash-and-carries jostle with halal malls; and sounds of cantors from synagogues

mingle with calls to prayer in mosques. You might even wonder whether the bearded neighbours are Jews or Taliban. Morocco may also be presented as a model of Muslims and Jews living together without hate and confrontation.

Another positive influence preventing clashes between rival ethnic groups could be bringing them together rather than separate them. When country folk move to towns they become more economically interdependent: they learn more cosmopolitan habits, growing accustomed to living with people from other groups.

Living together, trying to form joint projects and being useful to others, are very difficult things to do. but they have to be tried, if we really want to avoid conflicts and achieve peace.

Religious Dialogues

Peace might be even more difficult to achieve if we do not take religion into account. The whole secret of all religions is the close ties with others under the Lord's command of "Love your neighbor as you love yourself". Maybe we do not love the self very much. Religious leaders might play an important role in this achieving understanding through a peaceful dialogue between different cultures. Their key role is not to solve the political, social or economical issues which prevent peace – there are other 'experts' for that –, as much as to improve the adequate spiritual atmosphere upon which those issues may be settled.

I don't resist to add a few data from some Asian countries which show an inadequate spiritual atmosphere to achieve real peace: "When Asians convert to Christ it requires enormous courage. Converts typically are ostracized by family and neighbours – and often targeted for persecution. Chinese communists have demolished more than 1.500 houses of worship – most of them Christian – whose members refused to accept direction from the state. In officially secular India, scores of Christians have been murdered and their churches trashed since the rise of militant Hindu groups. On Christmas Eve, churches in nine Indonesian cities were bombed, killing at least 18 believers and wounding about 100 more. An additional 90 Christians were murdered for refusing to convert to Islam, and some 600 more are still being forcibly detained on the island of Kasiui". And, most recently, the self called Islamic State which started spilling the blood of fellow Muslims and local minorities but nowadays targets on infidels, beheading Westerners and Japanese, wherever they are found, without sparing Muslims, as the burning of a Jordan pilot, Muslim like them.

Unfortunately, this is not something exclusive of that geographical area or of any specific time. We find similar incidents anywhere, like Boko Haram, which loosely translates as "western education is forbidden", jihadists show in Africa slaughtering thousands of people. And today's news inform that the Somali terrorist group Al Shabab, one of the most violent

franchises of Al Qaeda, burst into a university in eastern Kenya and killed nearly 150 Christian students in the worst terrorist attack since the 1998 bombing of the United States Embassy here, laying bare the nation's continuing vulnerability after years of battling Islamist extremism.¹⁵

Media and the Web

Nowadays, 'ordinary people' like us control the media *via* the electronic world of the web, the 'new digital democracy'. So familiar already to the younger generations – bloggers, podcasters, 'dotcomers' –, Internet allows chatting with people all around the world to find out how we can help one another to heal the wounds produced by the lack of peace and understanding between different cultures. Consequently it can also be utilized for this initiative.

And last, but not least, the mass media also has an important role in this task: how news is presented, and which words are chosen – specially the adjectives, influence positively or negatively people's attitudes. Biased terms like 'revenge', 'vengeance', 'enemy', and similar, should be refrained. For example, the very same American retaliation after the September 11 events was presented in the U.S. as a response to terror, in Europe as a war on Afghanistan and Iraq, and in some Islamic countries it turned into a war against Islam. Consequently media could be either a main culprit in the developing of an eventual clash of civilizations or one of the main tools for a dialogue between them.

Inner Peace

A mere exterior peace is not enough. In order to influence positively our surroundings, each of us must learn to develop inner peace. Even if until now we have not had time for peace, the time has come to take on the commitment to heal our society, the world and ourselves.

PERSEVERANCE

I am aware that these ideas may be easier said than done, It is very simple to talk or to write presenting ideas about how to prevent violence or achieve peace (intellectuals need to be kept honest, tolerant, and solidarian towards humankind), but it is difficult to implement them (we academicians are not purer than other people). Patience needs to become a habit so that we can deal with our life in a better and more pleasant way. There is much goodwill; but there is also a lot of greed, selfishness, ignorance, and racial, religious and linguistic prejudice. The fight is far from over but, in the words of the Prince of Orange Willem de Zwijger, also widely known as William the Silent or William the Taciturn, "it is not necessary to hope in order to undertake, nor to succeed in order to persevere".¹ At the beginning of the

¹Cited by André L. Mechelync, summarising the concerns of the Pugwash movement. Ploughshare. 2001; 13: 1.

21st century, in spite of what we are experiencing in this very moment, peace among people is not a far distant utopia anymore.

ACKNOWLEDGMENTS

This work was supported by grants from Spanish Ministry of Science and Technology (BS2001/1224), of Spanish CICYT (Interministerial Commission for Science and Technology) (RS/MS2001-16-01), and from a RCC fellowship through Harvard University 2006-07. I also want to thank Elisabeth Kline for her professional editing.

REFERENCES

1. Ramirez JM, Farnicka, M, Editorial: A Central European Face of Criminology and Rehabilitation - Processes, Changes and Problems. *The Open Criminology Journal*. 2015; 8: 1-3. doi: [10.2174/1874917801508010001](https://doi.org/10.2174/1874917801508010001)
2. Walters TK, Monaghan R, Ramirez JM. Radicalization, Terrorism, and Conflict. Newcastle: Cambridge Scholars Publishing; 2013.
3. Ramírez JM, Morrison C, Kendall AJ. Conflict, Violence, Terrorism, and their Prevention. Newcastle: Cambridge Scholars Publishing; 2014.
4. Pugwash Conferences on Science and World Affairs. Statement on Iran Nuclear Talks. Website: <http://pugwash.org/2015/04/02/statement-on-the-iran-nuclear-talks/>. 2015; Accessed 2015.
5. American Psychiatric Association. Cultural Formulation Interview Supplementary Modules, DSM-5. Website: http://www.multiculturalmentalhealth.ca/wp-content/uploads/2013/10/2013_CFI_supplementarymodules.pdf. 2013; Accessed 2015.
6. Ramírez JM. The Ulster Peace Process as an experience of peacebuilding. *Behavioral Sciences on Terrorism and Violence*. 2011; 3(1): 72-76. doi: [10.1080/19434471003768867](https://doi.org/10.1080/19434471003768867)
7. Ramírez JM. Justification of Aggression in several Asian and European Countries with different Religious and Cultural Background. *International Journal of Behavioral Development*. 2007; 31(1): 9-15.
8. Ramírez JM. Peace through dialogue. *International Journal on World Peace*. 2007; 24(1): 65-81.
9. Clifford A, McCalman J, Bainbridge R, Tsey K. Interventions to improve cultural competency in health care for Indigenous peoples of Australia, New Zealand, Canada and the USA: a systematic review. *Int J Qual Health Care*. 2015. doi: [10.1093/intqhc/mzv010](https://doi.org/10.1093/intqhc/mzv010)
10. Nichols P, Horner B & Fyfe K. Understanding and improving communication processes in an increasingly multicultural aged care workforce. *J Aging Stud*. 2015; 32: 23-31. doi: [10.1016/j.jaging.2014.12.003](https://doi.org/10.1016/j.jaging.2014.12.003)
11. Thouless RH. Straight and Crooked Thinking. London: Pan; 1930.
12. Confucius, Analects (“Edited Conversations”), Book II, Ch. XIII to XVII (475 BC–221 BC) Watson, Burton, trans. New York: Columbia University Press; 2007.
13. Srinivassan R. Rethinking education in India. Website: <http://www.rediff.com/news/column/rethinking-education-in-india/20120510.htm>. 2012; Accessed 2012.
14. Maynard Smith J, Szathmáry E. The major transitions in evolution. Oxford: Freeman/Spektrum; 1995.
15. The New York Times. Somali Militants Kill 147 at Kenyan University. Website: http://www.nytimes.com/2015/04/03/world/africa/garissa-university-college-shooting-in-kenya.html?ref=todayspaper&_r=0. 2015; Accessed 2015.

Review

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Volume 1 : Issue 1

Article Ref. #: 1000PCSOJ1103

Article History:

Received: May 11th, 2015

Accepted: June 24th, 2015

Published: June 25th, 2015

Citation:

Bignetti E. From brain to mind: a plain route from neurobiology to psychology. *Psychol Cogn Sci Open J*. 2015; 1(1): 15-25.

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From Brain to Mind: A Plain Route from Neurobiology to Psychology

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SUMMARY

Mind sciences have not yet provided a definitive answer to the dual nature of self and to the existence of Free-will (FW), so the mechanisms operating in cognitive processes such as action decision-making remain partially elusive. In this review, we address the question of a so-called “voluntary” action from the agent’s and the scientist’s points of view (respectively from 1st and 3rd person perspectives) and conclude that the “Bignetti Model” (TBM) may offer a solution to reconcile both; i.e. FW is an illusion in line with the agent’s belief in the soul-embodied self and, along with this belief, it may play a functional role in cognition. With TBM, we explain cognition in a bottom-up track from a molecular to a psychological level without the need of soul-body duality.

KEYWORDS: Bignetti model; Self; Free-will; Probabilism; Determinism; Cognition; Inner speech; Bayes’ theory.

ABBREVIATIONS: FW: Free-will; TBM: Bignetti Model; fMRI: functional Magnetic Resonance Imaging; EEG: Electroencephalograph; BCI: Brain-Computer Interface; CEMI: Consciousness electromagnetic field theory; MM: Michaelis and Menten; SoO: Sense of ownership; SoA: Sense of agency; CM: Conscious Mind; UM: Unconscious Mind; IS: Inner Speech; BDT: Bayesian Decision Theory; AI: Artificial Intelligence.

INTRODUCTION

Advances in technology have proved invaluable in lending support to neuroscientists in revealing the complex architecture of the brain and its neurophysiology. In cognitive sciences, non-invasive methods are certainly preferred when assessing intimate brain activity. One of the most common technique to study the information flow state in brain areas is functional Magnetic Resonance Imaging (fMRI).^{1,2} Attempts to achieve integrated signals of the loop between muscles and brain decisions have been carried out also by using Electroencephalography (EEG); to this regard, a Brain-Computer Interface (BCI) was developed to allow direct communication between humans and computers by analyzing electrical brain activity, recorded at the surface of the scalp with EEG.³⁻⁶ These two techniques seem the most promising research and presents challenges for the study of neuroscience, signal processing, machine learning, neurorehabilitation, user interface etc.

Although the mind, consciousness, and cognitive processes remain open to different hypotheses, we trust that a model of mind and consciousness compatible with biophysics and the brain’s architecture, will sooner or later be discovered. In order to better understand the mechanisms underlying cognitive processes, we will assume that the relationship between brain and mind is the same as for any other organ of our body: structure and function. In this regard, the recent proposal of the “Consciousness electromagnetic field theory” (CEMI) made by McFadden is intriguing.⁷ The basis for his theory is that the brain’s electrical activity and magnetic fields have a reciprocal inductive effect, so that neurons behave like electrical cables. Due

to the brain's highly dense and compact wiring, the magnetic field associated with a firing neuron can modulate or even trigger electrical firing in its neighbours and *vice versa*. In summary, the sense of self, the conscious computational and representational experience and the associated "*qualia*"⁸⁻¹⁰ are far from being understood *via* the CEMI theory, yet it is a straightforward physical approach to a plausible solution of brain-mind duality.

Now the question is, can we understand cognitive processes by simply assuming as true the biophysical properties of CNS? Considering ever more complex functions, we may reach a point where we have to admit defeat, i.e. it may be that the higher cognitive functions can only be controlled by a soul or an immaterial agent. Thanks to considerable progress in neurosciences, one aspect in particular, has been brought to the forefront of the discussion: "Can the capacity to make decisions, perform voluntary actions and consequently believe in the existence of a self having FW, be sustained solely by brain biophysics?"

THE PARADOX OF BURIDAN'S ASS

The issue of action decision and performance can be illustrated using the "paradox of Buridan's ass". The paradox is incorrectly attributed to Buridan since it was formulated by others in a logical extrapolation of his thinking. A freely adapted version of this paradox says that before a hungry donkey there are two identical meadows or two identical hay sacks, but the donkey cannot decide which one to eat first and starves to death. This absurdity—even considering the dumbest of donkeys is used to support the thesis that if the mind is strictly "deterministic" or "mechanistic", it will be unable to decide between two perfectly identical situations, where there is no preference indication. In reality, the donkey would eat first from one sack and then from the other, apparently at random. The point is then, that the mind is not "strictly deterministic" yet is determined to reach its goal. In other words, the donkey is determined to satisfy its hunger and the probability of a successful outcome is no different whichever sack it chooses to eat from, and in whatever order. We may comment on this taking a reductionist view: it is the lack of food that leads to a drop of sugar levels in the donkey's brain; when the brain is off balance due to an external stimulus like this, it adopts a purpose-built strategy which is made initially by many aleatory attempts to search for food. In conclusion, hunger satisfaction is a statistical-deterministic goal that can be met by a stochastic search for food everywhere (like throwing a dice many times until we get the right number).

Is this behaviour of the mind so natural? The answer is yes! In nature there are many of these examples. Let's start with the brain.

Analyzing the different structural and organizational levels of the brain from the lower molecular level to the anatomical level, we can imagine a model of cognitive functioning which is complex but acceptable. Taking the single molecular component or sub-microscopic fragment of the nervous system such as

an ion channel, a membrane receptor or a synaptic bouton, we see that its functioning is unpredictable,¹¹ i.e. it is aleatory as if we were throwing dice. If the mind worked in a similar way to this, we would have serious difficulty satisfying our desires, e.g. hunger! Primarily, we would be unable to understand the meaning of hunger; moreover, it would be hard to decide how to eat etc. The switching of a single voltage-gated Na⁺ channel from a closed to an open state upon membrane depolarization seems to be an unpredictable-stochastic event, i.e. it occurs at random, is unconditioned by any desire or motivation and does not depend on the prior physical state of the channel. In other words, random behaviours of single CNS molecules would not explain decision-making and action coherence of the mind. If we now extend our angle of observation to supra-molecular organization, things change noticeably. First of all, we note that by stimulating a sufficiently large membrane patch, i.e. averaging over about 2000 Na⁺ channels per squared micrometer, we observe a stereotypical, predictable Na⁺ signal which is conditioned by a membrane depolarization upstream. Therefore, a collection of stochastic elements exhibits probabilistic-deterministic behaviour thus conforming to the cause-effect paradigm. The complex and coherent actions which derive from these events are the basis of common cognitive functions in large areas of the brain. Due to the complex structure of the brain, "collective" events can be synchronized by physiological stimuli evoked by the external or internal environment, so that a thinking mind may emerge from the brain without recourse to a soul-inhabited self.^{12,13} We should not forget, too, that the possibility of dialogue with the world is not a new characteristic of the brain; signal processing and the complex integration of different random systems in CNS was acquired thanks to genetic and epigenetic pressure.

In summary, we are able to successfully apply the Hodgkin-Huxley formalism¹⁴ to neuronal activity to describe the dynamics in terms of a deterministic theory and graded ionic currents; yet, we must admit that its success is due to a collective response of pores, synaptic boutons and receptors and not to any one of these elements taken singly.¹¹ Averaging microscopic currents by so many stochastic neuronal components working in parallel and serially, make macroscopic currents in brain areas highly predictable. Then, coherent and functional stream of thought is "deterministically" ruled by the laws of probability.¹⁵

Again, we would like to stress that probabilistic-deterministic systems are quite common in biology at all levels of organization. Some other examples taken from natural systems are shown below:

1. Let's consider a physical system determined by a fluid dynamic (or by molecules in a fluid) in a closed space (for instance a cell). The fluid molecules move by virtue of thermal perturbation, in every direction, at random. However, if they find a hole they spill over into the empty space in a spontaneous and irreversible way. An outside observer might think that the net flow of fluid in a specific direction depends on the "will" of the fluid, but for the fluid the mo-

tion is unconscious, it is the result of the fortuitous cooperation of two factors: the random motion of each molecule of the fluid and the probabilistic (thermodynamically-driven) direction of the molecules into newly-formed empty spaces. Similarly, thoughts are like fluid, ready to expand in every direction when stimuli come. Hunger, for example, and the sight of hay activates preferential pathways and thought becomes apparently coherent with a clear goal to pursue. Thought, thanks to its intrinsic “desire” to think, will continually take the pathways (open partitions) most likely to quell the stimulus.^{12,13}

2. In this example we refer to a scientific paper published few years ago in a reputable journal about a simple physical-chemical system displaying “intelligent” behaviour.¹⁶ The authors demonstrated that a drop of oil in a water maze at the first attempt finds the shortest way to reach the exit, similar to laboratory mice after lengthy training. Briefly, the “trick” of this “brainless intelligence” is that the drop and the maze’s exit have been treated with substances with a notoriously high reciprocal affinity and the drop moves in the maze in a probabilistic-deterministic way. The results of this experiment suggest that only two things are necessary to efficiently carry out a purpose-built strategy: there must be a certain “pre-existing” attraction between the subject and its goal and the movement toward the attraction entity must be carried out through a probabilistic-deterministic system.
3. The third example is biochemical. Enzyme mechanisms and the famous kinetics study of enzyme reactions in catalytic enzyme concentrations ($[E_0] \ll [S_0]$), carried out by Michaelis and Menten (MM).^{17,18} Initial velocities of enzyme catalysis obtained in the presence of varying experimental substrate concentrations, are plotted, thus obtaining the famous hyperbolic MM function, a sort of enzyme fingerprint whose maximal catalytic velocity (V_{max}) and Michaeli’s constant (K_M) are macroscopic parameters characteristic of each kind of enzyme. The MM study is a classic in biochemistry texts, since it demonstrates that each kind of enzyme exhibits specific kinetic behaviour. However, these texts rarely highlight the fact that each point on the MM curve is, in reality, the mean macroscopic observation of as many microscopic catalytic rates as the enzyme molecules working in the test tube. Certainly, the collisions between enzymes and substrates are random in water but MM experimental conditions are such that: a) in any experiment all enzyme molecules in the bulk have the same probability of colliding with a substrate molecule; b) this probability increases with substrate concentrations. So the statistical approximation of many stochastic rates calculated at different substrate concentrations concur to give rise to a predictable function.

Many other examples could be given of the statistical-deterministic behaviour of natural events, e.g. the allosteric

mechanisms regulating enzyme catalysis or the cooperative flagellar activity for efficient microorganism movement etc.^{19,20} However, our concluding remark on the Buridan’s ass paradox is that not a single ass would starve to death in such a ludicrous situation. To tackle the question of “action-decision making” and of “who is in charge?”, ambiguity rises from the idea that “deciding” an action and “being in charge” of it are synonymous with “self-awareness”.²¹ Rather, our opinion is that “decision” means (brain) elaboration of a response which may be considered statistically the most adequate reaction to a stimulus, in the natural interrelationship between the individual and his surroundings. This point of view is quite close to Autopoiesis, a theory introduced by Maturana and Varela.²² Initially, they introduced it to describe the chemical mechanism by which living cells self-maintain and reproduce. Then, the main characteristic of Autopoiesis and the focus on a continuous dynamic implicated in any rudimentary form of knowledge or cognition, lead researchers to apply it to many forms of self-organisation in human society.

In summary, the kind of “action decision and performance” we are dealing with, can be carried out by an unconscious brain without the simultaneous awareness of any form of agency. Only later on, the outcomes of an individual action might appear to self-consciousness like a pre-recorded broadcast. The process of an action (reaching one of the hay sacks to eat) can neither be based on a single stochastic model nor on a pure deterministic response, but rather is a sophisticated blend of the two. One stochastic “decision” at a time (like throwing dice only once) wouldn’t lead to a coherent and adequate solution of the problem. Conversely, a strictly deterministic brain would not have the means to choose between the two hay sacks as discussed above. Our final hypothesis is that of a (brain) model responding to a mix of probabilistic trial-and-error behaviour that leads to a successful deterministic conclusion. First of all, the perception of hunger would certainly open some nervous pathways leading to a final target: the meaning of eating. Moreover, the mind is unlikely to spend its life deciding what to do if the sacks of hay are identical; it would be more likely to stuff itself with the first available sack.

A deterministic brain would stop in front of a choice, while a probabilistic-deterministic brain would swing from one solution to another, allowing its thoughts to consider a range of possible situations until it finds a coherent answer to the initial stimuli. Obviously “trial and error” is an efficient experiential method provided it is accompanied by a specific memory store. The ass’s response refers both to stimuli such as hunger, i.e. physiological stimuli, as well as stimuli coming from our memory and our personal experience (e.g., the emotional world of the limbic system). Since each individual has his or her own personal history, it follows that each individual’s actions are unique.

Imagine the Buridan paradox where instead of one hungry donkey, there are two donkeys standing in front of two hay

sacks. The probability that the donkeys will fight over the same sack must be very low.

THE SELF AND THE FREE WILL

Self-awareness and the Senses of Agency and of Ownership

The specific mechanisms operating to achieve human self-recognition have recently been elucidated.²³ Very early on, in the uterus and then after birth by physical contact and social communication, we develop the conviction that our body belongs to us and that it has distinctive psycho-physical characteristics which distinguish it from the rest of the world. However, the Sense of ownership (SoO) is only one of the constituents leading to self-recognition; concomitant with the sense of ownership we realize our self is always in motion. All the feed-back sensations associated with our movements generate a growing Sense of agency (SoA) internally. A conscious agent refers to SoA when he feels causally involved in an action.²⁴ Moreover, by moving or trying to move our body in any direction (to perform either a mechanical or a logical task), we not only explore the limits of our body but we also realize the limits of our own effective power. Mainly dependent on this prerequisite an individual can develop the critical distinction between self-generated actions and actions generated by others, from which, in turn, leads to the sense of responsibility, a key function for mature self-recognition. In this respect, some years ago it was demonstrated that a lesion impairing spatial recognition in the brain, does in fact impair self-recognition of movement.²⁵ Later on, specific brain areas which can finely discriminate between a first-person and a third-person action, were discovered using neuroimaging techniques.^{26,27}

Long ago, Tolman demonstrated that voluntary action performance is determined by the incentive value of the outcome of the action itself.^{28,29} So that, each appetitive behaviour triggered by a motivational system stands on specific incentive value.

The “Bignetti Model” (TBM)

In humans, pure appetitive motivational states are rare. Moreover, hedonic incentives to possess an object are often secondary. The need to reinforce egocentric attributes, however, such as self-recognition, self-responsibility and self-esteem appears to be the necessary and sufficient incentive, regardless of what the material target to be reached may be. We unconsciously consider the voluntary action as a type of egocentric challenge to raise our level of skill or knowledge. Every time we act, we have the opportunity to test the relative efficacy of our incentives; thus, we may not only infer new information about the stimuli, but we can also evaluate the adequacy of our motivational system. In other words, the cognitive processes and motivational systems appear to be linked because depending on the outcome of an action, we learn how to finely tune our motivational system

for the future.¹²

The 5 stages of TBM³⁰ are:

1. The so called “voluntary” action is decided and performed by the agent’s Unconscious Mind (UM) by means of probabilistic responses to inner and outer stimuli.
2. After a slight delay, the agent becomes aware of the on-going action through feedback signals (somatosensory, etc.) that are conveyed to the brain as a consequence of its performance. Thus, the agent’s Conscious Mind (CM) always lags behind unconscious activity.
3. Owing to this delay, the CM cannot know the unconscious work that precedes awareness; thus the CM erroneously believes it has freely decided the action. Though objectively false, this belief is subjectively perceived as true (FW illusion). It is so persistent and deep-rooted in the mind that the CM is unwilling to abandon it.
4. The FW illusion satisfies a psychological need to secure the arousal of the sense of agency (SoA) and of responsibility (SoR) of the action. Both SoA and SoR inevitably lead the CM to self-attribute reward or blame depending on action performance and outcome.
5. Both reward and blame are motivational incentives that foster learning and memory in the CM; the updating of knowledge will provide new information and the skill required for further action (restart from point 1).

An overview of TBM suggests that human knowledge evolves in a circular sequence of intervention from the UM to the CM and back to the UM. A scheme of the flow of these events is reported in figure 1. CM has a distinct though complementary role with UM. CM resides in the ego (with the Freudian significance). Not all the operations of the ego are conscious; however, in this context, we assume the ego acts according to the “reality principle” (i.e. the ability of the mind to assess the reality of the external world, and to act upon it accordingly). In our context the ego is a virtual representation of our personal identity that emerges as a conscious thinking entity. The ego believes itself to be independent when interacting with the environment; so, premeditation to obtain a goal can be psychologically attributed to the ego as a free causal agent.

According to TBM we might infer that the so-called “voluntary” action is just a reaction of UM to an external stimulus in order to attain a new equilibrium with the environment.^{12,13,30-35} The action protocol at best follows unconscious memory skills. At the very moment we do something we have no time to intellectualise about our action or consider the purpose of acting as premeditated so we cannot be fully conscious of the nature of action agency. However, a second later, the back

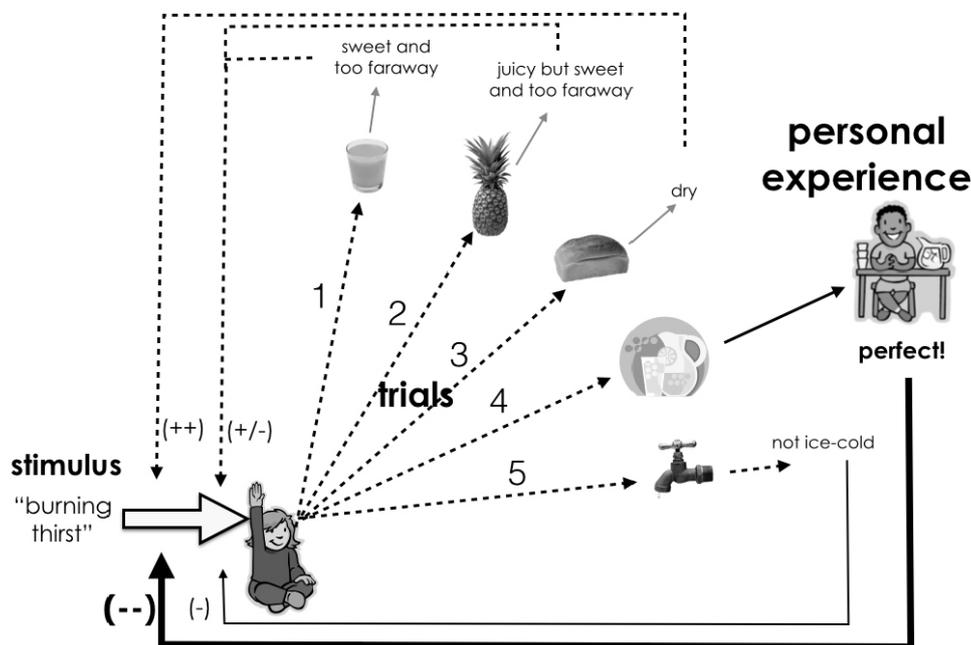


Figure 1: The course of a voluntary action according to TBM. Assume that's the first time that a burning thirst (external stimulus) is perceived by the boy; so, the past experience archived in memory stores cannot facilitate the unconscious mind (UM) in finding the correct trial that would extinguish it. Initially, the first choice is aleatory since the 5 hypotheses are equally probable. However, trial after trial, conscious mind (CM) can update memory stores on the basis of motivational incentives like reward and blame. Then, the trial and error paradigm of UM evolves towards a conditional probability, i.e. towards the choice 4 (perfect!) which CM has memorised as the most efficient one. Obviously, the less hypotheses remain, the faster and the more instinctive would be UM decision and the least will be CM intervention.

signals of the performing action draw the attention of the ego. Then, giving the ego the possibility to recall the overall timing of the event and analyse the action outcomes, it is beset with the sensation of having “wanted” and caused the action. Thus, the ego jumps to the false conclusion that it has freely decided that specific action among a number of options. The belief in FW has no rational basis, rather it looks like a self-referential appreciation of the ego exalting its power, i.e. a sort of psychological motivation to put itself in the forefront. Moreover, the false belief in FW which is the consequence of a subjective 1st person perspective, is not a mere psychological illusion. As a consequence of this illusion, the senses of agency (SoA) and of responsibility (SoR) arise in the ego leading it to self-attribute either a reward or blame, depending on the action outcomes. In cognitive sciences, reward and blame are generally considered the motivational incentives leading to action-decision making; in TBM, however, it appears in the ego ex-post. Therefore, every piece of experience leads to the updating of memory stores thus preparing the unconscious mind for further actions (restart from point 1). After a series of trials and errors, the ego has the opportunity to learn and memorise the correct protocol in response to the stimulus. In conclusion, the ego cannot decide an action, but can update its memory stores, thus providing the unconscious mind with the most accurate information possible with which to perform a similar action in the future.

According to the reductionist view of TBM, we might claim that the individual keeps believing in the ego as a spiritual

body-independent entity (with all the philosophical and psychological implications of the ambiguous nature of the individual self). In other words, the ego is the primary illusion of the mind, i.e. a virtual agent self-instantiated in mind *ad-hoc* to assume the responsibility of intentional actions. FW, which is a by-product of the ego, is also an illusion which, however, plays a functional role in cognition.^{30,32}

1st person and 3rd person perspectives

A further insight into understanding whether our FW is an illusion of the mind is based on perspective, i.e. the 1st person or the 3rd person perspective. My personal experience of self-consciousness sometimes alternating with an inner witness of the self, might shed some light on this aspect:

1. Self-consciousness: I have two personalities one of which belongs to the private sphere where I search for a pencil or eat quietly with my family; the other one belongs to the public sphere where I am engaged in scholarly discussion (for instance, when I’m publicly claiming that FW is an illusion!). In both situations I instinctively feel able to control my reactions with my innermost perceptions of SoA and SoR and am bewitched by the fascinating belief in FW. Both personality traits, public and private, coexist and alternate distinctly in the mind; even the transition from one to the other belongs to me, in accordance with Dennett’s phrase “My brain made me do it”.³⁶ These mental states do not enter into any psychological conflict with each

other. They alternate and never overlap either in time or in space but they are not so far apart as they might appear at first sight, originating from the same self.

According to the scientific literature, these personalities reflect “private self-consciousness” and “public self-consciousness”, respectively. The first is the introspection of the inner self and one’s feelings; the second, instead, is the awareness of the self as it might appear to others. These personality traits may co-exist without cross-influencing each other.³⁷ To these definitions I might add that the transition from one personality into the other, is perceived as an explicit fruit of my will, so that my belief in FW is reinforced. Moreover, both traits of Self-consciousness are conditioned by a unique subjective view (1st person perspective).

2. Inner witness: Sometimes during the day, I feel the awakening of an inner witness which, independent of psychological needs, desires and affects, begins observe my private and public personalities; likewise in a 3rd person perspective, it can analyse me, i.e. the 1st person, in a cold and detached way. It happens in certain self-inspired situations like in Hindu Transcendental Meditation where the first step in Sadhana (the ego-transcending spiritual practice pointing to the final target Moksha) is the awakening of the inner witness.

In summary, Psychology, then, seems to be the most suitable discipline for delving into the labyrinth of self-consciousness and is nearly able to give a reasoned answer to the question of whether decision-making is really free and whether FW is somehow a bias based on the 1st person or the 3rd person perspective.

The next question is: “how do the different kinds of self-consciousness and the inner witness become explicit in the mind? The most convincing theory in my opinion is the mechanism of “Inner Speech” (IS), also known as “intrapersonal communication”. IS is a sort of silent dialogue conducted with oneself at a fully- or semi- conscious level, in the mother tongue.

The Russian Vigotsky was the first to observe IS in children and suggested that it was a mental faculty fostering the development of higher cognitive functions. The mother tongue is learnt at an early stage and is spoken aloud for the purpose of social interaction; later it is internalized, first in a sub-vocal modality then in an inner modality. Inner speech constitutes a formidable tool not only to self-narrate and interpret the actions going on around us but also to guide personal behaviour by means of intimate reasoning. In contrast to the three major scientific theories (see: *constructivism, gestaltism and behaviourism*), Vigotsky proposed that learning always precedes maturation in children provided that they are accompanied in their early years by an external tutor.³⁸

We may suppose, then, that at the beginning of an indi-

vidual’s life the environment may be interpreted and memorized through very basic though vital language. Later on, individual thinking develops a higher level of sophistication until intrapersonal communication coincides with the mother tongue to enable communication with others. It is interesting to note that IS vanishes in automatic gestures, i.e. in a skill we have already acquired such as when crossing a street in a hurry at the green light or when we play a back-hand at tennis. It seems that in many repetitive actions, we no longer need to evoke the instructions to make them.

When I am aware of myself, I can constantly perceive IS: I am the one silently describing in Italian the thoughts going through my mind at this very moment. IS is not only a tool to describe the events around me but also a tool for reasoning about past actions, present desires, or future decisions (such as the wish to take the car, call someone by phone or have a drink instead of bread, etc.). Making this explicit reinforces SoA and SoR in my mind.³¹

This discussion typically provokes an epistemological debate in cognitive sciences about the meaning of “voluntary” action and the *ex-ante* or *ex-post* role of IS in action decision-making. The proposals of the scientific community may be divided into at least three main models:

- a. If one agrees with soul/mind-body duality and believes in FW, it is conceivable to think that action decision may be taken by a free or partially conditioned agent. Consequently, IS should play a significant role in decision making thus preceding the action.
- b. On the other hand, if one assumes a deterministic, non-dual position, the “voluntary” action, though made by a conscious agent, is a “conditioned” response dominated by cause-effect rules. Then, FW is a mere illusion and IS cannot mediate “proactive” thinking; at most, IS might be reduced to a chronicle of the action, i.e. a sort of void chattering.
- c. The third theory is TBM, another “non-dual”, reductionist position reconciling both 1st- and 3rd-person perspectives. Action-decision-making is carried out by the unconscious part of the mind (UM) on the basis of a statistical-probabilistic modality (see above for details). This is the first thought that is elaborated along the agency path, so it necessarily precedes the action itself. Slightly later, the agent becomes aware of what is occurring by means of feed-back sensory signals of the action performance and its outcomes. With the exception of very fast “gut” reactions (see below), these afferent signals are also translated by IS into a language comprehensible to the mind, so that SoA and its relative SoR can emerge in self-consciousness. The agent (the psychological Self) perceives that the action has been decided completely autonomously

and freely (FW illusion). SoA and SoR are a prerequisite for cognitive processes; even though they are false, they promptly foster IS to evaluate the action outcomes in order to self-attribute either the prize or the punishment, a necessary step for cognition.

There are several points to note: a) The belief in FW is a psychological need either of private and public self-consciousness to foster cognition. In other words, Self-consciousness and FW illusion represent a virtual binomial apt for cognition; b) the agent's affective conviction that he or she makes his or her own choices in daily life is a typical subjective 1st person perspective, while, the rational, detached approach of the functional role of FW illusion in cognition, leading the subject to perceive false SoA and SoR, is a 3rd person perspective. So 1st person perspective is necessary for the development of the individual knowledge while both 1st person and 3rd person perspectives are necessary for the development of scientific knowledge; c) IS is the tool by which the ego can converse with itself. The ego starts its dialogue too late to manifest a proactive effect in action decision-making but explicitly chronicles the events, then it can evaluate the action outcomes and reason with itself about the correctness and efficacy of the action. So, by means of IS, the agent can learn and memorize the correct protocol from the experience, thus making an action better and faster. Specific skills are ingrained in our memory so that a protocol based on trial and error is replaced by a single, instinctive and automatic gesture. Obviously, when this occurs, IS is no longer needed and the reaction time is so fast that IS vanishes (see above).

Jones and Fernyhough³⁹ claim in their "Forward Model" (FM) of motor control that IS is a form of action which precedes the action in order to create an emotional expectation of what is about to happen. If this expectation is promptly followed (milliseconds later) by the actual action, the perception of self-authorship will then increase. These authors admit that their FM borrows its ideas from Wegner's model of "apparent mental causation".^{40,41} However, Wegner's model does not clarify the ambiguity of the dual/non-dual position.³² Our objections to FM are as follows:

- a. The authors claim that IS is a "sort" of action; if this is the case then why this action is not preceded by a previous prediction state, or previous motor control of an intelligent agent? In a similar situation, Akins and Dennett's objection was that if IS is intelligently planned by a specific discourse plan, then there should be an intelligent entity planning IS and so we regress to infinity.⁴² We concur, and are unconvinced by Jones and Fernyhough's defence of FM in not assigning to IS a vital role in action planning. They circumvent this criticism claiming that the important thing is the mismatch between the predicted and the actual action; the mismatch is the crucial step that might lead to the neurological activity associated with passivity experiences, which may indeed lead to IS being experi-

enced as "unintended". However, assuming that instead of a mismatch there is a match between predicted and actual action, this event might unleash enormous affective implications on the growing the ego, i.e. on self-esteem and personal identity. In conclusion, with a matching situation the agent feels self-authorship, whereas, with a mismatch, the agent might ascribe his action to a stranger/an alien, lying to himself as if he were schizophrenic.

- b. Second, the authors seem to position the "motor command" timing of both IS and action milliseconds earlier than they actually occur. This is necessary to allow the final matching of the predicted and the actual action. IS should derive from the "desire state" which also programs action performance. Our question therefore is: "Who is really in charge of the motor command and IS? Moreover, IS is not used for action decision-making but only to check the final matching between expectations and the action itself. So, where does the awareness of a desire state (or action goal) come from?"
- c. FM theory claims that a matching mechanism occurs at the end of an action but nothing is said about the degree of matching for cognitive purposes. Since we cannot modify our trial and error in advance, it is more plausible that IS may be effective only when receiving information on what has already been done. Then, it would be plausible that cognition proceeds by means of a post-adaptive mechanism (through a sort of Darwinian cognitive mechanism); to this end, the real action is fragmented into tiny components to redirect the action by means of a "point-to-point protocol" (a similar hypothesis was proposed by Bodovitz)⁴³ in which IS though *ex post*, could really become useful along the action path to reach its goal.
- d. In FM, the main focus of interest is on the mismatch which determines the perception of other-authorship; nothing is said about events which may underlie further cognitive processes. In TBM, however, IS is an instrument of self-consciousness for the generation of intelligible experience with which to enrich the memory. A psychological reward for an achievement or punishment for failure in action performance is thought to have intrinsically the same epistemological value in TBM. In FM, the focus is more on the mismatch (and the other-authorship possibly deriving from it) rather than on the match (and self-authorship), and so there is a didactic asymmetry between prize and punishment taught by experience. In our opinion, the authors' intent was driven more by a concern for solving psychiatric problems than for proposing a model of human cognition.

TBM and Bayes' Decision Theory

The conditional probability calculated on the basis of

Bayes' theory (BT) is a widely used tool of information processing. Bayesian Decision Theory (BDT) and Artificial Intelligence (AI) share common roots and strive for similar goals by adopting the same probabilistic-computational approach of BT.⁴⁴⁻⁴⁶ Recently, it has been proposed that also the post-adaptive learning mechanism exhibited by TBM is compatible with BT.³⁰

Consider any two events A and E (with $P(E) > 0$); Bayes' equation:

$$P(A|E) = P(A) \times P(E|A)/P(E)$$

tells us how to update our degree of belief about A on the basis of the occurrence of E.⁴⁷ Some vocabulary:

- $P(A|E)$ stands for the "final" or also, less properly "posterior" probability of success of A, i.e. the hypothetical probability of A inferred on the basis of given E. In other terms it indicates the compatibility of experience E with the action A.
- $P(A)$ is the "initial" estimate of probability or also, less properly, "prior" probability.
- $P(E)$ is sometimes called the "marginal likelihood". This factor must be always positive. It is the same for all possible hypotheses being considered, since the term A does not enter it.
- $P(E|A)$ is the "likelihood function". It indicates the probability of observing E given action A or, in other terms, the compatibility of the final experience with a given hypothesis.
- $P(E|A)/P(E)$ is the "updating" factor, i.e. the term that multiplied by $P(A)$ can update the degree of belief of A.

Bayes' theorem can be applied to TBM with some specific caveats. We must consider that the conditional probability of success of action decision making may be calculated on the basis of this formula, given that:

- A crucial notion is the correlation between the events (see figure 1). On the one end, UM cannot know *a-priori* the effect of A; so, UM decides on A due to the close resemblance of the present situation with past experience (note this decision is the consequence of a conditioned will, not of free-will). On the other end, CM may evaluate the degree of success of A only after the occurrence of E. Therefore, the "updating" factor $P(E|A)/P(E)$ and, as a consequence, the degree of belief about A, will be revised by CM too late with respect to UM decision. This revision, however, will help UM in future (see point 5 of TBM).
- The agent's reaction A in response of a change E of the environment, has the aim to remove the stimulus and re-establish a new equilibrium. The resemblance between the interacting agent-environment system and the chemical equilibria according to Le Châtelier's principle is

striking.⁴⁸ This principle states that when a system near equilibrium is subjected to change in concentration, temperature, volume, or pressure, it readjusts itself to counteract the effect.

- In iterative actions, the "posterior" probability tends to match the "prior probability since the "updating" factor tends to 1; so, the interventions of CM and of IS are no longer needed (see "d" above). A further striking evidence is that the higher is the matching between results and expectations, the faster will be the action (see figure 1).
- $P(A|E)$ ranges between the limiting values 0 and 1 which correspond to two paradoxical situations, respectively: a virgin mind like a Lockean *tabula rasa* and a deterministic mind, like the "Laplace's Daemon". On the one hand, a decision made in the absence of any prior experience would be stochastic, with practically no chance of success; on the other hand, an intellect that would know all forces and the vast net of information set by nature would unequivocally be able to predict the future. As Laplace says: "... *Rien ne serait incertain pour elle, et l'avenir comme le passé, serait présent à ses yeux*".⁴⁹ This inference sounds like a deterministic prediction of the probabilism death.

Based on these principles, we are carrying out psychophysical experiments to monitor the time needed by a subject during voluntary actions in response to a series of known stimuli. Preliminary results seem to indicate that conscious "response" time reduces with trials, getting closer to the classic, instinctive "reaction" time. These data seem to corroborate the hypothesis of a post-adaptive cognitive mechanism and comply with the old Tolman's "cathexis" theory.²⁸⁻³⁰

CONCLUSIONS

The basic idea in TBM is that the brain is a probabilistic-deterministic machine using the trial and error paradigm in cognition. In particular, decisions are made by the agent's unconscious mind, while learning and memory processes fostered by personal experience are exclusively driven by the agent's conscious mind which is awoken by feed-back signals of action performance. So, what we learn and memorise from the outcome of a so-called "voluntary" action is a too-late experience for that specific action but it might be useful knowledge for the next one. The more repetitive a stimulus is the higher the likelihood of reacting faster and more efficiently to it.

Thus, TBM stands on a sort of "radical empiricism": it denies soul-body duality but admits the existence of a dual soul-body perspective in the mind as an inescapable "trick" which looks like a "teleological" design of evolution to increase cognition and respond optimally to environmental changes. This trick does not require a soul but simply a psychological mechanism giving rise to the virtual binomial Ego-FW.

In summary, the 1st and the 3rd person perspective can be reconciled in the name of human cognition: TBM (the 3rd person perspective of a voluntary action) claims that the conscious mind (the 1st person perspective of the agent) does not decide an action but can perform a psychological trick to make action experience comprehensible and fruitful. By assuming the ego and FW are real and by using inner speech to make the reasoning explicit and worthwhile, the agent is convinced he is fully responsible for the chain of events leading from a decision making to a fruitful experience.

In the preceding paper, we have discussed the potential impact of TBM in social life.³⁰ A great concern was given to the accountability of TBM in ethics. Moral rules enable social relationships to be organized on the basis of stable, predictable behaviour. Then, one might fear that, without FW, the conscious agent would not have sense of morality; however, he/she thinks to possess FW and this belief, though illusionary, is still real. As he/she perceives SoA and SoR as real these feeling make him/her responsible for determining their moral rules and their compliance with the law. It is evident that FW is an illusion but it is also evident that the FW illusion is the basis for human cognitive processes. So the solution of the moral question kicks the problem to how moral values can be imprinted by formal education together with familial and social environments.

Issues regarding the possible role of mirror neurons in TBM were also raised; they might play a primary role in agency and self-awareness, by facilitating the awakening of the agent's CM. According to TBM, the implication of mirror neurons in cognitive processes would come even prior than mimicking other's action.³⁰ In everyday life, the successful monitoring of behaviour requires continuous updating of the effectiveness of motor acts; one crucial step is becoming aware of the movements one is performing. To this regard, we should mention *anosognosia*, an interesting pathology which is viewed as a deficit of self-awareness. Sometimes, hemiplegic patients suffer from *anosognosia* and obstinately deny their motor impairment, claiming that they could move their paralyzed limbs. Denial was associated with lesions in several brain areas deputed to programming motor acts and the somatosensory cortex.⁵⁰ A review on the possible causes of *anosognosia* has been recently published;⁵¹ however, it is clear that further research is needed. Then, it might be interesting to investigate this disorder according to TBM perspective and see whether CM defect due to the lack of feed-back signals, might be the principal cause of self-awareness impairment.

REFERENCES

1. Lau HC, Passingham RE. Unconscious activation of the cognitive control system in the human prefrontal cortex. *J Neurosci*. 2007; 27: 5805-5811. doi: [10.1523/JNEUROSCI.4335-06.2007](https://doi.org/10.1523/JNEUROSCI.4335-06.2007)
2. Norris DJ. Principles of magnetic resonance assessment of brain function. *J Magn Res Imaging*. 2006; 23: 794-807. doi: [10.1002/jmri.20587](https://doi.org/10.1002/jmri.20587)
3. Huang D, Chen X, Fei D-Y, Bai O. A two dimensional brain-computer interface associated with human natural motor control, recent advances in brain-computer interface systems. In: Fazel R, Ed; 2011.
4. Griffin AL, Asaka Y, Darling RD, Berry SD. Theta-Contingent trial presentation accelerates learning rate and enhances hippocampal plasticity during trace eyeblink conditioning. *Behav Neurosci*. 2004; 118: 403-411. doi: [10.1037/0735-7044.118.2.403](https://doi.org/10.1037/0735-7044.118.2.403)
5. Cecotti H. Spelling with non-invasive brain-computer interfaces: current and future trends. *J Physiol*. Paris. 2011; 105: 106-114. doi: [10.1016/j.jphysparis.2011.08.003](https://doi.org/10.1016/j.jphysparis.2011.08.003)
6. McCane LM, Heckman SM, McFarland DJ, et al. P300-Based brain-computer interface (bci) event-related potentials (erps): people with amyotrophic lateral sclerosis (als) vs. age-matched controls. *Clin Neurophysiol*. 2015. doi: [10.1016/j.clinph.2015.01.013](https://doi.org/10.1016/j.clinph.2015.01.013)
7. McFadden J. The CEMI field theory: seven clues to the nature of consciousness. In: Jack A, ed. The emerging physics of consciousness. Springer, Berlin, 2006; 385-404.
8. Dennett DC. Quining qualia. In: Marcel AJ, Bisiach E, eds. Consciousness and contemporary science. 1988; 44-77.
9. Chalmers D. Facing up to the problem of consciousness. *JCS*. 1995; 2: 200-219.
10. Searle J. Mind, a brief introduction. Oxford University Press; 2004.
11. Koch C. Biophysics of computation. Oxford University Press; 1999.
12. Bignetti E. Dissacrazione della coscienza. In: Valico II, ed. Firenze; 2001.
13. Bignetti E. Cervello e mente: ovvero casualità e determinismo. *Ann Fac Med Vet Parma*. 2003; 23: 69-78.
14. Hodgkin AL, Huxley AF. A quantitative description of membrane current and its application to conduction and excitation in nerve. *J Physiol*. 1952; 116: 424-448.
15. Deco G, Rolls ET, Romo R. Stochastic dynamics as a principle of brain function. *Progress Neurobiol*. 2009; 88: 1-16.
16. Lagzi I, Soh S, Wesson PJ, Browne KP, Grzybowski BA. Maze solving by chemotactic droplets. *JACS*. 2010; 132: 1198-1199.

17. Johnson KA, Goody RS. The original michaelis constant: translation of the 1913 michaelis-menten paper. *Biochemistry*. 2011; 50: 8264-8269.
18. Berg JM, Tymoczko JL, Stryer L. Biochemistry. In: Freeman WH, ed. 5th ed. NY, USA; 2002.
19. Hilser VJ. An ensemble view of allostery. *Science*. 2010; 327: 653-654.
20. Bai F, Branch RW, Nicolau DV, Pilizota T, Steel BC. Conformational spread as a mechanism for cooperativity in the bacterial flagellar switch. *Science*. 2010; 327: 685-689.
21. Gazzaniga M. Who's in charge? Free will and the science of the brain. Hachette, UK; 2012.
22. Maturana HR, Varela JV. Autopoiesis and cognition: the Realization of the livings. Boston Studies in the Philosophy of Science. In: Cohen RS, Wartofsky MW, eds. Reidel Pub Co; Boston; 1980.
23. Jeannerod M. The mechanism of self-recognition in humans. *Behav Brain Res*. 2003; 142: 1-15. doi: [10.1016/S0166-4328\(02\)00384-4](https://doi.org/10.1016/S0166-4328(02)00384-4)
24. Gallagher S. Philosophical conception of the self: implication for cognition science. *TICS*. 2000; 4: 14-21. doi: [10.1016/S1364-6613\(99\)01417-5](https://doi.org/10.1016/S1364-6613(99)01417-5)
25. Daprati E, Sirigu A, Pradat-Diehl P, Franck N, Jeannerod M. Recognition of self-produced movement in a case of severe neglect. *Neurocase*. 2000; 6: 477-486. doi: [10.1080/13554790008402718](https://doi.org/10.1080/13554790008402718)
26. Farrer C, Frith CD. Experiencing oneself vs another person as being the cause of an action: the neural correlates of the experience of agency. *Neuroimage*. 2002; 15: 596-603. doi: [10.1006/nimg.2001.1009](https://doi.org/10.1006/nimg.2001.1009)
27. Farrer C, Franck N, Georgieff N, Frith CD, Decety J, Jeannerod M. Modulating the experience of agency: a positron emission tomography study. *Neuroimage*. 2003; 18: 324-333. doi: [10.1016/S1053-8119\(02\)00041-1](https://doi.org/10.1016/S1053-8119(02)00041-1)
28. Tolman EC. There is more than one kind of learning. *Psychol Rev*. 1949a; 56: 144-155.
29. Tolman EC. The nature and function of wants. *Psychol Rev*. 1949b; 56: 357-369.
30. Bignetti E. The functional role of free-will illusion in cognition: the bignetti model. *COGSYS*. 2014; 31-32: 45-60. doi: [10.1016/j.cogsys.2014.04.001](https://doi.org/10.1016/j.cogsys.2014.04.001)
31. Bignetti E. Consciousness can learn but cannot decide. *Ann Fac Med Vet Parma*. 2004; 24: 31-52.
32. Bignetti E. Free will is the illusionary by-product of self-perception. proc. of the 4th intl. nonlinear science conference, palermo. *The Soc For Chaos Theory in Psychology and Life Science*. 2010.
33. Bignetti E. Vie sensoriali e soft-brain. *Ann Fac Med Vet Parma*. 1994; 14: 65-95.
34. Bignetti E, Ghirri A. Mind and free will. *Ann Fac Med Vet Parma*. 2010; 30: 31-40.
35. Bignetti E. Ego and free will: a virtual binomial apt for cognition. Proc. Of Neuroplasticity and cognitive modifiability; Jerusalem; Medimond Editions; 2013.
36. Dennett DC. My Brain Made Me Do It (When Neuroscientists Think Can Do Philosophy). Max Weber Lectures (N° 201/01) Florence. 2011.
37. Simon B. Identity in modern society. Blackwell Publishing; 2004. doi: [10.1002/9780470773437](https://doi.org/10.1002/9780470773437)
38. Vygotsky LS. Mind in society: the development of higher psychological processes. Cambridge, MA: Harvard University Press. 1978.
39. Jones SR, Fernyhough C. Thought as action: inner speech, self-monitoring, and auditory verbal hallucinations. *Consciousness and Cognition*. 2007; 16, 391-399. doi: [10.1016/j.concog.2005.12.003](https://doi.org/10.1016/j.concog.2005.12.003)
40. Wegner DM, Wheatley T. Apparent mental causation: sources of the experience of will. *Am Psychologist*. 1999; 54: 480-492. doi: [10.1037/0003-066X.54.7.480](https://doi.org/10.1037/0003-066X.54.7.480)
41. Wegner DM. The illusion of conscious will. Massachusetts Institute of Technology. 2002.
42. Akins KA, Dennett DC. Who may i say is calling? *Behavioral and Brain Sciences*. 1986; 9: 517.
43. Bodovitz, S. The neural correlates of consciousness. *J Theor Biol*. 2008; 254: 594-598.
44. Moore JW, Fletcher PC. Sense of agency in health and disease: a review of cue integration approaches. *Consciousness and cognition*. 2012; 21: 59-68. doi: [10.1016/j.concog.2011.08.010](https://doi.org/10.1016/j.concog.2011.08.010)
45. Norris D. The Bayesian reader: explaining word recognition as an optimal Bayesian decision process. *Psychological Review*. 2006; 113: 327-357. doi: [10.1037/0033-295X.113.2.327](https://doi.org/10.1037/0033-295X.113.2.327)

46. Horvitz EJ, Breese JS, Henrion M. Decision theory in expert systems and artificial intelligence. *Intl J Approximate Reasoning*. 1988; 2: 247-302. doi: [10.1016/0888-613X\(88\)90120-X](https://doi.org/10.1016/0888-613X(88)90120-X)
47. Castagnoli E, Cigola M, Peccati L. Probability; Egea S.p.a., Milan; 2009.
48. Kay JJ. Application of the second law of thermodynamics and Le Châtelier's principle to the developing ecosystem. Handbook of Ecosystem Theories and Management. In: Jørgensen SE, Muller F, eds. CRC Press. Lewis publishers; 2000; 135-160.
49. Laplace PS. A philosophical essay on probabilities. John Wiley & Sons, New York. 1902.
50. Berti A, Bottini G, Gandola MPL, et al. Shared cortical analysis for motor awareness and motor control. *Science*. 2005; 15: 488-491. doi: [10.1126/science.1110625](https://doi.org/10.1126/science.1110625)
51. Heillman KM. Possible mechanism of anosognosia for hemiplegia. *Cortex*. 2014; 61: 30-42. doi: [10.1016/j.cortex.2014.06.007](https://doi.org/10.1016/j.cortex.2014.06.007)

Research

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Volume 1 : Issue 1

Article Ref. #: 1000PCSOJ1104

Article History:

Received: June 6th, 2015

Accepted: July 31st, 2015

Published: August 3rd, 2015

Citation:

Silver NC, Ullman J, Picker CJ. COMPCOR: a computer program for comparing correlations using confidence intervals. *Psychol Cogn Sci Open J*. 2015; 1(1): 26-28.

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COMPCOR: A Computer Program for Comparing Correlations Using Confidence Intervals

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ABSTRACT

Although there have been separate programs written for computing confidence interval procedures for independent and dependent correlations for some standard statistical software packages, the user must have solid knowledge of the statistical software package needed for their application. Moreover, if the confidence interval procedures are neither contained within a particular software package nor if there is a separate program or routine written to perform these procedures, then it becomes problematic for the user. Therefore, a user-friendly, interactive, stand-alone computer program written in FORTRAN 77, for a Windows environment, computes the confidence interval procedures for comparing independent and dependent correlations. The user simply inputs the necessary correlations and sample size and needs no intermediate or advanced knowledge of the statistical software package.

KEYWORDS: Independent correlations; Dependent correlations; Confidence intervals; Computer program.

ABBREVIATIONS: IT: Iowa Test of Basic Skills; CM: Children's Memory Scale; MBEMA: Montreal Battery of Evaluation of Musical Abilities.

INTRODUCTION

Comparing independent or dependent correlations is often based on standard statistical significance tests.¹⁻⁷ Independent correlations come from different samples. For example, suppose that a school administrator is interested in determining if there was a difference between the correlations of the mathematics scores on the Iowa Test of Basic Skills (IT) and scores on the Children's Memory Scale (CM) for grades 2 and 6 ($H_0: \rho_1 = \rho_2$). If the correlation for grade 2 was .50 and the correlation for grade 6 was .20 with sample sizes of 100 and 200, respectively, then the z-test for independent correlations would equal 2.79, $p < .01$. The conclusion would be that there is a significantly higher correlation between the mathematics scores of the IT and CM scores for grade 2 than for grade 6 children. Although the Fisher's z-test for examining the difference between independent correlations is shown in many standard statistics textbooks,¹ it is not usually contained in the standard statistical packages unless a researcher writes a separate program for performing it.

Dependent correlations, however, are those contained within the same sample. One hypothesis consists of testing the difference between two dependent correlations with one element in common ($H_0: \rho_{12} = \rho_{13}$). For example, suppose that the same administrator is interested in determining if the correlation between the mathematics scores on the IT would be significantly higher with CM scores ($r = .60$) than with the overall scores of the Montreal Battery of Evaluation of Musical Abilities (MBEMA) ($r = .30$) for 100 grade 5 children. Moreover, suppose that the correlation between the scores of the CM and MBEMA was .20. There are number of

procedures for testing the null hypothesis of $\rho_{12}=\rho_{13}$, that either compare the correlations using the t distribution² or *via* Fisher's z' transformation which purportedly distributes out as z.³ Research indicated that they were deficient under certain conditions with regard to Type I error rate and power.⁴ Consequently,⁵ offered Method D2 as an alternative to the standard techniques. They provided this alternative in R and S-PLUS programs. Nevertheless, using the³ z-test, the value was 2.832, $p<.01$ indicating that the correlation between mathematics scores on the IT and CM scores was significantly higher than the correlation between mathematics scores on the IT and MBEMA scores for grade 5 children.

A second hypothesis consists of testing the difference between two dependent correlations with no elements in common ($H_0:\rho_{12}=\rho_{34}$). Suppose that the administrator is now interested in determining if the correlation between the mathematics scores on the IT and CM scores would be higher ($r=.50$) after a brief memory skill course (e.g., mnemonics) than before one for grade 4 children ($r=.30$). Here is a hypothetical correlation matrix for a sample size of 50:

	IT before	CM before	IT after	CM after
IT before	–	.30	.75	.25
CM before		–	.15	.65
IT after			–	.50
CM after				–

Using the procedure,³ the z-test value was -1.75, $p>.05$. This indicates that there was no statistically significant difference between the correlations of the mathematics scores on the IT and CM scores before and after the mnemonic intervention for grade 4 children. In a simulation of four possible procedures for testing the null hypothesis of $\rho_{12}=\rho_{34}$, which included the z-test,³ one procedure was entirely too liberal, whereas the other three were a bit conservative when the predictor-criterion correlation was low.⁶ Nevertheless, the best significance test procedures for testing dependent correlations with zero and one element in common, based upon their findings,⁶ were programmed for Windows.⁷

Although statistical significance tests are used for test-

ing these hypotheses, more emphasis has been placed on confidence intervals for performing the same task. The confidence interval separately provides the magnitude and precision of the particular effect, whereas these characteristics are confounded in standard hypothesis testing *p* values⁸ provided confidence interval techniques which purportedly have better control of Type I errors and have more power than the standard statistical significance tests. Although many of these techniques have been programmed in R,⁹ and recently in SAS and SPSS as separate programs,¹⁰ the problem is that many researchers who are basic users of these packages or do not use them at all, may have difficulty in applying these programs. In some cases, researchers may resort to computing these techniques by hand. Therefore, in order to make these confidence interval approaches more generalizable to researchers, the purpose of the user-friendly, stand-alone program was to compute them for testing differences between: a) independent correlations;⁸ and b) two dependent correlations with either zero or one element in common⁸ in a Windows platform.

DESCRIPTION

The user is queried interactively for the particular test, correlations, sample size, and the confidence interval probability (e.g., 95%). The normal curve value associated with computing the confidence interval for the individual correlations was obtained using the algorithm by.¹¹ The program responds with a restatement of the input correlations, sample size, the confidence interval for the individual correlations, the confidence interval for testing the differences between correlations and a brief statement mentioning that confidence intervals containing zero are non-significant. The program is written in FORTRAN 77, using the GNU FORTRAN compiler, and runs on a Windows PC or compatible. The output is contained in COMPCOR.OUT.

Sample outputs based upon the hypothetical scenarios are given in Tables 1-3. The output indicates there are no differences in the general conclusions using the confidence interval approach⁸ and the standard statistical significance tests.⁶ Although there were no differences in the general conclusions, given the findings of⁷ in terms of Type I error rates and power,⁸ it is still important for researchers to have a potentially better option at their disposal.

The difference between independent correlations	Sample Sizes	Confidence Interval for r1	Confidence Interval for r2	Confidence Interval for the difference between r1 and r2
		The 0.9500 confidence interval for 0.5000	The 0.9500 confidence interval for 0.2000	The 0.9500 confidence interval for the difference between 0.5000 and 0.2000
r1=0.5000	r1=100.0000	has a lower bound of 0.3366	has a lower bound of 0.0630	has a lower bound of 0.0915
r2=0.2000	r2=200.0000	and an upper bound of 0.6341	and an upper bound of 0.3296	and an upper bound of 0.4917

If the interval contains 0, then it is non-significant.

Table 1: Sample output from COMPCOR for testing the difference between independent correlations.

Testing the difference between dependent correlations with one element in common	The sample size	Confidence Interval for r12	Confidence Interval for r13	Confidence Interval for the difference between r12 and r13
		The 0.9500 confidence interval for 0.6000	The 0.9500 confidence interval for 0.3000	The 0.9500 confidence interval for the difference between 0.6000 and 0.3000
r12 = 0.6000	100.0000	has a lower bound of 0.4575	has a lower bound of 0.1101	has a lower bound of 0.0914
r13 = 0.3000		and an upper bound of 0.7125	and an upper bound of 0.4688	and an upper bound of 0.5098

If the Interval contains 0, then it is non-significant.

Table 2: Sample output from COMPCOR for testing the difference between dependent correlations with one element in common.

Testing the difference between correlations with no elements in common	The sample size	Confidence Interval for r12	Confidence interval for r34	Confidence Interval for the difference between r12 and r34
		The 0.9500 confidence interval for 0.3000	The 0.9500 confidence interval for 0.5000	The 0.9500 confidence interval for the difference between 0.3000 and 0.5000
r12=0.3000	50.0000	has a lower bound of 0.0236	has a lower bound of 0.2575	has a lower bound of -0.4307
r34=0.5000		and an upper bound of 0.5338	and an upper bound of 0.6833	and an upper bound of 0.0235

If the Interval contains 0, then it is non-significant.

Table 3: Sample output from COMPCOR for testing the difference between dependent correlations with no elements in common.

AVAILABILITY

COMPCOR.FOR and the executable version (COMPCOR.EXE) may be obtained at no charge by sending an e-mail request to N. Clayton Silver, Department of Psychology, University of Nevada, Las Vegas, Las Vegas, NV 89154-5030 at fdn-silvr@unlv.nevada.edu.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

- Howell DC. Statistical Methods for Psychology. 8th ed. Belmont, CA: USA Wadsworth; 2010.
- Williams, EJ. The comparison of regression variables. *J of the Royal Stat Soc. Series B (Methodological)*. 1959; 396-399.
- Dunn OA, Clark VA. Correlation coefficients measured on the same individuals. *J Am Stat Assoc* 1969; 64, 366-377. doi: [10.1080/01621459.1969.10500981](https://doi.org/10.1080/01621459.1969.10500981)
- Hittner JB, May K, Silver NC. A Monte Carlo evaluation of tests for comparing dependent correlations. *J of Gen Psy*. 2003; 130: 149-168. doi: [10.1080/00221300309601282](https://doi.org/10.1080/00221300309601282)
- Wilcox R, Tian T. Comparing dependent correlations. *J of Gen Psy*. 2008; 135: 105-112. doi: [10.3200/GENP.135.1.105-112](https://doi.org/10.3200/GENP.135.1.105-112)
- Silver NC, Hittner JB, May K. Testing dependent correlations

with nonoverlapping variables: A Monte Carlo simulation. *J of Exp Ed*. 2004; 73: 53-69. doi: [10.3200/JEXE.71.1.53-70](https://doi.org/10.3200/JEXE.71.1.53-70)

- Silver NC, Hittner JB, May K. A FORTRAN 77 program for comparing dependent correlations. *App Psy Meas*. 2006; 30: 152-153. doi: [10.1177/0146621605277132](https://doi.org/10.1177/0146621605277132)
- Zou GY. Toward using confidence intervals to compare correlations. *Psy Meth*. 2007; 12, 399-413. doi: [10.1037/1082-989X.12.4.399](https://doi.org/10.1037/1082-989X.12.4.399)
- Diedenhofen B, Musch J. cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. Website: comparingcorrelations.org 2015; Accessed June 27, 2015.
- Weaver B, Wuensch KL. SPSS and SAS programs for comparing Pearson correlations and OLS regression coefficients. *Beh Res Meth*. 2013; 45: 880-895.
- Wichura MJ. Algorithm AS241: The percentage points of the normal distribution. *App Stat*. 1988; 37: 477-484. doi: [10.2307/2347330](https://doi.org/10.2307/2347330)