Zbornik 17. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2014

Zvezek C

Proceedings of the 17th International Multiconference

INFORMATION SOCIETY – IS 2014

Volume C

Kognitivna znanost
Cognitive Sciences

Uredili / Edited by
Olga Markič, Toma Strle, Urban Kordeš, Matjaž Gams

http://is.ijs.si

9.–10. oktober 2014 / October 9th–10th, 2014
Ljubljana, Slovenia

Zbornik 17. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2014

Zvezek C

Proceedings of the 17th International Multiconference

INFORMATION SOCIETY – IS 2014

Volume C

Kognitivna znanost

Cognitive Sciences

Uredili / Edited by

Olga Markič, Toma Strle, Urban Kordeš, Matjaž Gams

http://is.ijs.si

9. - 10. oktober 2014 / October 9th - 10th, 2014
Ljubljana, Slovenia

Uredniki:

Olga Markič

Toma Strle

Urban Kordeš

Matjaž Gams

Založnik: Institut »Jožef Stefan«, Ljubljana
Priprava zbornika: Mitja Lasič, Vesna Lasič, Lana Zemljak
Oblikovanje naslovnice: Vesna Lasič, Mitja Lasič

Ljubljana, oktober 2014

CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

165.194(082)(0.034.2)

MEDNARODNA multikonferenca Informacijska družba (17 ; 2014 ; Ljubljana)
Kognitivna znanost [Elektronski vir] : zbornik 17. mednarodne multikonference - IS 2014, 9-10 oktober 2014, [Ljubljana, Slovenia] : zvezek C = Cognitive sciences : proceedings of the 17th International Multiconference Information Society - IS 2014, October 9th-10th, 2014, Ljubljana, Slovenia : volume C / uredili, edited by Olga Markič ... [et al.]. - El. knjiga. - Ljubljana : Institut Jožef Stefan, 2014

Način dostopa (URL): http://library.ijs.si/Stacks/Proceedings/InformationSociety
ISBN 978-961-264-073-6 (pdf)
1. Gl. stv. nasl. 2. Vzp. stv. nasl. 3. Dodat. nasl. 4. Markič, Olga
27997735

PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2014

Multikonferenca Informacijska družba (http://is.ijs.si) s sedemnajsto zaporedno prireditvijo postaja tradicionalna kvalitetna srednjeevropska konferenca na področju informacijske družbe, računalništva in informatike. Informacijska družba, znanje in umetna inteligenca se razvijajo čedalje hitreje. Čedalje več pokazateljev kaže, da prehajamo v naslednje civilizacijsko obdobje. Npr. v nekaterih državah je dovoljena samostojna vožnja inteligentnih avtomobilov, na trgu pa je moč dobiti kar nekaj pogosto prodajanih tipov avtomobilov z avtonomnimi funkcijami kot »lane assist«. Hkrati pa so konflikti sodobne družbe čedalje bolj nerazumljivi.

Letos smo v multikonferenco povezali dvanajst odličnih neodvisnih konferenc in delavnic. Predstavljenih bo okoli 200 referatov, prireditev bodo spremljale okrogle mize, razprave ter posebni dogodki kot svečana podelitev nagrad. Referati so objavljeni v zbornikih multikonference, izbrani prispevki bodo izšli tudi v posebnih številkah dveh znanstvenih revij, od katerih je ena Informatica, ki se ponaša s 37-letno tradicijo odlične evropske znanstvene revije.

Multikonferenco Informacijska družba 2014 sestavljajo naslednje samostojne konference:

- Inteligentni sistemi
- Izkopavanje znanja in podatkovna skladišča
- Sodelovanje, programska oprema in storitve v informacijski družbi
- Soočanje z demografskimi izzivi
- Vzgoja in izobraževanje v informacijski družbi
- Kognitivna znanost
- Robotika
- Jezikovne tehnologije
- Interakcija človek-računalnik v informacijski družbi
- Prva študentska konferenca s področja računalništva
- Okolijska ergonomija in fiziologija
- Delavnica Chiron.

Soorganizatorji in podporniki konference so različne raziskovalne in pedagoške institucije in združenja, med njimi tudi ACM Slovenija, SLAIS in IAS. V imenu organizatorjev konference se želimo posebej zahvaliti udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2014 bomo drugič podelili nagrado za življenjske dosežke v čast Donalda Michija in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Janez Grad. Priznanje za dosežek leta je pripadlo dr. Janezu Demšarju. V letu 2014 četrtič podeljujemo nagrado »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobila nerodna izvedba piškotkov, jagodo pa Google Street view, ker je končno posnel Slovenijo. Čestitke nagrajencem!

Niko Zimic, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2014

The Information Society Multiconference (http://is.ijs.si) has become one of the traditional leading conferences in Central Europe devoted to information society. In its 17th year, we deliver a broad range of topics in the open academic environment fostering new ideas which makes our event unique among similar conferences, promoting key visions in interactive, innovative ways. As knowledge progresses even faster, it seems that we are indeed approaching a new civilization era. For example, several countries allow autonomous card driving, and several car models enable autonomous functions such as "lane assist". At the same time, however, it is hard to understand growing conflicts in the human civilization.

The Multiconference is running in parallel sessions with 200 presentations of scientific papers, presented in twelve independent events. The papers are published in the Web conference proceedings, and a selection of them in special issues of two journals. One of them is Informatica with its 37 years of tradition in excellent research publications.

The Information Society 2014 Multiconference consists of the following conferences and workshops:

- Intelligent Systems
- Cognitive Science
- Data Mining and Data Warehouses
- Collaboration, Software and Services in Information Society
- Demographic Challenges
- Robotics
- Language Technologies
- Human-Computer Interaction in Information Society
- Education in Information Society
- 1st Student Computer Science Research Conference
- Environmental Ergonomics and Psysiology
- Chiron Workshop.

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, SLAIS and IAS.

In 2014, the award for life-long outstanding contributions was delivered in memory of Donald Michie and Alan Turing for a second consecutive year. The Programme and Organizing Committees decided to award the Prof. Dr. Janez Grad with the Michie-Turing Award. In addition, a reward for current achievements was pronounced to Prof. Dr. Janez Demšar. The information strawberry is pronounced to Google street view for incorporating Slovenia, while the information lemon goes to cookies for awkward introduction. Congratulations!

On behalf of the conference organizers we would like to thank all participants for their valuable contribution and their interest in this event, and particularly the reviewers for their thorough reviews.

Niko Zimic, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

KONFERENČNI ODBORI
CONFERENCE COMMITTEES

International Programme Committee

Vladimir Bajic, South Africa
Heiner Benking, Germany
Se Woo Cheon, Korea
Howie Firth, UK
Olga S. Fomichova, Russia
Vladimir A. Fomichov, Russia
Vesna Hljuz Dobric, Croatia
Alfred Inselberg, Izrael
Jay Liebowitz, USA
Huan Liu, Singapore
Henz Martin, Germany
Marcin Paprzycki, USA
Karl Pribram, USA
Claude Sammut, Australia
Jiri Wiedermann, Czech Republic
Xindong Wu, USA
Yiming Ye, USA
Ning Zhong, USA
Wray Buntine, Finland
Bezalel Gavish, USA
Gal A. Kaminka, Israel
Mike Bain, Australia
Michela Milano, Italy
Derong Liu, Chicago, USA
Toby Walsh, Australia

Organizing Committee

Matjaž Gams, chair
Mitja Luštrek
Lana Zemljak
Vesna Koricki-Špetič
Mitja Lasič
Robert Blatnik
Mario Konecki
Vedrana Vidulin

Programme Committee

Nikolaj Zimic, chair
Franc Solina, co-chair
Viljan Mahnič, co-chair
Cene Bavec, co-chair
Tomaž Kalin, co-chair
Jozsef Györkös, co-chair
Tadej Bajd
Jaroslav Berce
Mojca Bernik
Marko Bohanec
Ivan Bratko
Andrej Brodnik
Dušan Caf
Saša Divjak
Tomaž Erjavec
Bogdan Filipič
Andrej Gams
Matjaž Gams
Marko Grobelnik
Nikola Guid
Marjan Heričko
Borka Jerman Blažič Džonova
Gorazd Kandus
Urban Kordeš
Marjan Krisper
Andrej Kuščer
Jadran Lenarčič
Borut Likar
Janez Malačič
Olga Markič
Dunja Mladenič
Franc Novak
Vladislav Rajkovič
Grega Repovš
Ivan Rozman
Niko Schlamberger
Stanko Strmčnik
Jurij Šilc
Jurij Tasič
Denis Trček
Andrej Ule
Tanja Urbančič
Boštjan Vilfan
Baldomir Zajc
Blaž Zupan
Boris Žemva
Leon Žlajpah
Igor Mekjavić
Tadej Debevec

KAZALO / TABLE OF CONTENTS

Zbornik 17. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2014

Zvezek C

Proceedings of the 17th International Multiconference

INFORMATION SOCIETY – IS 2014

Volume C

Kognitivna znanost

Cognitive Sciences

Uredili / Edited by

Olga Markič, Toma Strle, Urban Kordeš, Matjaž Gams

http://is.ijs.si

9. - 10. oktober 2014 / October 9th - 10th, 2014
Ljubljana, Slovenia

Multiconference Information Society 2014
Cognitive Science
October 9th – 10th 2014
Uredili / Edited by Olga Markič, Toma Strle, Urban Kordeš, Matjaž Gams

Jožef Stefan Institute, Ljubljana

This year's Cognitivne Science conference encompasses a wide variety of contributions from many different disciplines of and approaches to cognitive science. Contributions from authors from four different countries include theoretical as well as empirical research. Theoretical work tackles some core problems of philosphy of mind and cognitive science (such as the question of naturalistic understanding of the mind, the question of the right level of studying cognitive processes, the role of consciousness, etc.) and neuroethics. Empirical research presented includes studies both from the area of first-person research (empirical phenomenology) as well as from third-person sciences, such as neuroscience (fMRI, TMS , EEG… studies), psychology, educational sciences and other more clinically oriented approaches to understanding human mind in health and disease. One of the main goals of this year's conference is to highlight the need for critically evaluating, exposing and discussing various ethical questions rapidly emerging in many subfields of cognitive science. Some of important neuroethical topics and issues presented include: the issue of cognitive enhancement, the question of influence of consciousness on behaviour and its implications for moral responsibility, the question of implications of mechanistic understanding of human mind, implications of placebo studies for neuroethics, ethical questions pertaining to the use of serious games in child psychotherapy, etc. Contributions from the area of neuroethics form an important part of the conference since we believe that ethical considerations of research in sciences of the mind should by no means be neglected.

We have two main hopes for this year's cognitive science conferece, besides hosting excellent researchers. Firstly, we hope to foster reflection and critical discussion of ethical issues relevant for cognitive science and science in general. Secondly, we hope this year's conference opens the space for networking, debate, and exchange of knowledge between disciplines and different ways of thinking about the mind — connecting local and international, young and seasoned researchers.

Toma Strle
Olga Markič
Zala Kurinčič
Urban Kordeš
Matjaž Gams

Theta Burst Transcranial Magnetic Stimulation in the Treatment of Depression

Ruben Perellón Alfonso[1,2], Miroslav Henry Heriban[1,3], Indre Pileckyte[1,2], Matjaž Hegedič[4], Maja Kojović[1], Jure Bon[1]

[1]Laboratory for Cognitive Neuroscience, Department of Neurology, University Medical Centre Ljubljana, Slovenia

[2]University of Vienna, Austria

[3]Comenius University in Bratislava, Slovakia

[4]University of Ljubljana, Slovenia

e-mail: ruben.palfonso@gmail.com

ABSTRACT

In this paper we present the therapeutic possibilities offered by transcranial magnetic stimulation (TMS) in the treatment of depression in general and treatment resistant depression (TRD) in particular. An overview of the actual state of the art in the treatment of TRD shows that repetitive TMS (rTMS), is a young but widely used alternative to electroconvulsive therapy (ECT). A new set of TMS protocols have recently been developed and seem to improve on the positive results of rTMS, while reducing the discomfort and risks associated with the procedure. We announce the study plan to test the efficacy of these protocols thoroughly. Finally we present the preliminary methodological tests conducted to assess the feasibility of the study.

1 INTRODUCTION

This study is part of a larger developing project at the Neurological clinic (UKC Ljubljana), which focuses on the use of TMS in the treatment of depression (Influence of different transcranial magnetic stimulation protocols on biomarkers and symptoms of depression). Major depression disorder (MDD) is a mental disorder characterized by feelings of low self-esteem, emptiness, anxiety and loss of interest for otherwise pleasurable activities. It can be a severely disabling condition for patients, negatively affecting both their private and public lives, habits and general health. MDD is most commonly treated pharmacologically with antidepressants and with the use of psychotherapy, however a sizeable portion of patients fail to respond to such treatment, developing a condition called treatment resistant depression (TRD). This project is concerned with TMS acting as an alternative treatment mostly in cases of TRD, which (depending on definition) accounts for between 20 to 30% of all depression cases and 60% of overall MDDs [1]. TRD is a highly relapsing (higher readmission rate than general MDDs) and potentially chronic condition that is associated with increased mortality, disability and comorbidity, which in turn generates high healthcare and other indirect costs [1].

The most prominent alternative biological treatments (compared to psychotropic drugs) are electroconvulsive therapy (ECT) and the newly emerging TMS. While ECT is highly effective (50-60% for TRD, 80% for MDD [2]), it is associated with various adverse side effects (most notably retrograde amnesia, but temporarily also confusion, disorientation and anterograde amnesia) [2], thus it is considered a last-resort treatment. For this reason, emphasis has been recently put on exploring TMS as a safer, less invasive alternative treatment, however also less effective.

1.2 Repetitive Transcranial Magnetic Stimulation

One of the alternative electrical brain stimulation methods used in treatment of MDD is repetitive TMS (rTMS). It differs from ECT in many ways: it is a method of stimulating the cortex with a repetitive application of short magnetic pulses instead of a direct current that is used in ECT. Only a small area of the brain is stimulated (namely the dorsolateral prefrontal cortex – DLPFC), a seizure is not triggered and the administration can be done while the patient is awake. There are virtually no adverse cognitive effects after the treatment [3].

Over the last decade, enough evidence has emerged to establish rTMS as a viable, but modestly effective treatment of MDD. Most recent studies suggest that around 35-40% of patients reach remission after undergoing rTMS treatment [4], however, efficacy varies significantly across different stimulation protocols. A protocol is mainly defined by the stimulation intensity, frequency, duration and coil position. In conventional rTMS treatment protocols, DLPFC is stimulated with intensities ranging from 80% up to 120% of a patient's resting motor threshold (RMT), at frequencies ranging from 0,5 up to 20 Hz, in several 2-60 second long trains.

There is presently no consensus on optimal stimulation protocols for rTMS treatment and in an effort to improve its efficacy, novel methods are being studied and sought after. One of the proposed alternatives to the conventional rTMS is the Theta-burst stimulation (TBS) protocols.

1.3 Theta Burst Stimulation

One of the main drawbacks of the conventional rTMS treatment protocols in use today is that the procedure itself is long-lasting and generally considered quite unpleasant for the patient. TBS, on the other hand, offers significantly lower stimulation intensity and duration in comparison to conventional rTMS. In TBS, the cortex is stimulated with 3-5 pulse high-frequency bursts (30-50 Hz) delivered with a frequency corresponding to the Theta rhythm range (4-7 Hz) [5]. The most prominent TBS protocol, proposed by Huang [6], and sometimes referred to as standard TBS protocol, consists of bursts of three pulses separated by 20ms (50 Hz) delivered every 200ms (5 Hz) (Figure 1). In standard TBS, intensity is set at 80% of a patient's active motor threshold (AMT), and the stimulation itself lasts only 20 or 40s (300 or 600 pulses, respectively). This means the experience is less unpleasant for the patient, which is the primary advantage of TBS over conventional rTMS; however, that is meaningful only under the assumption that TBS is effective in treating MDD as well.

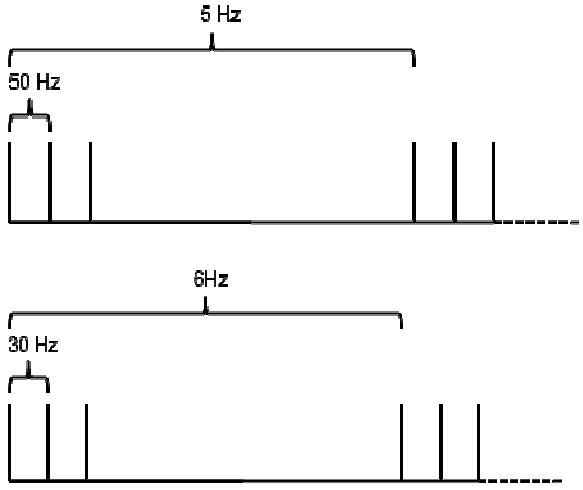


Figure 1: *Diagram of the 50 Hz (upper) and 30 Hz (lower) cTBS protocols. Both protocols consist of bursts composed of 3 pulses delivered at either 50 or 30 Hz frequency. Bursts are delivered either in 5 or 6 Hz frequency respectively, and up to a total of 100 to 200 bursts.*

Since its introduction in 2005 until today, most of the research done on TBS has dealt with its application to the primary motor cortex (M1), since the modulatory effects of cortical stimulation are the most measurable there (using measures such as motor evoked potentials - MEPs). A comparison of various studies shows that these effects, both excitatory and inhibitory, last longer after TBS than any other conventional rTMS protocol (Figure 2). Whether such comparisons of rTMS and TBS effects on M1 are also valid for DLPFC, remains an open question; in part because very little is known about actual neurobiological mechanisms of TBS. Electric brain stimulation works by inducing neuroplasticity (the strengthening and weakening of synapses, and modifications of neuronal ion channel function) – structural changes that lead to functional changes. However, consensus is yet to be reached on how this happens. One hypothesis proposes long-term depression- and potentiation-like effects where NMDA receptors play a role [6], while some others put emphasis on GABA and BDNF receptors as well [5].

Long-lasting neuroplastic TBS after-effects were also demonstrated outside of the motor cortex; for example, measurable improvement has been shown in stroke patients suffering from visual neglect after stimulation of the contralesional posterior parietal cortex (PPC). The effects lasted up to 32 hours [7]. In a similar study, TBS stimulation of PPC in healthy subjects caused behavioral changes [8]. Recently, it has also been successfully used to induce neuroplasticity in the somatosensory cortex [9]. We have encountered only a couple of studies using TBS in treatment of MDD directly. One study, done on 7 TRD patients, has shown a consistent significant improvement after TBS [10], however other contributing factors were not well controlled. Another compared TBS treatment to a sham stimulation control group, finding measurable improvements, but the sample size of the latter (n=4) was too small for results to be statistically significant [11].

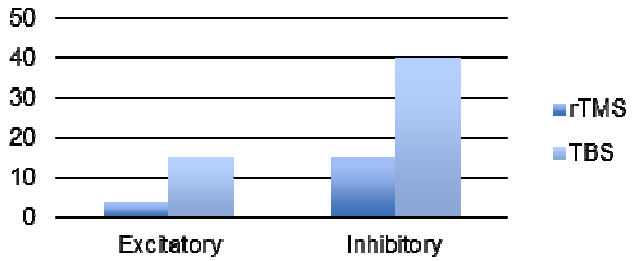


Figure 2: *Duration of neuroplastic effects after stimulation, in minutes* [4].

1.4 TMS and the Primary motor cortex

Since the response of the DLPFC to inhibitory TMS protocols cannot be assessed directly, we decided to measure the effects of these protocols on the primary motor cortex (M1), which could indicate a similar response for different brain structures. As of now, studies on the effects of TMS protocols on M1 are fairly common. One innovative aspect involves the possible cumulative effects produced by the repeated application of inhibitory TMS protocols over an extended period of time, which is one of the two innovative additions we intend to incorporate into

our study. Continuous theta-burst stimulation (cTBS), as a modification of the conventional low frequency inhibitory rTMS protocols is considered to be generally of lower stimulation intensity, shorter application time per session and with longer-lasting after-effects when compared to the latter alternative [5]. The most extensively used cTBS protocol in motor system studies is the 50 Hz protocol [12]. There is also a relatively novel 30 Hz cTBS protocol that shows promise of more stable and perhaps longer-lasting inhibitory effects [13, 14].

2 PRELIMINARY EXPERIMENTAL PROTOCOL

The effects of the 50 and 30 Hz cTBS protocols will be assessed and compared by means of various single- and paired-pulse TMS techniques and by recording the responses at a chosen muscle using electromyography (EMG). The other significant innovative aspect of our study will be the continuous recording of EEG data (TMS-EEG technique) in order to deepen the understanding of TBS effects on the cortex.

3 METHODOLOGICAL CONSIDERATIONS

3.1 Simultaneous EEG and TMS

The introduction of EEG in TMS experiments poses one fundamental drawback: an increase in the distance between the TMS coil and the scalp. In order to ensure that this would not jeopardize the study, we compared MEP amplitude and resting motor threshold (RMT) before and after 50 Hz TBS, both with and without the EEG cap. The results show a slight decrease in RMT and MEP amplitude when the EEG cap is on the scalp, however TBS produced clear facilitation in both cases. Moreover, hot spot localization was not altered or made difficult to find by the EEG cap. The results of this methodological test led us to conclude that while the increase of distance produces a slight decrease in MEP amplitude and RMT, such decrease is negligible regarding the effectiveness of TBS.

3.2 Intrinsic variability of TMS induced MEPs

It is a well known issue in TMS studies that variability of MEP amplitude from one trial to another is considerable [15]. It is also expected that this variability can increase due to factors such as, inaccurate definition of the optimal point of stimulation, coil movement throughout a series of trials or inappropriate coil inclination and orientation respect to the scalp. Given that our study would mostly rely on MEP data for assessing the effects of TBS we deemed important to ensure that our methods are according to standards in TMS. To this regards we recorded various EMG measurements in consecutive days to ensure that the coil position and thresholds are consistently measured over different sessions. This test was conducted on one volunteer and the results indicate that we were successful in finding approximately the same optimal point of stimulation in consecutive sessions. RMT was also similar and the variability observed in MEP data shows that we are within the usual 20% for TMS studies.

4 CONCLUSION

In this paper we have shown that TMS opens a new array of possibilities for treating DMM. Particularly TBS is a very attractive candidate for treatment, due to its lower risk, greater comfort and, presumably, higher stability. Therefore, we consider an essential goal in research of both depression treatment and TMS in general, to test thoroughly the possibilities and benefits of these innovative protocols over traditional rTMS.

Having successfully finished the fundamental methodological testing, the piloting of the actual study here sketched and justified will start at the time of submission of this extended abstract. Preliminary results will be presented at the conference.

References

[1] Fekadu, A., Wooderson, S. C., Markopoulo, K., Donaldson, C., Papadopoulos, A., & Cleare, A. J. (2009). What happens to patients with treatment-resistant depression? A systematic review of medium to long term outcome studies.*Journal of affective disorders*, 116(1), 4-11.

[2] Allan, C. L., & Ebmeier, K. P. (2011). The use of ECT and MST in treating depression. *International Review of Psychiatry*, 23(5), 400-412.

[3] Daskalakis, Z. J., Levinson, A. J., & Fitzgerald, P. B. (2008). Repetitive transcranial magnetic stimulation for major depressive disorder: a review. *Canadian journal of psychiatry. Revue canadienne de psychiatrie*, 53(9), 555-566.

[4] George, M. S., Taylor, J. J., & Short, E. B. (2013). The expanding evidence base for rTMS treatment of depression. *Current opinion in psychiatry*, 26(1), 13-18.

[5] Cárdenas-Morales, L., Nowak, D. A., Kammer, T., Wolf, R. C., & Schönfeldt-Lecuona, C. (2010). Mechanisms and applications of theta-burst rTMS on the human motor cortex. *Brain topography*, 22(4), 294-306.

[6] Huang, Y. Z., Chen, R. S., Rothwell, J. C., & Wen, H. Y. (2007). The after-effect of human theta burst stimulation is NMDA receptor dependent. *Clinical Neurophysiology*, 118(5), 1028-1032.

[7] Nyffeler, T., Cazzoli, D., Hess, C. W., & Müri, R. M. (2009). One session of repeated parietal theta burst stimulation trains induces long-lasting improvement of visual neglect. *Stroke*, 40(8), 2791-2796.

[8] Cazzoli, D., Wurtz, P., Müri, R. M., Hess, C. W., & Nyffeler, T. (2009). Interhemispheric balance of overt attention: a theta burst stimulation study. *European Journal of Neuroscience*, 29(6), 1271-1276.

[9] Jacobs, M. F., Tsang, P., Lee, K. G., Asmussen, M. J., Zapallow, C. M., & Nelson, A. J. (2014). 30 Hz Theta-burst Stimulation Over Primary Somatosensory Cortex Modulates Corticospinal Output to the Hand. *Brain stimulation*, 7(2), 269-274.

[10] Holzer, M., & Padberg, F. (2010). Intermittent theta burst stimulation (iTBS) ameliorates therapy-resistant depression: a case series. *Brain stimulation*, 3(3), 181-183.

[11] Plewnia, C., Pasqualetti, P., Große, S., Schlipf, S., Wasserka, B., Zwissler, B., & Fallgatter, A. (2014). Treatment of major depression with bilateral theta burst stimulation: a randomized controlled pilot trial. *Journal of affective disorders*,156, 219-223.

[12] Huang, Y. Z., Edwards, M. J., Rounis, E., Bhatia, K. P., & Rothwell, J. C. (2005). Theta burst stimulation of the human motor cortex. *Neuron*, 45(2), 201-206.

[13] Goldsworthy, M. R., Pitcher, J. B., & Ridding, M. C. (2012). A comparison of two different continuous theta burst stimulation paradigms applied to the human primary motor cortex. *Clinical Neurophysiology*, 123(11), 2256-2263.

[14] Wu, S. W., Shahana, N., Huddleston, D. A., & Gilbert, D. L. (2012). Effects of 30Hz Theta Burst Transcranial Magnetic Stimulation on the primary motor cortex. *Journal of neuroscience methods*, 208(2), 161-164.

[15] Awiszus, F. (2014). Of thresholds and" hot spots". Quo vadis transcranial magnetic stimulation?. *Clinical neurophysiology: official journal of the International Federation of Clinical Neurophysiology*.

WHAT CAN WE LEARN FROM OBSERVATION AND FILMING OF A BABY?

Tina Bregant
Paediatrics ambulatory unit, Health Centre Medvode

e-mail: tina.bregant@siol.net

ABSTRACT

In the article we present what can we learn from observation and videotaping a baby. We focus on spontaneous activity of a baby. We present General Movements (GM) Assessment. By discussing 3 pertinent patients, babies aged one to three months, from the ambulatory unit, we learn that GM assessment is a quick, non-invasive and cost-effective way to identify neurological issues which may lead to cerebral palsy and other developmental disabilities. The assessment is most reliable from birth to 3 months of age, later on some modification to observation must be incorporated, which we learn from a baby with traumatic brain injury.

Keywords: General Movements (GMs), spontaneous activity, early development, baby.

1 INTRODUCTION

First nontherapeutic research of babies which included observation and documentation of it, was performed during world wars. Anatomist Davenport Hooker from the University of Pittsburgh performed and filmed between 1932 and 1963 more than 150 human fetuses and studied their reflexive movement (Wilson, 2014). His research, though not possible anymore due to different ethics standards we follow today, has changed the perspective on foetuses, babies, as well as biomedical research. Technological advances in ultrasonic scanning and magnetic resonance imaging (MRI) have made it possible to observe and document the babies and fetuses in vivo, allowing us to observe the spontaneous movements of the fetus already in the womb. With advaced medical care the survival of preterm babies improved and we are able to observe babies of the same gestational age both in utero as well as in incubators, which enable us to understand specific developmental issues.

The pioneering work on baby's development, including observation, documentation, and assessment tool was developed by professor Heinz Prechtl, a Developmental Neurologist, from Graz in Austria. His first reports came from term babies and observation of their behaviour while he was working as a researcher in Gronningen, Netherlands. He described spontaneous movement, now called general movement (GM) in term babies and discovered that the quality of spontaneous general movements in the fetus and young infant could provide information on the integrity of the young nervous system. His approach to the qualitative assessment of general movements in newborn infants is nowadays a widely used, highly sensitive and specific tool in the prediction of neurological impairments.

2 GENERAL MOVEMENTS (GMS)

General movements (GMs) are a distinct movement pattern that is evident in babies before birth (foetuses from 9 weeks) and after birth (up to 18 weeks post-term). The movement pattern is observed when the baby does it spontaneously and without any external stimulation, such as a parent playing or talking to them. Observation of GMs are helpful in the early diagnosis of an impaired central nervous system, By observation of GM we can predict later neurological conditions. If a baby is assessed as being ‘at risk’ of having cerebral palsy, then intervention can start early with potentially better outcomes for the child.

GM is frequently observed in the preterm period, followed through sequential weeks until it is dropped out until around 20 weeks after term. However, GMs continue to exist several months after the expected date of delivery, but they are changed in quantity as well as quality. Hopkins and Prechtl (Hopkins in Prechtl, 1984) characterized GMs as changing in nature, from

a writhing phase to a fidgety phase at about 2 months after the expected date of delivery. After that, according to Einspieler et al. (Einspieler et al., 1997) GMs gradually disappear at about 60 weeks of postmenstrual age. Recently, studies on GMs have shown that a qualitative assessment of GMs is a better predictor of neurological outcome than the traditional neurological examination using a reflex test (Prechtl, 1997; Cion et al.,1997). These studies indicate that GMs may play a role in the transition from movements in the early preterm period to later behavior, reflecting the maturitiy and integrity of nerve system.

Apart from whole body movements, baby engage also in parial body activities. Studies have shown that infants engage in prenatal hand–mouth contact (HMC) and hand–face contact from the 12th week of gestation. Interestingly, we can observe this movement continuously during the development, in premature babies this movement reflecting the immaturity of their nerve systems. HMCs and hand–face contacts in the preterm period have been observed in preterm infants as well as fetuses in the womb. Butterworth and Hopkins (Butterworth and Hopkins, 1988) filmed spontaneous arm and hand movements of newborn babies. Detailed analyses of the films revealed that a newborn baby can move her hand to her mouth either directly or indirectly via the perioral region of the face, and that the mouth opens in anticipation of the arrival of the hand. Butterworth and Hopkins suggested that HMC by newborn babies involves coordinated movements between the hand and the mouth. However, this can well be just a coincidence, due to the fact, that newborns' arms are usually observed in a flexed posture, which brings their hands close to their face, thus making it easier for their hands to make contact with their mouths (Hopkins et al., 1988).

Along with HMCs, other spontaneous movements that appear later in development have been noted in the movements of preterm infants in the preterm period. These observations suggest that birth at about 40 weeks gestation is not accompanied by a profound change in the infant's neurological and behavioural repertoires, although a few distinct exceptions do exist. Prechtl (Prechtl, 1997) insisted that many neural functions characteristic of the fetus continue after birth, until a major transformation takes place at the end of the second postnatal month. Butterworth (Butterworth, 1990) also described three types of newborn behaviour. Some newborn behaviour may exist as the temporary continuation of an intrauterine activity, which soon diminishes with no further implications for development. Other behaviour develops from birth and is not present in the intrauterine environment, such as the Moro reflex. A third type of newborn behaviour may be a continuation of intrauterine activity, anticipating, to some degree, the needs of later development. However, the variety of spontaneous movements has not been thoroughly classified in early development, and their relationships to developments in early motor behaviours are still unclear because of the methodological difficulties associated with demonstrating a link between neonatal and later behaviour. When observing a baby, one takes into account GMs, HMC as other behaviour. General impression following the Gestalt principle, is also incorporated into evaluation of a baby.

3 METHODS

We have selected three babies, low-risk term infants and followed them regularly during their development in our outpatients departement. They were selected using video recordings due to the pertinent signs, they showed:

-one healthy baby girl (aged 3 months), with typical GMs and vocalization;

-one healthy baby boy with asymmetry (most pertinent at 1 month, almost normal at 3 months), who only after filming identification of problem was possible and the work-up was done. A benign cyst in tegmentum was found.;

-one healthy term baby girl (aged 3 months), who had a traumatic brain injury at age of 6 months and at 11 months showed a distinctive pattern, which can resemble an unskilled eye to a 3-month baby.

Each infant was videotaped several types, for presentation only the most pertinent videotapes were used. We obtained the parents' informed consent. The parents agreed on educational use of the videotapes of their children.

The infants were filmed for 3–10 min on a bed or a therapeutic mat in the outpatients' clinics. The video camera was positioned above the infants. During the observation period, the infants were naked and free to move in the supine position. Assessment was done with video, not simultanously.

From the videotaped recordings, judgments were made about the state of each infant using Prechtl's five states' criteria (Prechtl, 1997):
-stage 1: the infants' respiration was regular and its eyes were closed;
-stage 2: respirations were irregular, the eyes were closed and the body was moving;
-stage 3: respirations were regular and the eyes were open;
-stage 4: respirations were irregular, the eyes were open and the body was moving;
-stage 5: the infant was crying.
Actograms of the infants' movements were made by transcribing the videotaped recordings. The actograms included the 11 categories of spontaneous movements employed by Prechtl and Cioni (Cioni, Ferrari and Prechtl, 1989). We observed also HMC, which was characterized as putting the fingers and/or thumbs in the mouth. When the infants showed no movement, their postures were outlined in the actograms.

4 RESULTS

The assessment can be done by observing the baby as they lay in a natural situation, such as on a mat on the floor. However the assessment can best be done by watching a video of the child in that same situation, which we present practically. By observing three babies we have learnt from different developmental issues which were identifiable only by observation and after analysis of videotapes.

5 CONCLUSIONS

Our examination of the behaviours of three selected infants suggests that careful examination of a newborn as well as thee month old baby points to the developmental issues which are otherwise not easily accesible. As important neural transformations in humans take place at the end of the second postnatal month, exam of a three month baby is very valuable to a general paediatritian, who has no access to other diagnostics tools but his own observation and clinical exam.

5 REFERENCES

1. Butterworth, G. (1990). On U-shaped and other transitions in sensorimotor development, in: A. Ribaupierre (Ed.), Transition Mechanisms in Child Development, vol. 94, Cambridge University Press, Cambridge, 1990, 283–296.
2. Butterworth, G., Hopkins, B. (1988). Hand–mouth coordination in the new-born baby. British journal of developmental psychology, 6, 303–314.
3. Cioni, G., Ferrari, F., and Prechtl, H.F.R. (1989).Posture and spontaneous motility in full term infants. Early human development, 18, 247–262.
4. Cioni, G., Prechtl, H.F.R., Ferrari, F., et al. (1997). Which better predicts later outcome in full-term infants: quality of general movements or neurological examination? Early human development, 50, 71–86.
5. Einspieler, C., Prechtl, H.F.R., Ferrari, F. et al. (1997). The qualitative assessment of general movement in preterm, term and young infants: review of the methodology. Early human development, 50, 47–60.
6. Hopkins, B., Janssen, B., Kardaun, O., et al. (1988). Quieting during early infancy: evidence for a developmental change?. Early human development, 18, 111–124.
7. Hopkins, B., Prechtl, H.F.R. (1984). A qualitative approach to the developments during early infancy, in: H.F.R. Prechtl (Ed.), Continuity of Neural Functions from Prenatal to Postnatal Life. Clinical Developmental Medicine, 94, Blackwell, Oxford, 1984, 179–197.
8. Prechtl, F.H.R.(1997). Editorial: state of the art of a new functional assessment of the young nervous system. Early human development, 50, 1–11.
9. Wilson, E.K. (2014). Ex utero: live human fetal research and the films of Davenport Hooker. Bulletin of the history of medicine, 88, 1.

Cognitive function test battery evaluation for repeated use

Nadja Kobold (a), Grega Repovš (b), Liana Machado (c), Mara Bresjanac (a)
(a) Laboratory for Neural Plasticity and Regeneration, Institute for Pathophysiology, University of Ljubljana Faculty of Medicine, Zaloška 4, Ljubljana, Slovenia; T: +386 1 543 7033;
(b) Mind and Brain Laboratory, Department of Psychology, University of Ljubljana Faculty of Arts, Ljubljana, Slovenia;
(c) Department of Psychology, University of Otago, Dunedine, New Zealand.

ABSTRACT

The aim of this work was to evaluate a battery of computerised neuropsychological tests in healthy young adults in order to determine the suitability of this battery for repeated use in research of pharmacological and nonpharmacological manipulations of cognitive functions. The battery tested five domains: visuomotor, inhibitory, response switching, selective attention, and working memory. The results showed that some of the simpler tests displayed reproducible outcomes across six test sessions, whereas several more difficult tests displayed clear practice-dependent improvement both acutely and over two-week intervals. This calls for further battery testing and stresses the need for careful study designs when employing these and similar cognitive function tests in research.

1 INTRODUCTION

Research of pharmacological challenges and various nonpharmacological interventions on cognitive functions requires robust and stable tests of different cognitive domains for reliable assessment of subjects' performance under different conditions and over time. In preparation for research of pharmacological and nonpharmacological manipulation of cognition, a short battery of cognitive function tests was developed to assess a wide range of domains: visuomotor, inhibitory control, response switching, selective attention and working memory. The aim of this study was to evaluate the stability of results obtained with this cognitive test battery upon repeated use in healthy adult subjects.

2 SUBJECTS AND METHODS

Fifteen subjects of both genders, aged between 19 and 33 volunteered to participate in the study and signed the informed consent form. They chose optimal time for their cognitive performance and were always tested at the same time of day. All subjects were right-handed and had normal or corrected-to-normal vision.

The subjects completed the battery of 9 tests on three days separated by 14 day intervals. On each test-day two consecutive 30 minute test sessions were administered, separated by a 10 minute intermission, when the subjects rested at the test station while their attention was engaged by listening to an audio recording via a headset.

Testing was always done at the same computer test-station with a 21-inch LCD screen, keyboard and mouse. The stimuli were displayed on a black background using the MATLAB program (The MathWorks, Natick, MA) and the Psychophysics Toolbox.

During the first visit the subjects observed a demonstration of all the tests performed by the experimenter, who also explained test requirements and ensured that the subjects understood every task. When seated at the test station, the subjects could read instructions for each subsequent test on screen and confirmed that they had read and understood the info by clicking the space bar. The same click activated a practice run of the same test. They had to actively select to either repeat the practice run or advance to the actual test.
Tests progressed in the order from simpler to more complex tasks with higher cognitive demand. The battery comprised the following tests:
- *simple reaction time* ([1]; key press in response to a visual stimulus),
- *pro reaction time* ([1]; key press on the side of the screen, where a green square appears),
- *anti reaction time* (a version of antisaccade task [2]; key press on the side of the screen, opposite to where the red square appears),
- *pro/anti reaction time* ([3]; switching between pro and anti key press in response to red and green squares),
- *Simon* ([4]; left key press for one of two target consonants, right key for the other; letters appear left or right of the fixation point resulting in congruent and incongruent target-position combinations),

- *flanker* ([5]; two target letters, assigned to left and right keys; simultaneous appearance of target and distractor letter; key press for target only when appearing on fixation dot position, distractor letter above or below; distractor can be the same letter as target (congruent) or different from target (incongruent trial))
- forward spatial span ([6]; 9 stationary gray squres on screen illuminate in random sequences (increase in length from 2 - 9 squares); mouse click on squares to indicate the order of illumination)
- backward spatial span ([7]; same as forward spatial span, but clicking in reverse order of illumination sequence), and
- two-back ([8]; 90 letters appear one at a time, left key press indicates the appearance of the letter that was on screen two letters before (match), right key indicates recognition of a new letter (non-match).

As stated, for forward and backward spatial span tests, participants responded using mouse. For the other tests, they responded by pressing the 'a' (left) or the 'l' (right) keyboard key (marked with yellow dots) in adherence to the instructions for each test.

Test results (reaction times and accuracy) were subjected to a two-way repeated measures ANOVA with factors day and session. $p < 0.05$ was considered significant.

3 RESULTS

The composite image in Figure 1 shows group results on individual tests across the three visits (axis labels days 1, 2 and 3) and for both sessions on each day (1st session - red, 2nd session - cyan). Significant differences are indicated in every graph. The simple visuomotor tests showed stable results (no significant differences in simple, pro or anti reaction times). The anti/pro test showed a significant reduction in reaction times between consecutive sessions on the same day as well as across the three visits. Tests of cognitive inhibition showed a significant improvement in reaction times across days. The two-back working memory task showed significant improvement in accuracy and reaction times across 3 days and from the first to the second session on the same day, and there was a significant session x day interaction for reaction times and accuracy in two-back match recognition. The spatial working memory tasks showed either no significant difference (forward spatial span) or an effect of day and an effect of session for the more difficult backward spatial span task.

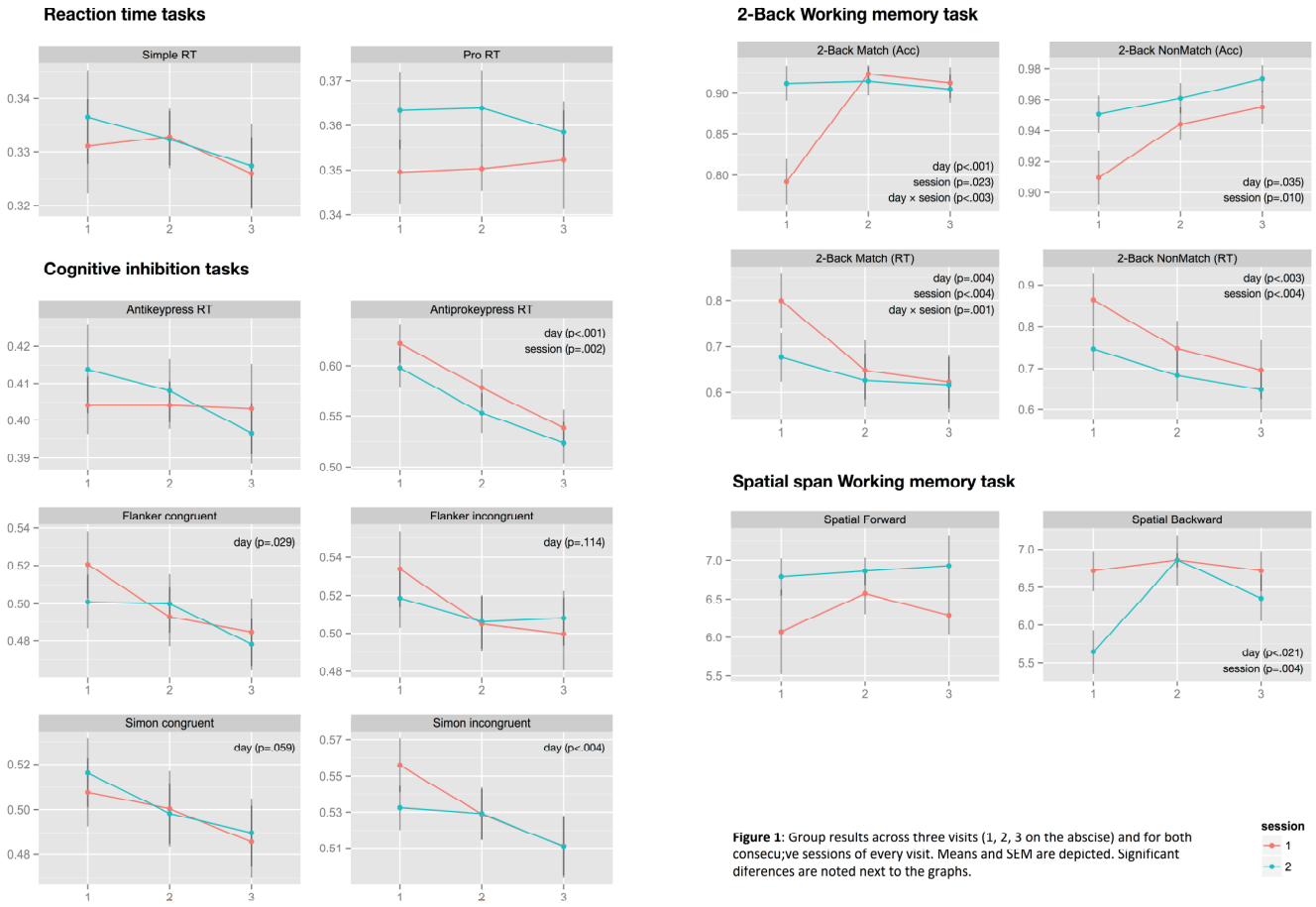


Figure 1: Group results across three visits (1, 2, 3 on the abscise) and for both consecu;ve sessions of every visit. Means and SEM are depicted. Significant diferences are noted next to the graphs.

4 DISCUSSION

The study aimed to evaluate the short battery of computerised cognitive function tests to determine if it can be used in future research of pharmacological and nonpharmacological challenges to cognitive function in healthy adult subjects. The result of the current study show that some tests displayed stability and reproducibility across all testings, while others showed practice effects between successive sessions on the same day and between visits, separated by two-week intervals. The simpler tests in our battery displayed higher outcome consistency and the more difficult tests showed improvement on re-testing. It is plausible that the subjects performed the simpler tasks at near peak capacity already at the first visit and had no room for improvement under basal conditions, while also not manifesting significant fatigue across testing sessions and visits. With the more difficult tests the practice effects are visible in improved results not only from the first to the second session on the same day, but also across the three visits, spaced two weeks apart. By far the weakest performance on the first session of the first day suggests that the observation of the battery tasks performed by the experimenter did not sufficiently prepare the subjects for the subsequent test demands. This could be circumvented by introducing a single familiarization session or by training candidate subjects with the same battery prior to the first testing until they reach a plato - an approach that would require experimental validation prior to battery employment as a research tool. In regards to the aim of the present study, it seems that unless the effects of pharmacological challenges and other interventions were very pronounced, some tests in our battery would not be likely to reveal them.

5 CONCLUSION

The results suggest that some, but not all of the tests in the present battery can be employed to study possible cognitive effects of pharmacological and nonpharmacological challenges.

6 ACKNOWLEDGEMENT

This work was supported by the ARRS grant P3-0171 (MB).

References

[1] Lemay S, Bédard M-A, Rouleau I, Tremblay P-LG. Practice effect and test-retest reliability of attentional and executive tests in middle-aged to elderly subjects. Clin Neuropsychol 2004; 18: 284-302.
[2] Hallett PE. Primary and secondary saccades to goals defined by instructions. Vision Res 1978; 18: 1279-96.
[3] Diamond A, Briand L, Fossella J, Gehlbach L. Genetic and neurochemical modulation of prefrontal cognitive functions in children. Am J Psych 2004; 161: 125-32.
[4] Simon JR, Wolf JD. Choice reaction time as a function of angular stimulus- response correspondence and age. Ergonomics 1963: 6: 99-105.
[5] Eriksen BA, Eriksen CW. Effects of noise letters upon the identification of a target letter in a nonsearch task. Perception & Psychophysics 1974; 16: 143-9.
[6] Kessels RPC, van Zandvoort MJE, Postma A, Kappelle LJ, de Haan EHF. The Corsi block-tapping task: Standardization and normative data. App Neuropsych 2000; 7; 252-8.
[7] Koenigs M, Barbey AK, Postle BR, Grafman J. Superior parietal cortex is critical for the manipulation of information in working memory. J Neurosci 2009; 29: 14980-6.
[8] Jonides J, Schumacher EH, Smith EE, Lauber EJ, Awh E, Minoshima S, Koeppe RA.. Verbal working memory load affects regional brain activation as measured by PET. J Cog Neurosci 1997; 9: 462-5.

Učenje matematike s pomočjo umetnosti

Anja Brezovnik[1], Tina Bregant[2]

[1] Pedagoška fakulteta, Univerza v Ljubljani, Slovenija
[2] Predšolska ambulanta, Zdravstveni dom Medvode, Slovenija

e-mail: anja.brezovnik@gmail.com

POVZETEK

V prispevku predstavimo utemeljitve, ki pomagajo razumeti vlogo umetnosti pri učenju matematike. Za razumevanje matematike so pomembne izkušnje, ki jih otroci sprva pridobivajo preko lastnega telesa, nato pa preko izkušenj iz okolja. Otroci spoznavajo količine preko igre: ko razvrščajo kamenčke po velikosti, obliki in barvi; zbirajo različne odpadle listke ali nalepke. Pri tem spoznavajo količine, kar je ključno kasneje pri razumevanju abstraktnih matematičnih konceptov. Korakanje po taktu, ploskanje, učenje izštevank, spoznavanje, kdo je večji in kdo manjši, kdo ima več bonbonov, miselne predstave, vključno z razumevanjem perspektive, kot jih razvija likovna umetnost, pa predstavljajo različne modalnosti, ki vse označujejo količino in lahko pomembno pripomorejo pri prehodu iz intuitivnega razumevanja matematike v bolj abstraktne pojme, ki vključujejo algoritme in zahtevnejše miselne operacije.

Ključne besede: matematične kompetence, otroci, šolanje, pedagoško delo, umetnost

1 UVOD

Slovenski osnovnošolci sprejemajo in razumejo matematiko zelo različno. Nekaterim je najljubši predmet, mnogim vzbuja strah in marsikdo se bojuje z negativno oceno (Kavkler, Žerdin in Magajna, 1991). Nekateri se v njej hitro znajdejo, a takih učencev je malo. Drugi so srednje dojemljivi in nimajo posebnih težav pri dojemanju pojmov, oziroma se te pokažejo le pri določenih delih snovi. Ni pa zanemarljivo malo tistih učencev, z resnejšimi težavami (Zajc in Koželj, 2001). Matematika je predmet, ki ima v predmetniku poleg slovenščine največ ur na teden, 4–5 ur. Poleg tega, pri njej dobivajo učenci izmed vseh predmetov najpogosteje negativne ocene; teh je kar 30% (Peklaj, 2012; Kavčič, 2005).

Kakovost pouka matematike hromi tudi strah učencev, ki se pojavi že v prvih letih šolanja (Forgasz in Rivera, 2012). Zanj je značilno tesnobno duševno stanje, zaradi v naprej pričakovanih neprijetnosti. Posledično strah uničuje spoznavne strategije in delovni spomin (Ashcraft, 2002). Predavatelji so prepričani, da gre za posledico napačnega pristopa poučevanja. Zato nekateri univerzitetni učitelji dobršen del posredovanja svojega pedagoškega dela namenjajo načinom poučevanja, s katerim bi ga omilili. Ena izmed učinkovitih rešitev je v vključevanju umetnosti v pouk matematike.

2 RAZVOJ MATEMATIČNIH KOMEPTENC

Novejše raziskave kažejo, da je ljudem usvajanje aritmetičnih sposobnosti vrojeno (Bregant, 2012; Levstek, Bregant in Peklaj, 2013). Ocenjevanje številčnosti neke skupine, primerjanje dveh števil oz. količin po velikosti ter osnovno seštevanje (dodajanje) in odštevanje (odvzemanje) so biološko določene sposobnosti in so vrojene tako živalim kot ljudem (Chochon idr.,1999; Dehaene, 1997, 2009; Feigenson, Dehaene in Spelke, 2004). Lahko bi jih imenovali tudi 'smisel za števila' ali matematična intuicija; nekateri to sposobnost imenujejo numerična kognicija. Sestavljata jo dva temeljna koncepta: prvi je

količina in se nanaša na kardinalnost niza objektov oz. dogodkov ter odgovarja na vprašanje »Koliko?«, drugi koncept pa je rangiranje oziroma razvrščanje in se nanaša na vprašanje »Na kateri poziciji?« (Nieder in Dehaene, 2009).

V razvoju otrok prepoznamo razvojna obdobja, v katerih lahko opazujemo izrazit telesno-gibalni napredek, čustveni in socialni ter spoznavni razvoj. Teorija kognitivnega razvoja otrok Jeana Piageta pravi, da razvoj sledi časovno določenim stopnjam, ki jih lahko opišemo kot zaznavno – gibalna, predoperativna, konkretno operativna in formalno operativna faza (Piaget, 1959; v Marjanovič Umek, 2001). Otroci do drugega leta starosti svet doživljajo predvsem skozi telesno-gibalne zaznave in sposobnosti. V zgodnjem otroštvu lahko opazujemo refleksne odzive in večinoma naključno vedenje. Do šestega leta starosti večina otrok razvije simbolno mišljenje, ki presega zaznavne izkušnje. Do enajstega leta večina otrok usvoji logično in fleksibilno mišljenje, razvije se prostorska predstava, otrok usvoji sposobnost kategorizacije, iskanja vzročnosti in dojemanja konstantnosti količine. Šele po enajstem letu pa se razvije abstraktno mišljenje, konkretne stvari lahko otrok zamenja s simboli, otroci postanejo zmožni učenja algebre in analize ter razumevanja metafor. Po Piagetovem mnenju poznajo otroci do drugega leta starosti zgolj zaznavno-gibalno razumevanje števil, ne posedujejo pa razumevanja aritmetike. Do šestega leta naj ne bi bili posebej dovzetni za aritmetiko, logično-matematične izkušnje pa naj bi začeli pridobivati šele kasneje, s spominskim oziroma rutinskim učenjem in brez uporabe intuicije (Dehaene, 1997). Vigotski (1962; v Marjanovič Umek idr., 2001) poudarja pomen učenja, ki je strukturirano tako, da nekoliko presega že doseženo razvojno stopnjo. Meni, da je z učenjem potrebno spodbujati razvoj. Usvajanje kompetenc med vrstniki je zanj ključnega pomena. Tudi Bruner (1966; v Marjanovič Umek, 2001) poudarja pomen učenja in trdi, da nobene vsebine same po sebi niso pretežke, saj jih otrok dojema na njemu lasten način.

Otrok spoznava svoje okolje sprva preko lastnega telesa, nato pa vstopa v interakcijo z okoljem. Pri matematičnem mišljenju si lahko zelo učinkovito pomagamo s predmeti, ki nas obdajajo. Tako lahko otroci za spodbudo matematične intuicije predmete zlagajo, razvrščajo, jih enačijo po obliki ali neki drugi podobnosti. S tem začenjajo razumeti prve matematične koncepte. Ko vidijo neko količino fizično predstavljeno, si lahko zanjo ustvarijo ustrezno miselno predstavo; to količino lahko tudi poimenujejo in označijo, na primer dolžina, čas, masa (Bristow, Cowley in Daines, 2001). Prve matematične izkušnje učencev postavlja učitelj tudi izhajajoč iz konkretnih problemskih situacij, ki pa jih lahko odrasla oseba razume drugače od učencev. Na primer, zastaviti vprašanje, koliko barve potrebuješ, da prepleskaš svojo sobo, je konkreten problem, za katerega pa ne moremo reči, da izhaja iz učenčevih realnih izkušenj (Cotič, 2011).

3 UČENJE MATEMATIKE PREKO RAZLIČNIH MODALNOSTI

Na področju vključevanja umetnosti v pouk matematike je bilo do zdaj izvedenih največ povezav med matematiko in glasbo, nato med matematiko in plesom/gibom, najmanj pa v povezavi z likovno umetnostjo. Škoda, da ne bi pedagogi pogosteje koristili prednosti, ki jih likovna umetnost nudi učencem na področju vidnih predstav. Združevanje teh predmetov je lahko uspešen način, da učenci najdejo svoje močne poti in prek njih podprejo znanje šibkejšega predmeta (Shaffer, 1997; Eisenberg, 1997; Elliott, 2005). Raziskovalka matematike na področju osnovne šole Clausen May zagovarja stališče, da lahko razvoj slikovne predstave v možganih pomaga učencem na preprostejši način razumeti ključne

matematične koncepte (Clausen May, 2005). Holtzman in sodelavci so redno sodelovali pri izvajanju likovno-matematičnih projektov na šoli. Z večletnimi raziskavami so potrdili ugotovitve, da je likovna umetnost učinkovita in stimulativna za doseganje kompleksnih matematičnih konceptov in procesov, matematične spretnosti pa so dragocene za prepoznavanje umetniških vsebin, ki jih ponuja naravno okolje (Holtzman in Susholt, 2011).

Učitelji se zavedajo, da pogosto nimajo na voljo sredstev, predvsem pa časa za načrtovanje ur, ki predpostavljajo delo z nenavadnimi (»eksotičnimi«) materiali in dolgimi postopki priprav na posamezno učno uro. A vseeno so našli kar nekaj preprostih in izvirnih poti za dosego omenjenih ciljev. Priporočajo izbiro osnovnih materialov. Ko se učencem za izvajanje določene naloge ponudi vsakodnevno uporabne materiale, kot so: zastava, kamenje, mreža, časopis idr., se ozavestijo, da sta likovna umetnost in matematika del vsakodnevnega sveta (Zupančič, 2006; Schwarz, 2000).

Da je v matematiki in matematični abstrakciji lepota, je opisal že Platon. Tudi danes matematiki opisujejo lepoto matematičnih enačb, ki jo povezujemo s preprostostjo, skladnostjo, eleganco in izraznostjo „resnice“. Sodobna raziskava s fMRI je pokazala, da se področje medialne orbitofrontalne skorje, ki integrira zaznavne izkušnje, čustva in odločitve, aktivira ob opazovanju ali poslušanju umetniških del, pa tudi ob opazovanju in delno tudi razumevanju matematičnih enačb (Zeki idr., 2014).

4 ZAKLJUČEK

Za razumevanje matematike morajo otroci/učenci povezati števila in matematične probleme z besedami in s količinsko predstavo, izbrati je potrebno najbolj ustrezno metodo za reševanje določenega problema. Pri tem ima šolanje ključno vlogo, saj je potrebno algoritmom dati pomen in razumevanje. Predšolski otroci imajo dobro razvito matematično intuicijo, znajo oceniti številčnost skupine, preštevajo, seštevajo in odštevajo, vendar na svoj intuitiven način, ki ga nato tekom šolanja nadgradijo z učenjem algoritmov (Levstek, Bregant in Peklaj, 2013).

Miselni preskok iz intuitivnega, avtomatiziranega procesa v načrtovan, miselno bolj zahteven proces je za nekatere otroke zelo zahteven. Prav tu pa je lahko v veliko pomoč uporaba umetnosti, zlasti likovne umetnosti, ki zahteva dobre in izostrene miselne predstave. Pri intuitivnem določanju števila elementov oz. količine si pomagamo ljudje z vidno predstavo – mentalno številsko osjo, ki je ključnega pomena za razumevanje matematike (Dehaene, 1997, Gilmor idr., 2010). Halloway in Ansari (2008; v Dehaene, 2009) sta proučevala 6–8 letne otroke in ugotovila, da je sposobnost primerjanja dveh števil napovednik matematične uspešnosti in da uspešnost ne-simbolnega primerjanja števil napove matematične dosežke preko celotnega šolanja (Halberda idr., 2008; v Dehaene, 2009). Pri preskoku iz intuitivnega v abstraktni svet nam bi torej lahko pomagala likovna umetnost. Zato predlagamo nadaljnje raziskave, v katerih bi preučili, do kolikšne mere likovna umetnost vpliva na krepitev razumevanja izbranih matematičnih vsebin.

5 LITERATURA

1. Ashcraft, M. H. (2002). Math Anxiety: Personal, Educational and Cognitive Consequences. Current Directions in Psychological Science, 11 (5), 181–185.
2. Bregant, T. (2012). Razvoj, rast in zorenje možganov [Brain development, growth, and maturation]. Psihološka obzorja, 21(2), 51-60.
3. Bristow, J., Cowley, P. in Daines, B. (2001). Spomin in učenje. Ljubljana: Educy.
4. Chochon, F., Cohen, L., Moortele, P. F. in Dehaene, S. (1999). Differential contributions of the left and right inferior parietal lobules to number

processing. Journal of Cognitive Neuroscience, 11, 617-630.
5. Clausen May, T. (2005). Teaching Math to Pupil with Different Learning Styles. London: Paul Chapman Publishing.
6. Cotič, M., Medved Udovič, V., Starc, S. (2011). Razvoj različnih pismenosti. Koper: Univerzitetna založba Annales.
7. Dehaene, S. (1997). The Number Sense: How the Mind Creates Mathematic. Oxford University Press.
8. Dehaene, S. (2009). Origins of Mathematical Intuitions. The Case of Arithmetic. The Year in Cognitive Neuroscience.
9. Eisenberg, M. A. (1997). Creating Polyhedral Models by Computer. Journal of Computers in Mathematics and Science Teaching 16 (4), 477–511.
10. Elliott, J. (2005). AquaMOOSE 3D: A Constructionist Approach to Math Learning Motivated by Artistic Expression. Unpublished doctoral dissertation, Georgia.
11. Feigenson, L., Dehaene, S., Spelke, E. (2004). Core systems of number. Trends of Cognitive Science, 8(7), 307-314.
12. Forgasz, H., Rivera, F. (2012). Towards Equity in Mathematics Education: Gender, Culture, and Diversity. San Jose: Springer.
13. Gilmore, C. K., McCarthy, S. E. in Spelke, E. S. (2010). Non-symbolic arithmetic abilities and mathematics achievement in the first year of formal schooling. Cognition, 115(3), 394-406.
14. Holtzman, C., Susholtz, L. (2011). Object Lessons: Teaching Math Through the Visual Arts, K-5. Portland: Stenhouse Publishers.
15. Kavčič, R. A. (2005). Učenje z gibanjem pri Matematiki. Priročnik gibalnih aktivnosti za učenje in poučevanje matematike v 2. razredu devetletke. Ljubljana: Bravo.
16. Kavkler, M., Žerdin, T. in Magajna, L. (1991). Brati, pisati, računati. Murska sobota: Pomurska založba.
17. Levstek, T., Bregant, T. in Podlesek, A. (2013). Razvoj aritmetičnih sposobnosti. Psihološka obzorja, [Spletna izd.], 22, 115-121. Dostopno na: http://psy.ff.uni-lj.si/psiholoska_obzorja/arhiv_clanki/2013/levstek_et_al.pdf.
18. Marjanovič Umek, L., Zupančič, M. (2004). Teorije psihičnega razvoja. V Marjanovič Umek, L., Zupančič, M., Fekonja, U… Bratanič, B. (2004). Razvojna psihologija. Znanstvenoraziskovalni inštitut Filozofske fakultete.
19. Marjanovič Umek, L., Kroflič, R., Videmšek, M., Kovač, M., … Japelj Pavešič, B. (2001). Otrok v vrtcu: priročnik h kurikulu za vrtce. Založba Obzorja, Maribor.
20. Nieder, A. in Dehaene, S. (2009). Representation of Number in the Brain. Annual Review of Neuroscience, 32, 185-208.
21. Peklaj, C. (2012). Učenci z učnimi težavami v šoli in kaj lahko stori učitelj. Ljubljana: Znanstvena založba Filozofske fakultete.
22. Schwarz, M. (2000). Težave pri računanju? Kako lahko starši pomagajo? Ljubljana: Založba Kres.
23. Shaffer, D. W. (1997). Learning Mathematics Through Design: The Anatomy of Escher's World. Journal of Mathematical Behavior 16 (2), 95–112.
24. Zajc, I. in Koželj, M. (2001). Matematika v srcu umetnosti. Ljubljana: Jutro.
25. Zeki, S., Romaya, J. P., Benincasa, D.M. idr. (2014). The experience of mathematical beauty and its neural correlates. Frontiers in Human Neuroscience, dostopno na: DOI: 10.3389/fnhum.2014.00068
26. Zupančič, T. (2006). Metoda likovnopedagoškega koncepta: priročnik za učitelje. Ljubljana: Zavod Republike Slovenije za šolstvo.

UMETNA INTELIGENCA IN NATURALIZACIJA INTUICIJ

Od zavrnitve Descartesa do zavrnitve dualizma

Aleš Ernecl
Filozofska fakulteta Univerze v Mariboru
Koroška cesta 160, 2000 Maribor, Slovenia
Tel: +386 1 4773419; fax: +386 1 4251038
e-mail: ernecl.ales@gmail.com

POVZETEK

V tem članku se bomo ukvarjali z možnostmi »umetne inteligence« in s t.i. naturalizacijo intuicij, s katero je, tako se zdi, projekt umetne inteligence, če naj bo kaj takega možno, neizogibno povezan. V prvem delu članka bomo predstavili razmišljanje o možnostih umetne inteligence, v drugem delu bomo pokazali na neupravičenost kritike descartesa, ki je še danes temelj zavračanja dualizma, v tretjem delu pa bomo na posameznih primerih propozicij iz naravoslovnih učbenikov pokazali, najprej, da in kako jezik poljudne psihologije vdira v jezik opisovanja,nato, kako, če naravoslovci ne poznajo problema, oblikuje njihov pogled na problem uma in telesa.

1 UVOD

Glede na to, da nam je človeška inteligenca, karkoli že to je, merilo, po katerem je edino mogoče presojati, kdaj naj bi nekaj umetnega bilo inteligentno ali »popolni simulator inteligence«, je jasno, da pot do umetne inteligence vodi preko naturalizacije človeških intuicij, tj. preko odkrivanja končnega števila človeških intuicij in/ali odkrivanja mehanizma, po katerem se človeške intuicije oposameznjujejo. Kdor verjame, da je mogoča umetna inteligenca oziroma »popolni simulator inteligence«, ta verjame, da je oposameznjevanje človeških intuicij realizirano skozi subtilno strukturo nekega mehanizma, za katerega delovanje, kakor je to dostopno človeškemu opisovanju, ni potrebno »sukcesivno poseganje stvarnika v stvarstvo«, če s »sukcesivnim poseganjem stvarnika v stvarstvo« mislimo tako »ustvarjanje«, ki se človeku kaže kot »nereducibilnost intuicij«. Morda na prvi pogled off topic, pa, po našem mnenju, nič manj pomembno: kdor verjame, da je »naturalizacija človeških intuicij« možna, ta ne rabi verjeti, da je propozicija o človeku, ustvarjenem po božji podobi, napačna. Ta ne rabi verjeti, da človek nima svobodne volje, v kolikor svobodne volje ni dojemal kot »neodvisnost od stvarnika«. Ta mora verjeti le, da je oposameznjevanje človeških intuicij inteligibilno in postavljeno v zakoniti odnos do psihološke in fizikalne strukture sveta, kar nas, če človeka dojemamo kot končno bitje, ne bi smelo čuditi.

2

Pomembno pravilo: mehanizem, po katerem se človeške intuicije oposameznjujejo, je sam na nek način tudi intuicija, »najsplošnejši algoritem« in je, če ga je mogoče odkriti, samo nekaj, kar imajo skupnega vse posamezne intuicije, vsi »posamezni najsplošnejši algoritmi«. Je tisto obče v različnih najsplošnejših algoritmih. Kaj mislimo z »najsplošnejšim algoritmom«? Intuicijo, s katero vsak metafizik prične sestavljati svoj filozofski sistem, npr.: pri Aristotelu sta najsplošnejši algoritem »snov in oblika«, pri Descartesu »razsežna in misleča substanca«. Gre za osnovno intuicijo o tem, kaj je najsplošnejšega v svetu, dostopnem človeškemu spoznavanju. Aristotel bi npr. dejal: vsaka posamezna stvar, ki je dostopna mojemu spoznavanju, je kombinacija snovi in oblike. Obstajajo različne kombinacije, toda vsem je skupno, da so kombinacija snovi in oblike. Descartes bi dejal: vsaka posamezna stvar, ki je dostopna mojemu spoznavanju, je bodisi misleča bodisi razsežna. Obstajajo različne misleče in razsežne stvari, toda vsem je skupno, da so misleče ALI (izključujoča disjunkcija) razsežne. Materialisti, če pojem materije enačimo z »razsežnim«, v najširšem pomenu besede, bi dejali, da obstajajo samo »različne« razsežne stvari. Njihov »nasplošnejši algoritem« je »razsežna substanca«. Zdi se, da se večina zgodovinskih materialistov, ki si danes raje nadevajo imena kot so »fizikalisti« ali celo »naturalisti« (kar je po našem mnenju najmanj korektno poimenovanje, saj samovoljno enači fiziko in naravo, kakor bi tisti, ki verjamejo, da poleg razsežnih obstajajo še misleče stvari, ne verjeli, da so tudi misleče stvari, če o njih govorimo kot o substancah, v končni posledici ustvarjene substance in del narave ali stvarstva) naslanja na domnevno nerešljivost problema interakcije med posamezno razsežno in posamezno mislečo stvarjo, kakor lahko preberemo v knjigi slovenskega analitičnega filozofa, Dr. Janeza Breganta, ki navaja Descartesovega sodobnika Gassendija:

»Pojasniti moraš (skrita predpostavka, da transcendentalnih pogojev delovanja/bivanja interakcije med različnima razsežnima stvarema ni potrebno pojasniti, to je, da je breme pojasnjevanja na drugi strani, ali da je ta pojasnitev splošno znana, da jo vsi sprejemamo kot »znanje«), kako je ta interakcija, če si breztelesen, se ne raztezaš v prostoru in si nedeljiv (skrita predpostavka, da je jasno, kako sta dve različni stvari, ki se raztezata v prostoru in imata dele, lahko v interakciji: pojasnitev, ki jo zahteva Gassendi, je 1. Kategorialna napaka, 2. Zahteva posebno obravnavo svoje pozicije ali 3. Logična zmota sklicevanja na obče znanje, v smislu, da to »tako vsi vemo«), možna. /…/ Kako se lahko povežeš z možgani ali z njihovimi deli, če pa ima vsak njihov del ne glede na to, kako majhen je, velikost in se razteza v prostoru. Kako lahko, če nimaš delov, vplivaš na dele? /…/ In če si nekaj ločenega, kako lahko skupaj s snovjo tvoriš celoto?« (Descartes, 1985b, 238)

Ne Aristotel, ne Descartes, ne »materialisti« ne morejo pojasniti transcendentalnih pogojev delovanja/bivanja interakcij, ki jih preprosto predpostavljajo, ki so zanje: najsplošnejši algoritmi. Vsak med njimi preprosto reče: 1. Vse, kar obstaja, je kombinacija snovi in oblike in so meje človeškega spoznavanja začrtane s spoznavanjem različnih kombinacij, 2. Vse, kar obstaja, so posamezne razsežne in posamezne misleče stvari in je s tem začrtana meja človeškega spoznavanja, 3. Vse, kar obstaja, so posamezne razsežne stvari in so z njimi začrtane meje človeškega spoznavanja. Nihče med njimi ne pojasnjuje, zakaj ali kako je možno, da je vse, kar obstaja, ali zakaj verjame, po kateri metodi je prišel do spoznanja, da je propozicija »Vse, kar obstaja, je…« resnična. Po »intuiciji« privzamejo neko načelo, nek princip, nek, kot se že ves čas izražamo, »zanje najsplošnejši algoritem« - in od tod sestavljajo in razstavljajo »puzzle«. Reči, da obstajajo različne misleče in različne razsežne stvari, ni nič druga kot reči, da verjameš, da so tako modeli prvoosebnega kot tretjeosebnega opisovanja verodostojni modeli opisovanja nam dostopne realnosti. Reči, da obstajajo le različne razsežne stvari, ni nič druga kot reči, da so le modeli tretjeosebnega opisovanja verodostojni modeli opisovanja nam dostopne realnosti. Pojasnitev obeh pozicij, tj., zakaj verjameš, da je resnična ena ali druga propozicija, pa je možna samo v modelu prvoosebnega opisovanja. Ne obstajajo pojasnitve, utemeljitve materialističnih pozicij v kakem modelu tretjeosebnega opisovanja.

Naše prepričanje je, izhajajoč iz gornje teze, da gre pri vseh treh za različne človeške intuicije, da obstaja neka skupna struktura vsem trem intuicijam in da na podlagi odkritja te strukture ni potrebno, da bi delali seznam vseh človeških intuicij, da bi lahko simulirali »človeško inteligenco«. Z odkritjem te strukture si lahko obetamo uspešno simulacijo človeške inteligence, to je, poenostavljeno, »opolnomočimo stroje«, da simulirajo človeško inteligenco. Simulirati človeško inteligenco, simulirati tisto, čemur ljudje prisojamo »faktor x« v človeški naravi, ne pomeni, po naše, nič druga kot simulirati posameznega filozofa. Noben posamezni filozof seveda nima »v spominu vgrajenih« vseh intuicij, je pa sposoben relativno novih intuicij, ker je »opolnomočen" z najsplošnejšim algoritmom, s pomočjo katerega počne tisto, čemur pravimo "človeško filozofsko razmišljanje". Ta najsplošnejši algoritem, ki se ga da, po naše, abstrahirati iz vseh zgoraj omenjenih najsplošnejših algoritmov (najsplošnejših za posamezne filozofe) in ki se ga da prepoznati v vsaki posamezni propoziciji "naravnega jezika", kar bomo pokazali nekoliko kasneje, je: vse, kar obstaja, je večno bitje z neskončnimi zmožnostmi ustvarjanja, struktura stvarstva, ki je realizacija njegovih načrtov, končno bitje s končnimi možnostmi spoznavanja in ustvarjanja. Če skušamo "praktično" ponazoriti, kako in v katerem smislu ljudje "kreativno mislimo«, glej »razmišljamo«: vedno izhajamo iz nekega prepričanja o strukturi stvarstva. Svet/narava/struktura stvarstva (verjamemo, da so to sinonimi) je taka, da v njem vedno, ko zaznaš x, lahko obenem zaznaš y. In zdaj »kreativna misel«: ali bi lahko struktura stvarstva bila drugačna, bi jo lahko večni stvarnik z neskončnimi zmožnostmi ustvarjanja ustvaril drugačno? Lahko bi. Toda, ali bi to, če bi jo ustvaril drugačno (pa si zamislimo specifični način drugačnega stvarjenja), obenem pomenilo (trije dodatni pogoji/stipulacije, s katerimi zamejujemo naše razmišljanje), da: 1. Je večno bitje z neskončnimi zmožnostmi ustvarjanja ustvarilo strukturo, katere del bi bilo logično protislovje tipa »okrogel trikotnik«, 2. S tem, ko je ustvaril strukturo takšno, ni ustvaril najboljšega vseh možnih svetov in 3. Nas s tem, ko je ustvaril strukturo takšno, »vara«. Vsakdo med zgoraj omenjenimi filozofi, Aristotel, Descartes, »materialisti«, verjame to, kar verjame, oziroma je izbral najsplošnejši algoritem na podlagi specifičnega zaporedja pozitivnih in negativnih odgovorov oziroma privzetij/zavračanja teh treh zamejitev razmišljanja. Če jih »pritisnete ob zid«, vam bo vsakdo rekel, da verjamejo, da obstaja samo x zato, ker ne bi bilo »logično«, »smiselno« ali da bi bilo »nenavadno«, če bi bilo drugače. Raba teh pojmov je razložljiva le, če poznamo najsplošnejši algoritem, ki ga omenjamo zgoraj. Na primerih iz različnih psiholoških in naravoslovnih učbenikov bomo pokazali, da se ta najsplošnejši algoritem človeškega razmišljanja kaže v zakoniti strukturi, ki jo je mogoče abstrahirati iz posameznih propozicij, ki so zasnovane kot »enotni« in/ali enoviti odgovori na zgoraj omenjena vprašanja…

Poglejmo si prvi primer, iz knjige Jima Barnesa, *Essential Biological Psychology:* »Hypothalamus (transcendentalni pogoj delovanja/bivanja – KER je Hypothalamus, spimo tako kot spimo/spimo nasploh): *controls* (da Hypothalamus kaj nadzira, ima pomen le, če je Hypothalamus transcendentalni pogoj delovanja/bivanja, v našem primeru avtomatskih funkcij kot je krmiljenje spanja; če je smiselno reči, da ZATO, KER biva Hypothalamus, krmiljenje spanja poteka tako kot poteka oziroma krmiljenje spanja sploh biva) automatic functions such as regulating sleep /…/« (Barnes, 2013, 16)

Hypothalamus je »fiziološki predmet«, nekaj, kar je očitno mogoče opisati v modelu tretjeosebnega opisovanja in zdi se, da od tega, da skušaš iz vedno na posamezni primer se nanašajočih primerov opazovanja sklepati na obstoj strukture stvarstva, čemur radi rečemo tudi »zakonitost« (struktura stvarstva je taka, da vedno ko x, dobiš y – zakonita korelacija med x in y), prideš do tega, da x z y nekaj počne, ga nadzira, potrebuješ posebni »skok«, ki mu bomo rekli: vdor poljudne psihologije v jezik opisovanja. Tega so »znanstveni učbeniki prepolni«. In mnogi bodo rekli, da se tisti, ki so člani znanstvene skupnosti, zavedajo »metaforike« tega jezika, toda mi bomo tukaj izrazili močan sum, da se ne, ki temelji na 1. Pogovorih z znanstveniki, na 2. Dejstvu, da se mnogi znanstveniki ukvarjajo s filozofijo in da kot filozofi zavzemajo pozicijo fizikalizma, za katerega imajo v tem, s čimer se profesionalno ukvarjajo, podlago le in samo, če jemljejo ta »metaforični jezik« zares, 3. Dejstvu, da je »fizikalizem« najpopularnejše stališče v odnosu do problema uma in telesa, česar se ne da pripisati le temu, da filozofi napak razumejo tisto, kar vsi znanstveniki – strokovnjaki razumejo drugače. Gassendijev očitek Descartesu temelji na prepričanju, da nam t.i. »znanstveni opisi« prinašajo jasno sliko tega, kako lahko posamezni razsežni stvari vplivata druga na drugo. To je mogoče verjeti le, če verjameš, da Hypothalamus RES nadzira določene funkcije.

Poglejmo si primer iz knjige *Cognitive Neuroscience:* »The occipital lobe processes visual information /…/« (Gazzaniga, Ivry, Mangun, 2009, 107)

Kaj bi bil »filozofsko nevtralni opis«: Verjamemo, da je struktura stvarstva takšna, da lahko fiziološkim korelatom vidnih občutkov v možganih VEDNO sledimo od »occipital lobe – a« dalje. Veriga fizioloških korelatov vidnim občutkom v možganih ima točno določeno in zakonito pot, ki se vedno prične v tistem, čemur pravimo »occipital lobe«. V tem occipital lobe nima statusa transcendentalnega pogoja delovanja/bivanja, v gornjem primeri iz učbenika pa ga očitno ima

3 SKLEP

Verjamem, da smo v članku pokazali na meje človeške inteligence, s tem pa tudi nakazali pot k umetni inteligenci ali popolni simulaciji umetne inteligence. S pomočjo pojmovne analize in argumentacije smo pokazali, da je kritika Descartesa s strani Gassendija bila slabo argumentirana, je pa še vedno temeljno za današnje zavračanje dualizma. V zaključku smo na primerih propozicij iz naravoslovnih učbenikov uspeli pokazati, kako jezik poljudne psihologije vdira v jezik opisovanja in na podlagi analize propozicionalne strukture pokazali, kako lahko neobčutljivost za problem rabe jezika oblikuje filozofski pogled naravoslovca na odnos med umom in telesom.

Viri

[1] Gazzaniga, Michaels S., Ivry, Richard B., Mangun, George R., Steven, Megan S. Cognitive Neuroscience. The Biology of the Mind. Norton & Company, New York, London, 2009

[2] Barnes, Jim. Essential Biological Psychology. Sage. Los Angeles, London, New Delhi, Singapore, Waschington DC. 2013

[3] Bregant, Janez. Misel kot vzrok. Ali so mentalna stanja vzročno učinkovita? Pedagoška fakulteta. Maribor, 2004

[4] Aristotel (2002). O duši. Ljubljana: Slovenska matica, 2002

[5] Descartes R. (2004). Meditacije o prvi filozofiji, v katerih je dokazano bivanje božje in različnosti človeške duše in telesa. Ljubljana: Slovenska matica, 2004

ACTUAL EXTINCTIONS OF ANIMALS AND HUMANS

Matjaž Gams
Department of Intelligent Systems, Jožef Stefan Institute
Jamova cesta 39, 1000 Ljubljana, Slovenia
matjaz.gams@ijs.si

ABSTRACT

This overview paper deals with extinction of animal species and in analogy to extinction of languages and human subspecies and societies. The overview analysis presents a tentative hypothesis that we humans live in a false impression that our environment and societies are quite stable. The hypothesis presents the opposite view: that our environment, flora and fauna, and human society are under transformation changes unseen before absolutely and in terms of speed of change. While the extinction of animal (sub-)species is more or less an accepted scientific fact, where humans are in recent decades able to prevent from extinctions at least species of big animals such as panda or the blue whale, we are still quite oblivious in regards to animal subspecies. Moreover, the tentative hypothesis is that we humans are oblivious to the extinction of languages and subspecies of humans due to globalization and ideology.

1 INTRODUCTION

It is well known that our world constantly changes. In terms of old proverbs, Πάντα ῥεῖ (panta rhei) "everything flows" probably best denotes the evolutionary nature of our environment that inevitably leads to the process of extinction. Accidently, the “everything flows” proverb was not spoken by Heraclitus. This aphorism actually comes from Simplicius [1], a neoplatonist (facts exist on their own whether humans are aware of them or not), and from Plato's Cratylus. The word rhei (cf. rheology) is the Greek word for "to stream", and to the etymology of Rhea according to Plato's Cratylus.

Heraclitus, on the other hand, is well known by another aphorism, similar to the “everything flows”: "Ever-newer waters flow on those who step into the same rivers."

In this paper we first examine extinction and near-extinction or significant reduction in animal demographics and causes for it. From the process evidenced in animals we speculate that similar processes are present in humans, yet largely ignored by our public and scientific opinion.

Extinction is the end of an organism or a species or subspecies [2]. The moment of extinction is generally considered to be the death of the last individual of the species, although the capacity to breed and recover may have been lost before this point. *Minimum viable population (MVP)* is a lower bound on the population of a species, such that it can survive in the wild. More specifically, MVP is the smallest possible size at which a biological population can exist without facing extinction from environment or in-breeding effects. For the extinction, it is important to denote actual extinction of the subspecies or species. The example from Wikipedia denotes the extinction of the undomesticated dromedary camel in its natural wild habitat; but there is a domestic population in captivity and an additional feral population in Australia. The genetic pool therefore exists and the species is not threatened even though not existing in wild. In publications, however, MVP is most commonly used to refer solely to a wild population, such as the red wolf. In addition, in the simulations, the human influence is not embedded in the extinction process. In a typical simulation, several tens of healthy not genetically too similar individuals are needed to provide a successful breed for a revival of a population, denoting a line between extinction and reintroduction.

It is well known that one of the most important factors in recent extinctions are humans. The influence comes through two ways [3]:

- environment changes in terms of global warming or loss of habitat or introduction of invasive species
- influence on the (sub-)species such as overhunting or reintroduction or conservation in a concentrated effort on a specific subspecies.

2 ANIMAL EXTINCTION

There are some well documented processes of animal extinction due to human overhunting. For example, the Passenger Pigeon, a special pigeon species, was hunted to extinction over the course of a few decades in Northern America. It was once the most abundant bird in North America [4, 5] with estimated 5 billion birds, approximately the number of all people in the world. It accounted for more than a quarter of all birds in North America. One flock in 1866 in Ontario was described as being 1.5 km wide and 500 km long, taking 14 hours to pass, and held in excess of 3.5 billion birds. The species went from being one of the most abundant birds in the world during the 19th century to extinction early in the 20th century. A slow decline between about 1800 and 1870 was followed by a catastrophic decline between 1870 and 1890. Martha, thought to be the world's last passenger pigeon, died on September 1, 1914, at the Cincinnati Zoo [5].

Immediately, two observations could emerge:

- the Passanger Pigeon could have been saved rather trivially with small expenses or even by amateur conservationists if only the ecological and conservationist opinions would matter at that time, and
- could something like this happen to humans?

Figure 1: Two species extinct from New Zealand hundreds of years ago: the Haast's Eagle and moa. *(Wikipedia)*

The list of human-caused extinction goes a long way back since humans were agile and efficient hunters already hundreds of thousands years ago. For example, a new genetic study of moa fossils points to humankind as the sole perpetrator of the birds' extinction, and consequently the Haast's Eagle, predating the moa.

Scientists have long argued about what caused the extinction of many species of megafauna—giant animals including mammoths, mastodons, and moas—beginning between 9000 and 13,000 years ago, when humans began to spread around the world. Often, the animals disappeared shortly after humans arrived in their habitats, leading some researchers to suggest that we exterminated them by overhunting. But other scientists have pointed to natural causes, including volcanic eruptions, disease, and climate change at the end of last Ice Age, as the key reasons for these species' demise. The moas present a particularly interesting case, researchers say, because they were the last of the giant species to vanish, and they did so recently, when a changing climate was no longer a factor [6]. More and more studies indicate that it was indeed the influence of humans that led to the extinction of the species.

It is the case that most extinctions have occurred naturally, prior to *Homo sapiens* walking on Earth: it is estimated that 99.9% of all species that have ever existed are now extinct. However, the extinction it not linear in time; rather, it occurs in relatively stable periods accompanied by abrupt *mass extinctions*.

There have been at *least five mass* extinctions in the history of life on earth in which many species have disappeared in a relatively short period of geological time. A massive eruptive event is considered to be one likely cause of the "Permian–Triassic extinction event" about 250 million years ago, which is estimated to have killed 90% of species then existing, nearly temporarily ending life on our planet [7]. Another mass extinction was the Olson's Extinction. The Cretaceous–Paleogene extinction event (K-Pg) occurred 66 million years ago. It marked the end of non-avian dinosaurs and several other species. The K–Pg extinction event was severe, global, rapid, and selective. Based on marine fossils, it is estimated that 75% or more of all species were wiped out. Several analyses indicate that the temperature raised over 1000 degrees, killing all animals above the ground and water, significantly effecting the ocean and the sun light for years. In the scientific world, there is a growing awareness that such events, also very rare, do happen occasionally, and that we are facing the *sixth major extinction*.

3 THE CURRENT ANIMAL EXTINCTION

In 2014, the book by Elisabeth Kolbert summarizes the current knowledge [8]. We quickly examine the book chapters:

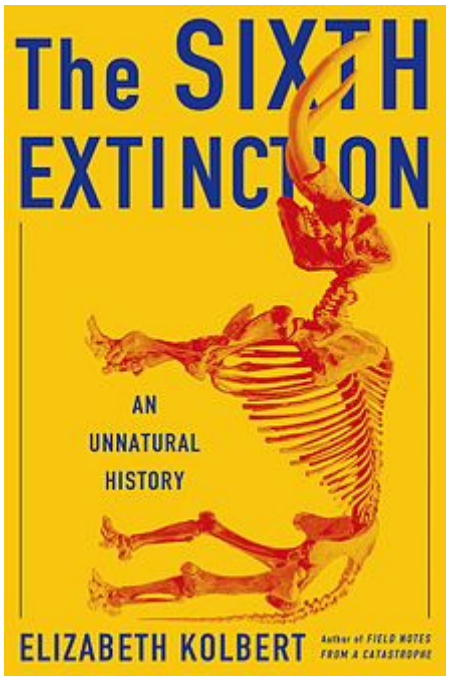


Figure 2: The sixth mass extinction, caused by humans, currently going on. *(Wikipedia, Amazon)*

Chapter 1: The Sixth Extinction

Why are the frogs dying out? As one study shows, the most likely reason for the increased mortality of Panamanian frogs is due to a type of Chytrid fungi, introduced by humans visiting Panamo. Kolbert uses the frog-fungi relationship as a symbol of how humans are introducing invasive species to the local species who would normally have the proper distribution of alleles for their environment.

Chapter 2: The Mastodon's Molars

According to a French naturalist and zoologist Georges Cuvier, there was no reason the mastodon should have died out. Kolbert uses the mastodon as a symbol for the idea that a (human-caused) catastrophe is an important mechanism of extinction.

Chapter 3: The Original Penguin

The great auk was a large flightless bird that lived in the Northern Hemisphere, a kind of European penguin. When the first settlers arrived in Iceland, the auk's population was probably in the millions. It disappeared from wild on 3 July 1844, and from captivity in 1852. Kolbert uses the great auk as a symbol of how human overexploitation resources is an important mechanism of extinction.

Chapter 4: The Luck of the Ammonites

Kolbert explains that the main cause of the Cretaceous-Paleogene extinction event was not the impact of the asteroid itself, but the debris and the dust created by the impact resulting e.g. in ocean changes. While catastrophes in a short period cause extinctions of species existing for a long time, it is the complex effect of various parameters and ingredients that cause it.

Chapter 5: Welcome to the Anthropocene

Kolbert uses the extinction of graptolites and other clades to explain the effect of carbon dioxide levels on ocean life. She states that human activity has transformed between a third and a half of land surface on the planet (BTW, in Slovenia we intend to build new and new roads and highways). For example, we have dammed most of the major rivers of world, used more than half of the world's readily accessible freshwater, removed more than one third of the primary producers of the oceans' coastal waters, and changed the composition of the atmosphere by deforestation and fossil fuel combustion.

Chapter 6: The Sea around Us

The levels of carbon dioxide in the atmosphere is increasing at an alarming rate in the last decades, already reaching the highest concentration in the last several million years. We have added approximately 365 billion tons by burning of the fossils fuels and an additional 180 billion tons by deforestation, increasing by 6% annually. As a result, lowering the pH of oceans is killing many of our marine life, some also in relation to overexploitation.

Chapter 7: Dropping Acid

One of the effects is ocean acidification, and one of possible consequences could be extinction of corals in ocean reefs. However, one should note that some recent studies dispute this conclusion showing that some species of corals are quite robust in this sense, in particular if appropriate measures are taken.

Chapter 8: The Forest and the Trees

Global warming is most commonly seen as a threat to cold-loving species. As temperatures rise, the ice at the North and South Pole melt to greater degrees. Kolbert surfaces attention to the fact that the poles are not the only place affected by global warming. She explains that climate change is a major force in mass extinction because the effect is global.

Chapter 9: Islands on Dry Land

Kolbert points out how everything in life is interconnected, demonstrating relations in the life-forms of many species. She explains that one minor change can cause a domino effect in various ecological systems.

Chapter 10: The New Pangaea

Kolbert points out there is a constant evolutionary arms race in which each species must be equipped to defend itself and that globalization shreds local defenses. She presents an example of American chestnut, once the dominant deciduous tree in the eastern forests. Then, a fungus (Cryphonectria parasitica) started to cause chestnut blight. It was nearly 100% lethal. The fungus was unintentionally imported to the U.S. Invasive species due to globalization are one cause of extinctions. Note: in recent decades we had or still have similar problems with chestnut and walnut in Europe and Slovenia. Second note: Why many Slovenians gladly accept invasive species threating and exterminating local flora and fauna?

Chapter 11: The Rhino Gets an Ultrasound

The Sumatran Rhino was once so abundant in numbers it was considered an agricultural pest. However, as Southeast Asia's forests were cut down, the rhino's habitat became fragmented. In the 1900s, the rhino population has been shrunk to just a few hundred. Today, there are only four living rhinos. Kolbert uses the rhino to show habitat fragmentation as a mechanism of extinction. Note: In such sad cases humans have the only dilemma left: should we preserve the species in zoos or let them become extinct. While we somehow manage large species like tigers or rhinos, subspecies of rhinos or tigers are still becoming extinct. For example, the *western black rhinoceros* (Diceros bicornis longipes) or West African black rhinoceros is an extinct subspecies of the black rhinoceros, declared so in 2011.

Chapter 12: The Madness Gene

What happened to Neanderthals that inhabited Europe for at least a hundred thousand years? About 30,000 years ago, the Neanderthals vanished. Fossil records show that modern humans arrived to Europe 40,000 years ago. Within 10,000 years, Neanderthals were bred out. With molecular sequencing it was found out that there is 1-4 percent Neanderthal DNA in all non-African humans. Kolbert states there is every reason to believe that Neanderthals would still exist if it weren't for us, modern humans.

Chapter 13: The Things with Feathers

Kolbert concludes with the hope in humanity. Whether meaning to or not, we are deciding which evolutionary pathways will be shut off forever and which can be left open to flourish. With the growing sense in naturalism, conservationism and healthy environment, we can hope to at least to slow down the negative consequences.

Indeed, we humans were able to preserve several animal species from extinction. For example, the numbers of rhinos plummeted several decades ago, but in particular with white rhino reappeared strongly again due to the world-wide effort. Similarly, sspecies previously classified as Extinct in

the Wild that have improved in IUCN Red List status thanks to the reintroduction of captive-bred animals from zoos. They include the Przewalski's horse (*Equus ferus przewalskii*), black-footed ferret (*Mustela nigripes*) and California condor (*Gymnogyps californianus*). Thanks to the same conservation actions, the threat status of the Arabian oryx (*Oryx leucoryx*), European bison (*Bison bonasus*) and red wolf (*Canis rufus*) was reduced from Extinct in the Wild already before the time period considered.

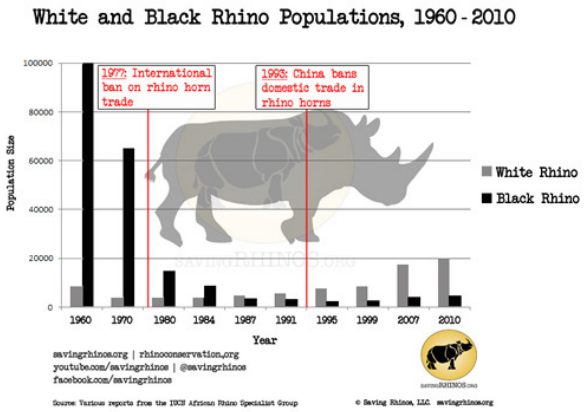


Figure 3: The reappearance of Rhino due to human naturalists' efforts.

Wilson [9] estimated in 2002 that if current rates of human destruction of the biosphere continue, one-half of all plant and animal species of life on earth will be extinct in 100 years. Some groups are going extinct much faster. Amphibians, for example, are disappearing at as much as 45,000 times their extinction rate at K-Pg. Despite such extreme losses on a global scale, the public's interest in extinction is in a world-wide decline because of the neo-liberalistic pressure to split the human society into two classes.

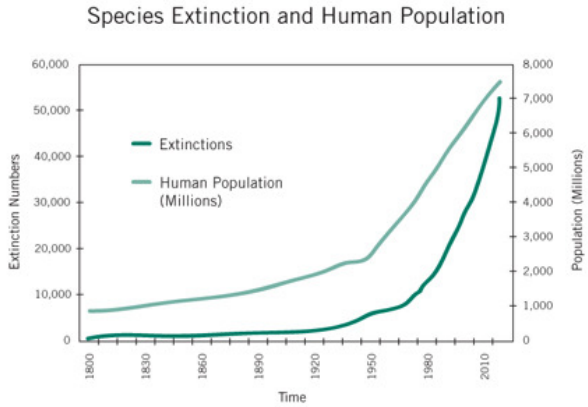


Figure 3: The correlation between animal species extinction and human population can hardly be denied.

4 HUMAN EXTINCTION

Today, it is predicted that at least half of the world's 6,000 languages will be dead or dying by the year 2050 [10]. Languages are becoming extinct at twice the rate of endangered mammals and four times the rate of endangered birds. Some even suggests that as many as 90 percent of languages could become moribund or extinct by 2100. In these projections, 20 percent to 40 percent of languages are already moribund, and only 5 percent to 10 percent are "safe" in the sense of being widely spoken or having official status.

This effect is widely visible in Slovenia as well and can be perceived in at least two aspects:

- Slovenian dialects are dying out at a fast rate. A couple of decades ago, an inhabitant of one part of Slovenia would have troubles understanding a fellow countrymen from another part. Currently, only one region of Slovenia remains hardly understandable to all other regions while all the others are being merged to similar grounds.
- Slovenian language is becoming less and less protected, be it in terms of obliged percentage of Slovenian music or the percentage of employed legally demanded to understand and speak Slovenian.

Slovenian public and even more its political leadership is oblivious to these facts, as are the world leaders in relation to the language extinction.

Second, we humans have eliminated the two species that coexisted with us in the last century: the European Neanderthals and the *Homo floresiensis* ("Flores Man"; nicknamed "hobbit" and "Flo"). The around 1m high extinct species in the genus *Homo* (more prehistoric than the Neanderthals, which appeared very human-like and were probably not a species but a subspecies), was probably still in existence around 10.000 years ago [11]. Folk saying at Flores includes several stories of small people that liked to warm at the fires of locals. One story describes the extinction (burning the caves) of the last group of *ebu gogos* because they have stolen children of local inhabitants.

The Neanderthals were genetically mixing with the modern human and the Homo floresiensis very likely not, but the open question remains how many subspecies of humans exist today. This issue is first of all scientifically complex and second is prone to extreme ideologies that have no place in semi- and scientific papers. But luckily, in recent decades due to the age of modern genetic methods, genetic clusters of the human populations are generated. In this way, the term "race" or "species" is avoided, since the whole existing human population does classify as one species as a result of the established fact the differences are insufficient.

Analyzing different genetic subgroups, one suddenly observes the dynamic and cataclysmical decreases in specific human genetic subgroups. An example could be American Indians, nearly wiped out by the European settlers.

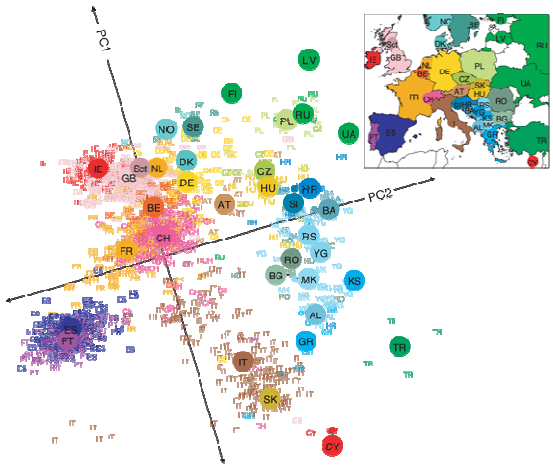


Figure 4: European genetic groups [12]. These are not human species, not even subspecies, but genetic groups that distinctly differ one from another.

Similarly to the language extinction, the world and scientific community are oblivious to the extinction of human genetic groups. One of those meta-groups determining European populations is also in the process of extinction in sharp contrast to awareness of the process by Europeans. For example, if one looks at the books, it is possible to find books about language extinction, while no semi- or scientific book about extinction of human genetic groups was discovered through the internet search by the author, nor was any colleague aware of it. The related information found on the internet was mostly political, of the extremist parties.

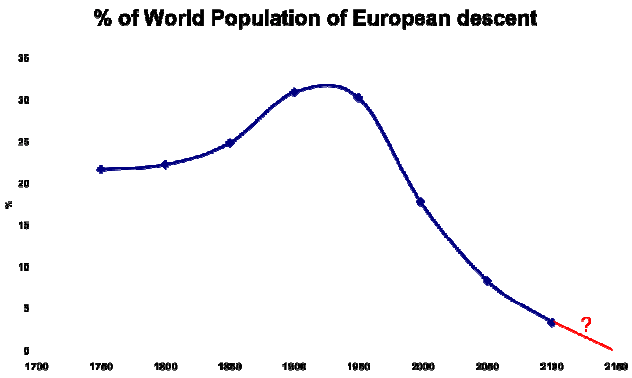


Figure 4: The decline of European native population, ignored by the public similar to the endangered animal species centuries ago.

There are several analyses and predictions of the human population, some predicting incredible progress [13] and the others predicting its decline due to the wrong orientations and false values [14] where the human sheer power and numbers will cause its demise. Fred Guterl, the executive editor of Scientific American, explores six looming scenarios for potential human extinction [15]. However, in regard of the actual extinctions, these predictions seem pretty futuristic and out of the scope of this paper.

6 CONCLUSION

Animals are becoming extinct at the rate 100 higher than normally, as have been shown by several scientific studies, including the Boston scientists [16]. It is estimated that around 100 species become extinct per day.

We humans caused most of the extinctions, in particular of bigger species where it is easier to show the deadly influence. In recent decades and years we are reasonably taking care of at least species of bigger animals; however, subspecies are still not our major concern as well as other, not so famous animals. While several decades or even species ago nobody was concerned with the extinction of animals that could be rather easy saved from extinction, currently we face a similar indulgence towards subspecies extinction even of the biggest animals like rhinos or tiger and leopard.

Another problem is that in terms of conservationism where several opposing visions for preserving species exist in the world and in Slovenia. The author shares a distinctive admiration for one and cannot understand the other viewpoint, e.g. that all zoos should be dismantled. Namely, in order to preserve a species from extinction, all measures are not only allowed, but are highly welcome. Taking a look at Slovenian legal system in regard to this issue, it seems that several rules probably have a negative effect on Slovenian endangered or rare species.

Even more disputable is the following hypothesis, proposed here: Are we not oblivious to extinction of the human genetic groups and languages as we were hundreds of years ago in relation to animal species? We disregard human subspecies, or better – genetically different subgroups of the human species, and the importance of genetic divergence, and promote globalization as if not the globalization was the major cause of animal extinction and will likely have similar effect on the human diversity. While we should care far more for the animals and the environment as we do today (the author is a dedicated amateur naturalist and environmentalist), the following issue comes into mind: **Are we more aware of animals than of ourselves**?

References

[1] W. K. C. Guthrie. A History of Greek Philosophy, vol. 1, Cambridge University Press, 1962.
[2] http://en.wikipedia.org/wiki/Extinction
[3] K. Holsinger. "Types of Stochastic Threats". EEB310: Conservation Biology. University of Connecticut. 2007.
[4] BirdLife International. "Ectopistes migratorius". IUCN Red List of Threatened Species. Version 2013.2. International Union for Conservation of Nature. November 2012.

[5] ""Martha," The Last Passenger Pigeon". National Museum of Natural History. Smithsonian Institution. August 2014.
[6] M.E. Allentoft, R. Heller, C.L. Oskam, E.D. Lorenzen, M.L. Hale, M.T.P. Gilbert, C. Jacomb, R.N. Holdaway, M. Bunce. Extinct New Zealand megafauna were not in decline before human colonization. Proceedings of the National Academy of Sciences, USA. Published on-line 17 March 2014.
[7] M. Benton. When Life Nearly Died: The Greatest Mass Extinction of All Time Paperback, September 1, 2005.
[8] E. Kolbert. The Sixth Extinction: An Unnatural History Hardcover, February 11, 2014.
[9] E. Wilson. The Future of Life, March 11, 2003.
[10] D. Harrison. When Languages Die: The Extinction of the World's Languages and the Erosion of Human Knowledge, 2008.
[11] W. F. Zimmerman. Homo floresiensis: the "hobbits" of Flores Island (What Every Human Should Know), 2010.
[12] J. Novembre, T. Johnson et al., and C. D. Bustamante. Genes mirror geography within Europe, Nature vol. 456, 2008.
[13] R. Kurzweil. The Singularity is near. New York: Viking Books. 2005.
[14] C.T. Rubin. Eclipse of Man: Human Extinction and the Meaning of Progress, 2014.
[15] F. Guterl. The Fate of the Species: Why the Human Race May Cause Its Own Extinction and How We Can Stop It, 2013.
[16] Estimating the Normal Background Rate of Species Extinction, J. M. De Vos, L. N. Joppa, J. L. Gittleman, P. R. Stephens, Stuart L., S. L. Pimm. Estimating the Normal Background Rate of Species Extinction, Article first published online: 26 AUG 2014 DOI: 10.1111/cobi.12380. 2014

Redefining Placebo: implications for future directions in neuroethics

Niko Gorjup [1], Rado Gorjup [2,3]

[1] Department of Biophysics, Faculty of Natural Sciences and Mathematics, , University of Maribor
[2] Faculty of Education, University of Primorska, Koper
[3] Department of Life Sciences, Psychology Unit "Gaetano Kanizsa", University of Trieste, Italy

E-mail: nikogorjup@gmail.com

Abstract

How we define something, depends on our current knowledge, common sense, beliefs, values, and on scientific evidence. However, these definitions have a strong impact on perception and construction of our attitudes and belief systems and thusly on our reality. In other words, our knowledge, our temporary physical, cognitive, behavioral, and emotional capacities will decide what kind of definitions and actions someone accepts, follows, and reinforces, what is true and what is not, what is possible for someone and what is not… it is the subjective interpretation of the perceived situation. It is about what we expect and believe to happen. Placebo is not an inert entity but instead it has a potential of subjective interpretation, a healing potential of its own, over and above that of any healing potential of the medication per se. Such healing potential is greatly dependent on how strong the interpretation value in being healed is that is created by the doctor. We show how Placebo effect goes beyond the usual "sugar pill" approach by using the evidence-based approach - A science of compassionate care! By introducing the new concept of redefined terms of Placebo phenomenon, we clearly show that the human mind (unconscious and conscious) is an inevitable substance involved in the medical treatment. The terms "placebo", "placebo effect", and "placebo response" are replaced with the new working definitions, which offers implications for future directions in neuroethics.

Key words: Placebo, Bioelectromagnetics, Evidence Based Medicine, Compassionate Care, Neuroethics

1 INTRODUCTION

More than 50 years ago a revolutionary book titled "Introduction to a Submolecular Biology" announced the crucial importance of quantum physics in biological systems (Szent-Gyorgyi, 1960). Less than fifteen years later research in biophysics showed that electromagnetic frequencies as energetic signaling mechanisms are one hundred times more efficient and incredibly faster in transmitting information from the environment compared to the chemical signals such as hormones or neurotransmitters (McClare, 1974). Energies like microwaves, radio frequencies, extremely low frequencies, sound frequencies, and scalar energy have shown to have a significant influence on each aspect of biological regulation. Indeed discovery that quantum physics but not Newtonian laws regulate molecule movements, which in addition generate life has offered further support of previous findings (Pophrstic & Goodman, 2001).

Despite the fact that many of pioneering scientific reports in the past sixty years have revealed the importance of those "invisible" forces of electromagnetic spectrum and were even published in peer reviews, these finding were somehow neglected (Blackman et al, 1993a, 1993b, 1998; Liboff, 2004, Jin et al, 2000, Sivitz, 2000, Blank, 1992, Simkó, 2004). Many professional and locally produced devices have been constructed for research purposes in order to manipulate experimental conditions by exposing the living organisms to different ranges and frequencies of

electromagnetic fields (Gorjup, 2011). In one experimental study, the Germination and growth of Lemma Minor by exposure to square pulse and 16 Hz sinusoidal magnetic fields revealed statistically significant differences (Gorjup & Jerman, 2014). Back to the very beginning of the humankind, it is not that hard to understand that culture is deeply embedded into human biology because of perceptual and attentional processes (Moerman, 2002, Moerman, 2005). Speaking about old primitive societies, they had long healing ceremonies and very complex rituals that sometimes lasted even more than a week (Moerman, 2002). Such meaningful healing strategies in primitive cultures were extremely impressive and respected for they were capable to induce powerful psychological (symbolic) component of the healing process, nowadays known as psychosocial context or meaning response (Moerman, 2005). Rituals might trigger subjective expectations of different emotional states: joy, anxiety, relaxation, altered states of consciousness through biased attention. Attentional biases can influence what information people prefer to focus upon. Indeed subjects with chronic pain and emotional problems show increased attention to information regarding their concerns (Schoth & Liossi, 2010, Bar-Haim et al., 2007). This bias in attention accompanied by emotional states and perceived from the cognitive perspective corresponds to hypervigilance (Eysenck, 1997). Cognitive self-evaluation about amount of reported failures in memory and attentional domains is a good predictor of vigilance performance in complex tasks (Gorjup et al., 2013b).

Anxiety modulates attention (Mathews, & MacLeod, 2005), in particular trait anxiety modulates top-down, executive control network (Bishop, 2009) while, state anxiety is more responsible for bottom-up, alerting and orienting attentional networks (Pacheco-Unguetti et al, 2010). Furthermore, in a computer-based neurocognitive test using the ANTI-V paradigm individual differences in vigilance performance were measured. A step-wise multiple regression analysis showed that vigilance performance (Signal Detection Theory-SDT indices of Vigilance), were predicted by cognitive and somatic state anxiety, but not trait anxiety (Gorjup et al., 2014). Under negative psychological states usually present in subjects with health problems, it is obvious that their hyper-vigilant attentional focus depends on the level of concerns in how to get well again. In this regard, psychosocial context through a compassionate care can become an important healing determinant.

Contemporary medicine (evidence-based) has on the other hand developed scientific methods and highly sophisticated technology, which enables it to be more successful in the pharmacological and physiological component of the healing process. In his doctoral dissertation, Getz highlights an interesting topic that fits well with the concerns of Heidegger and Foucault about the sophisticated technology. He says: “Can it be that professionals as well as lay people are currently becoming increasingly distracted and desensitized, as a result of medical technology’s particular way of enframing the human condition, in such a way that we lose sight of the essence of what it means to be human, in sickness and in health?”(Getz, 2006, page 113).

For our discussion, it is important that the placebo/nocebo response is an integral component of every treatment, and can not be avoided in even the most modern, sophisticated evidence-based medical treatment. Both the modern medicine and the primitive treatments of our ancestors share the same integral component of the healing process: the “nonspecific” component of the treatment. If we accept that, the history of medicine until first world war was more or less the history of the placebo response (Shapiro & Shapiro, 1997) than we can assume that the modern medical treatment has evolved from the placebo treatment, or to put another way, the “specific” factors have evolved from the “nonspecific” ones. Furthermore, if the primitive, nonscientific treatments of our ancestors had been so useless, or if “nonspecific” factors had not played an integral role in the healing process throughout history, it is very likely that humankind would not have survived those harmful “nocebo”

treatments, and thus there would have been no modern evidence-based medicine (Gorjup & Gorjup, 2012, Gorjup, 2013a).
Taking into account above arguments, we can hypothesize that what we perceive and to what we narrow our focus of attention on, becomes important, meaningful and makes sense for our further understanding and interpretation.

2 A BRIEF HISTORY OF PLACEBO DEFINITIONS

In the following table, we can see how the term Placebo has changed from the late 18th century until the beginning of the third millennium (Thompson, 2005).

Table 1: Some dictionary definitions of Placebo

Source	Year	Definition of Placebo
New Medical Dictionary	**1785**	A common place method **of** medicine
Hooper's Medical Dictionary	1811	An epithet given to any medicine, adapted more to please than to benefit the patient.
Dunglison; Dictionary of Medical Science	1874	"I will please" (from placebo) – A medicine usually prescribed rather to satisfy the patient than with any expectation of its effecting a cure.
Medical Lexicon	1881	Name for a medicine given by a doctor to a patient simply to satisfy the patient's mind; usually of a harmless nature, e.g. water colored with cochineal (dried insects used as dye).
Standard Dictionary of the English Language	1895	Any harmless substance as bread pills, given to soothe a patient's anxiety rather than as a remedy.
Century Dictionary	1900	A medicine adapted rather to pacify than to benefit the patient.
Chalmers Twentieth-Century Dictionary	1911	A medicine given more to humor or gratify a patient than to exercise any curative effect.
Pepper, O.H.P.	1948	The giving of a placebo… seems to be a function of the physician which, like certain functions of the body, is not to be mentioned in polite society.
Stedman's Medical Dictionary	1953	An indifferent substance in the form of a medicine, given for the moral or suggestive effect.
Oxford English Dictionary	1953	A medicine given to humor rather than to cure the patient.
American Pocket Medical Dictionary	1953	An inert substance given as a medication.
Britannica World Language	1960	Any harmless substance given to humor a patient or as a test in controlled experiments. Anything said to flatter or please.

Webster's 3rd New International Dictionary	1971	An inert medicament or preparation given for its psychological effect, esp. to satisfy a patient or act as a control in an experimental series.
Taber's medical Dictionary	1971	1. Inactive substance given to satisfy patient's demand for medicine. 2. Also used in the controlled studies of drugs. The placebo is given to a group of patients, and the drug being tested is given to a similar group; then the results obtained in the two groups are compared. Also, something tending to soothe or gratify.
Brewer's Dictionary of Phrase and Fable	1981	An innocuous medicine designed to humor a patient, and which may have a beneficial psychological and physical effect.
Collins Dictionary of Medicine	1992	1. A pharmacologically inactive substance made up in a form apparently identical to an active drug that is under trial. 2. A harmless preparation prescribed to satisfy a patient who does not require active medication.
Oxford Concise Medical Dictionary	1999	A medicine that is ineffective but may help relieve a condition because a patient has faith in its powers. New drugs are tested against placebos in clinical trials: the drug effect compared with the placebo response, which occurs even in the absence of any pharmacologically active substance in the placebo.
Dorland's Medical Dictionary, 29th edition	2001	Any dummy medical treatment; originally a medical preparation having no specific pharmacological activity against the patient's illness or complaint given solely for the psycho-physiological effects of the treatment. More recently, a dummy treatment administered to a control group in a controlled clinical trial in order that the specific and nonspecific effects of the experimental treatment can be distinguished – i.e. the experimental treatment must produce better results than the placebo in order to be considered effective. Active placebo, impure placebo: A substance having pharmacological properties that are not relevant to the condition being treated.

It is important to note, that the definition from the 1785 was misquoted (Shapiro & Shapiro, 1997) and instead of “a common place method of medicine” the actual definition was “a common place method or medicine”. So the early definitions classify as placebo not only medicines or active drugs, but also other non-drug treatments and methods such as magic, psychotherapy, hypnosis…

Early definitions did not define placebo as an inert substance until about 1950, when the double blind randomized clinical methodology appeared in the literature. To conclude, the metamorphosis of the term “Placebo” goes as follows: from the original definition placebo, which included not just medicines (substances) but also methods, later on the definitions of

the term Placebo were limited only to medicines and further to inert substances.

Finally, due to the new scientific research methodology, the definition of Placebo was revised. Today again, any method of the treatment is proposed to be added to the definition in order to provide a broader concept, which includes physiological as well as psychological treatments (i.e. active medication, surgical procedures and psychotherapy).

Shapiro's phenomenological definition:

"A placebo is any therapy (or that component of any therapy) that is intentionally or knowingly used for its nonspecific, psychological, or psycho-physiological, therapeutic effect, or that is used for a presumed specific therapeutic effect on a patient, symptom, or illness, but is without specific activity for the condition being treated. A placebo, when used as a control in experimental studies, is a substance or procedure that is without specific activity for the condition being treated" (Shapiro & Shapiro, 1997; p. 41). Oddly enough, how can something causing an effect be non-specific?

3 MODERN DEFINITIONS OF PLACEBO

If men define situations as real, they are real in their consequences, is a well-known Thomas theorem that was formulated in 1928 as a fundamental Law of Sociology (Thomas & Thomas, 1928). Curiously how Thomas and Thomas with their theorem, perhaps unknowingly at that time, were coming close to some of the modern definitions of placebo.

The definitions proposed by some of the contemporary researchers such as Barrios, Benedetti, Di Blassi, Moreman and others agreed that perhaps the term "placebo effect" and "nonspecific effect" have some negative connotations and should be replaced by some more proper terms. Barrios points out that the placebo response is based on the power of belief or expectation (Barrios, 2002). Benedetti shows that the classic concepts of "placebo effect" are too restrictive, that we need a broader term, namely the "medical context", and that it is the context effect (meaningful induced expectations) that can explain the placebo effect through the doctor - patient interaction **(**Benedetti, 2002). Di Blassi and colleagues proposed that "placebo effect" should be used interchangeably with the term "context effect" (Di Blasi et al., 2001). Moerman shows how meaning interacts with the illness and the healing process. He proposes the term "meaning response" as the physiological or psychological effect of meaning (Moerman, 2002).

4 THE NEED FOR NEW DEFINITIONS OF PLACEBO, PLACEBO EFFECT AND PLACEBO RESPONSE

So far, we recognized that there is no need any more for the use of the term placebo and placebo effect. Furthermore, there is no need even for using such terms as "nonspecific", "inert" or "inactive". Therefore, we propose new working definitions of Placebo, Placebo effect and Placebo response to replace the previous ones (Gorjup & Gorjup, 2012, Gorjup, 2013a):

"Interpretation Potential" (IP) instead of "Placebo",

"Interpretation Value" (IV) instead of "Placebo Treatment and/or Therapeutic Treatment",

"Interpretation Effect" (IE) instead of "Therapeutic Effect" and/or "Placebo Effect" and

"Interpretation Response" (IR) instead of the term "Placebo Response/Treatment Response.

5 CONCLUSIONS

We believe that our proposed Placebo definitions are challenging enough and worth to rethink of their possible impact on future directions in bio/neuroethics. There is ample evidence supported by strong arguments claiming that it would be unethical to avoid Placebo effects (Moerman, 2005). Avoiding placebo effects means that we are avoiding real improvements of human well-being. Dorland's Medical Dictionary from 2001 (see

table 1) demonstrates another conceptual inconsistency of traditional medical paradigm. While all drugs have to show they are better than placebo in order to be approved, there is one exception. Cancer drugs are never compared with placebo but instead these experimental drugs are always compared among themselves (Zaijcek, 1995). In oncology, placebo effect is regarded as unethical, but alleviating the negative psychological states with empathy and compassion could certainly help to reduce the immunosuppression thus helping patients to get well again (Barrios, 2002). It is now or never. Mind body interactions indicate no differences between pharmacodynamic and psychosocial effects, or to put another way cognitive affective events induced in a psychosocial context can trigger similar mechanisms as those activated by drugs (Colloca & Benedetti, 2005). If medical society will recognize the opportunity to define placebo as proposed above, then the art of a healing compassion can become a science - A science of compassionate care (Gorjup & Gorjup, 2012, Gorjup, 2013a). By doing so the non-specific effect will become specific and the treatment will have the added effect. This effect is "gratis" and should be regarded in the future as psychosocial evidence based interpretation effect. By contrast, if medical society will insist on old definitions of Placebo in terms of duality then others will continue to manipulate and take advantage of the Placebo phenomenon. Let us here conclude with the last sentence from the book "The Powerful Placebo: from ancient Priest to modern Physician": "If the non-specificity of the placebo effect can be rendered specific and its strength can be unleashed, the terms placebo and placebo effect can appropriately disappear into medical history." (Shapiro & Shapiro, 1997, page 237)

REFERENCES:

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & Van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and non-anxious individuals: A meta-analytic study. *Psychological Bulletin.*

Barrios, A. A. (2002). Science in Support of Religion: From the Perspective of a Behavioral Scientist. *Banning, California, Cancer Federation Press.*

Benedetti, F. (2002). How the Doctor's Words Affect the Patient's Brain. *Evaluation & the Health Professions*, 25(4):369-386.

Bishop, S. J. (2009). Trait Anxiety and impoverished prefrontal control of attention. *Nature Neuroscience*, 12, 92-98.

Blackman, C. F., Benane, S. G., & House, D. E. (1993a). Evidence for direct effect of magnetic fields on neurite outgrowth. *FASEB J*. 7, 801–806.

Blackman, C. F., Benane, S. G., House, D. E., & Pollock, M. M. (1993b). Action of 50 Hz magnetic fields on neurite outgrowth in pheochromocytoma cells. *Bioelectromagnetics* 14**,** 273–286.

Blackman, C. F., Blanchard, J. P., Benane, S. G., House, D. E., & Elder, J. A. (1998). Double blind test of magnetic field effects on neurite outgrowth. *Bioelectromagnetics* **19**, 204–209.

Blank, M. (1992). NaK-ATPase function in alternating electric field. 75th Annual Meeting of the Federation of American Societes for Experimental Biology, April, 23th, 1992, Atlanta, Georgia.

Colloca, L., & Benedetti, F. (2005). Placebos and Painkillers: is mind as real as matter? *Nature Reviews Neuroscience,* 6:542–552.

Di Blasi, Z., Harkness, E., Georgiu, A, & Kleijnen, J. (2001). Influence of Context Effects on Health Outcomes. A Systematic Review. *Lancet;* 357:757-762.

Eysenck, M. W. (1997). Anxiety and Cognition. A Unified Theory. Hove, England, Psychology Press.

Getz, L. (2006). Sustainable and Responsible Preventive Medicine. Conceptualizing ethical dilemmas arising from clinical implementation of advancing medical technology. Doctoral Thesis. Norwegian University of Science and

Technology. Faculty of Medicine, Department of Public Helath and General Practice.

Gorjup, N. (2011). Magnetic field generator (ABSNEI 15). Eaeldorao, Inc.

Gorjup, N., & Gorjup, R. (2012). To redefine or not to redefine? This is the question. Elsaeldorado, Inc., Unpublished Manuscript.

Gorjup, N., & Jerman, I. (2014). Germination and growth of Lemma Minor by exposure to square pulse and 16 Hz sinusoidal magnetic field. The 8th International workshop on biological effects of electromagnetic fields, 21th -26th September, 2014, Varna, Bulgaria.

Gorjup, R. (2013a). Towards Understanding the Importance of Redefinition of Placebo Effect. Sinapsa Neuroscience Conference ˈ13, Ljubljana, Slovenia, September, 27th-29th, 2013. Book of Abstracts. Sinapsa, Slovenian Neuroscience Association and Faculty of Medicine, University of Ljubljana, Slovenia. [ISBN 978-961-91704-5-8].

Gorjup, R., Bernardis, P., Grassi, M., & Gerbino, W. (2013b). The influence of anxiety, general self-efficacy and motivational systems on cognitive self-evaluation and performance during the ANTI-V task. Proceedings of the 16th International Multiconference, Information Society – IS 2013, October 7th -11th Ljubljana. Cognitive Science, 299-302. Jožef Stefan Institute, IJS, Ljubljana, Slovenia [ISBN 978-961-264-066-8].

Gorjup, R., Bernardis, P., Grassi, M., & Gerbino, W. (2014). Individual differences in the ANTI-V paradigm. 37th European Conference on Visual Perception – ECVP 2014, August 24th-28th, 2014, Belgrade, Serbia. *Perception*, Volume 43: 25. Pion, Ltd. London, UK.

McClare, C. W. E. (1974). Resonance in Bioenergetics. *Annals of the New York Academy of Sciences*, 227:74–97.

Methews, A., & MacLeod, C. (2005). Cognitive Vulnerability to emotional disorders. *Annual review of clinical psychology,* 1, 167-195.

Moerman, D. E., & Wayne B. J. (2002). De-constructing the Placebo Effect and Finding the Meaning Response. *Annals of Internal Medicine*, 136 (6):471-476.

Moerman, D. E. (2005). Sorcerers, Magic, Meaning, and Healing: Or, Why it is Unethical to Avoid "Placebo Effect". Abstracts (136), 11th World Congress on Pain. Seattle, WA, IASP Press.

Pacheco-Unguetti, A. P., Acosta, A., Callejas, A., & Lupiañez, J. (2010). Attention and anxiety: different attentional functioning under state and trait anxiety. *Psychological Science*, 21(2):298-304.

Pophrstic, V., & Goodman, L. (2001). Hyperconjugation of steric repulsion leads to the staggered structure of the ethane. *Nature,* 411: 565-568.

Schoth, D. E., & Liossi, C. (2010). Attentional bias towards pictorial representations of pain in individuals with chronic headache. *The Clinical Journal of Pain*. 26 (3): 244–250.

Shapiro, A. K., & Shapiro, E. (1997). The Powerful Placebo: From Ancient Priest to Modern Physician. Baltimore, Johns Hopkins University Press.

Simkó, M. (2004). Induction of cell activation processes by low frequency electromagnetic fields. *The Scientific* World *JOURNAL*, 4(S2), 4–22.

Sivitz, L. (2000). Cells proliferate in magnetic fields. *Science News,* 158: 195.

Szent-Gyorgyi, A. (1960). Introduction to a Submolecular Biology. New York Academic Press.

Thompson, W.G. (2005). The Placebo Effect and Health. Combining Science and Compassionate Care. Prometheus Books, New York.

Zajicek G. (1995). The placebo effect is the healing force of nature. *The Cancer Journal*, Volume 8, 2: 8-11.

ONE CANNOT "JUST ASK" ABOUT EXPERIENCE

Alja Lah, Urban Kordeš
Faculty of Education
University of Ljubljana
Kardeljeva ploščad 16, 1000 Ljubljana, Slovenija
Tel: +386 1 5892 200
e-mail: urban.kordes@pef.uni-lj.si

ABSTRACT

The present article concentrates on second-person in-depth phenomenological inquiry (SIPI) into human experience. In order to delineate important characteristics of SIPI we use an example of a phenomenological case study. The study comprised of descriptive experience sampling, writing of diary, and a series of elicitation interviews.

The essential characteristic that we want to point out is a shift from the relationship researcher-subject to a participatory one of two co-researchers. Additionally we want to call attention to required interest and responsibility as well as openness and trust of the two co-researchers involved. We claim that "just ask" approach does not suffice and therefore methodologically most urgent prerequisite of SIPI or any kind of method trying to learn about second person view of cognition should be active and repeated training in observation as well as reporting about it. Such repetition can be achieved with a series of hermeneutical dialogues where "don't know" attitude is of essential role.

1 INTRODUCTION

Research of human experience, has expanded across various fields of research and practice and progressed noticeably in the recent decades. On one end it extends from purely quantitative approaches where questionaries' about personal experience complement neuropsychological research (Mason et al., 2007; Parnas, Sass, & Zahavi, 2013; Schooler, Reichle, & Halpern, 2004). On the other it encompasses in-depth qualitative approaches where interview techniques are used to compose profound, detailed and vivid picture of respondent's experiential landscape (Hurlburt, 1992; Petitmengin, 2006). Most modern methods of researching subjective experience have recently developed within cognitive science. "Capitalizing on the ability of our species for self-reflection and combining it with the detailed measures of brain function that modern technology allows, cognitive neuroscience may be better able to reveal what is unique about the human mind" (Christoff, Smith, Gordon, Smallwood, & Schooler, 2009; p.8723).

The present article concentrates on second-person in-depth phenomenological inquiry (SIPI) into human experience. This is an interview-based approach constructed as a combination of methods originally designed by Hurlburt (1992) and Petitmengin (2006). The purpose is to delineate some important characteristics of SIPI and with this reveal yet another possibility inside phenomenological research that can bring us closer to understanding human cognition. The essential characteristic that we want to point out is a shift from the relationship researcher-subject or researcher-participant to a participatory one of two co-researchers. In examining experience the role of the one experiencing becomes active. He or she is not just a reporter or an information source but must become an active collaborator in the study. To portray such participatory research relationship we will use the term researcher (the person leading and facilitating the interview) and co-researcher (the one researching and reporting on his or her experience). We use the term second-person inquiry (as used by Varela & Shear, 1999 and Petitmengin, 2006) meaning the dialogical research with shared responsibility for conducting the research.

Through the process of this kind of research the co-researcher can expand his or her existential understanding of own experiential landscape. Therefore this technique can be viewed as a kind of self-research process, thus approaching mindfulness and some Husserl based psychotherapies (Giorgi, 2005; Kondratyuk, & Perakyla, 2011).

In order to illustrate the characteristics of SIPI we will use an example of a phenomenological case study. For this aim we selected a case study of suicidal ideation[1]. Our basic research question was to learn as much as possible about suicidal ideation related experience. There are varying definitions offered for the concept suicidal ideation but in the present article it is used to refer to our subjects' experiential world connected to suicide, retreat or nonbeing. Let us emphasize again that this paper's purpose is not to add to widely researched area of suicidal ideation. We will mostly use the example of a methodologically clear and

[1] The study is presented in detail by Radovanović & Kordeš (2009), for the purpose of this paper we only present a selected part.

well-conducted case study to illuminate interesting and essential characteristics of SIPI.

2 RESEARCH DESIGN

In phenomenological research we never can know into what kind of experiential landscapes we will meander and because of the sensitive matter of this study we had to be very careful in preparing and designing it. Bearing in mind the possible dangers and ethical considerations of such research in suicidal ideation is principal. We have to be very selective in choosing the co-researcher and all possible outcomes have to be weighted out. Nevertheless we were encouraged by other studies with suicidal participants that report benefits to taking part in a research as it enables them to discuss problems (sometimes for the first time), which more often than not brings them some kind of relief (Cukrowicz, Smith, & Poindexter, 2010).

2.1 Co-researcher

The co-researcher was a 32-year-old female, for the purpose of this paper we will call her Mary. At the time of the research she was undergoing her own psychotherapy process and also studying to become a psychotherapist. Occasionally she would experience suicidal thoughts hence her psychotherapist proposed they signed an anti-suicide contract. After signing it Mary "realized her suicidal fantasies comfort her when she is feeling extremely bad, for they represent a possible way out of the hell she is experiencing, although that way out is death". When she expressed these feelings to her psychotherapist, she received approval that it is all right to be as she is – even if that is suicidal. The response she received from her psychotherapist laid the grounds for her to become intrigued by feelings of anger and her willingness to "fight for the right to have suicidal fantasies". This eventually led to deeper curiosity to research these suicidal states from a first person perspective. In the time being she did not want to get rid of them rather to understand them better. She approached the phenomenological research group with a suggestion to commence a phenomenological case study of these phenomena.

Before the study we made sure that Mary and her therapist understood the nature of phenomenological research. Her psychotherapist evaluated the possible dangers of her entering a self-research process like this and gave the study a green light. It was made clear that Mary or her psychotherapist could stop the research at anytime if needed. Furthermore we had a third person attend the research process as a kind of extra attention and perspective to ensure safety at each step.

2.2 Procedure

The whole research was designed as a phenomenological case study (comprehensively described by Kordeš, 2009). The research consisted of two phases. In the first phase we used descriptive experience sampling technique (DES; Hurlburt, 1992), which gives an overview or the first outlook of the researched phenomena and trains the co-researcher in observing and reporting on her experience. Practical application of such surveying involves a research subject carrying a device, which emits a discrete signal 7 to 10 times per day at randomly selected moments. The subject attempts to "freeze" the experience just prior to the signal by writing it down into a notebook as precisely as possible. Within the frame of 24 hours an in-depth interview is conducted to thoroughly examine and describe all recorded experiences. The process is repeated several times, until the co-researcher is well trained in observing her own experience and feels that the gathered "samples" give an appropriate depiction of the structure of the entire experiential landscape.

In this case we expected that random sampling might not catch enough moments of experiencing suicidal ideation so we additionally instructed the co-researcher to keep a diary where she noted down every suicide thought throughout the day, with the intent to direct attention to this segment of experience. In-depth interviews were used to investigate diary entries as well.

When enough samples were gathered we introduced the second phase, which consisted of elicitation interview technique (Bitbol, & Petitmengin, 2013; Vermersch, 1994). The basis of elicitation interviews were selected experiential modalities of suicidal ideation found in the first part. We carried out five elicitation interviews in three months time.

In the end we gathered three types of data: transcripts of DES interviews, diary entries and transcripts of elicitation interviews. Content analysis was performed in line with case study methodology. The data was coded and put on the timeline so we could extract the temporal relations. The categories were defined and charted along the timeline.

3 SELECTED RESULTS

The aim of this section is not a presentation of characteristics of suicidal ideation connected experience but more a presentation of a selected theme to serve as an example for subsequent discussion about characteristics of SIPI (we omit the rest of the results in this paper because of the limited space).

Prior to commencing the study Mary was asked about the quantity of her suicidal thoughts and reported of few at the time being. Interviews that included moments gathered with DES sampling and diary entries quickly showed a surprising number of suicidal thoughts, which was contrary to Mary's initial estimation. A diary excerpt will best portray Mary's experiential insight into the frequency of her suicidal ideation.

"I cannot believe how often I have suicidal thoughts. I am shocked. Now, when I pay attention to them and observe them, it seems that they are somehow constantly hidden in me. Just below the surface, always ready…

I thought that they are practically gone. I didn't realize that they are there also when I am not currently in trouble or feeling bad. Even the smallest criticism I think about, and doesn't need to come from other people, upsets me and I respond to it with a suicidal thought."

Mary's reports before the research started largely underestimated the amount and persistence of suicidal ideation. Therefore "just asking" about the co-researchers experience without repeated observation wouldn't give us an accurate portrait.

4 DISCUSSION

The aim of the present article is to reveal essential characteristics of second-person phenomenological inquiry on an example of a case study of experiencing suicidal ideation. We will start with a fundamental characteristic of our own knowledge of our experience, which is a vital element to consider when investigating experience and it further impacts the principal characteristics of SIPI.

4.1 We don't know our experience

Our case study in suicidal ideation is a good example of a case where the "just ask" approach does not suffice (Hurlburt, 1979; Hurlburt & Sipprelle, 1978). When Mary was asked about the frequency of her suicidal thoughts she erroneously reported there were a lot less of them then we later discovered with DES technique and diary writing. Assumptions that people are well acquainted with their experience and therefore need only to be asked about it usually lead to confirmation of our own notions of what experiential landscape should look like (Kordeš, 2013).

Therefore methodologically most urgent prerequisite of SIPI or any kind of method trying to learn about human experience should be active and repeated training in observation as well as reporting about it. Such repetition can be achieved with a series of hermeneutical dialogues where "don't know" attitude is of essential role. Conducting SIPI with suspended judgments reflects the crucial methodological guideline of Husserl's concept of phenomenological reduction.

For SIPI research to produce any kind of genuine data it has to be iterative which is achieved by repeated interviews with participants. A systematic and persistent training in observation of the experiential landscape is necessary as was suspected by Várela (1996) and later empirically proven by Hurlburt (2009, 2011). Our practice shows that DES is a good starting technique to explore and describe experience. Systematic observation is later achieved by a series of in-depth interviews.

4.2 Interest and responsibility

Genuine interest in the researched phenomena and willingness to take full responsibility for entering as well as making each subsequent step of the research process is in our view essential for any co-researcher before starting phenomenological inquiry. In our case study the co-researcher initiated the study out of her own personal interest and was aware of the uncertain terrain we were walking as well as took responsibility for proceeding or stopping with the research if necessary.

4.3 Openness and trust

For the co-researcher to be able to access her intimate and unknown dimensions, she must abandon her representations and beliefs about herself. She must take off her usual skin, agree to relax without it and enter a state of vulnerability. For her to allow herself to be guided to carry out this intimate effort, she must feel the researcher totally present, attentive, open-minded and humble. The objective is to open up space for the co-researcher and make it possible for her to go into the realms of experience where she normally does not let herself roam to. The co-researchers are bound together bi intentions of exploring experience with the focus on "how" rather than "why". Petitmengin (2006, p.255) stressed the importance of an open-minded position on both sides because "While the interviewee does not know what he knows, the interviewer does not know what he is looking for". The cornerstone of the dialogue is the relationship of trust between the two people involved (Petitmengin, 2006).

4.4 No expectations

It is of utmost importance to emphasize that Mary did not enter the research process with intent to change her experience (and become less suicidal), on the contrary –she felt she doesn't have to change which gave her a feeling of security she needed to be able to research a part of her experience that was intimidating and painful. She trusted the researcher to continually re-create an open space of security and acceptance without having any expectations. We believe this is one of the core requirements of these kinds of studies; letting go of all expectations of outcomes by the researcher and co-researchers. It is also vital that a researcher is skilled in putting his or her usual judgments, expectations and desires for change aside – putting them into "brackets" or epoche in Husserlian terms and applying phenomenological reduction – the reduction of the observed phenomena "as the only thing given and certain in experience".

4.5 Pure observation

Undertaking an attitude of pure observation without the intent to change – gazing into what is already there - is a foundational position upon which the following stages of the study can be built, and only then can true insights arise. It gives the co-researcher an opportunity to learn in a direct experiential way that relating to the world from set preconceptions interferes with open contact with the present moment. Often we try to change or flee our present experience, which we barely even know because it gets obscured by our concepts and fears. Consequently, the space for pure observation is of utmost value. To our great surprise, bringing an open and friendly curiosity to how

(unpleasant) experiences can be 'felt' experientially in patterns of ever-changing sensations creates a sense of greater freedom, clarity and choice than we can ever experience when ruminating about or trying to avoid the experience. Boss (1963; p.179) emphasized, "We must be capable of allowing what appears before us to remain intact and as what it immediately shows itself to be… We have to learn again just to look at the things actually confronting us and to let the phenomena, which we encounter, themselves tell us their meaning and content".

6 CONCLUSION

We are heading into exciting times of growing interest for consciousness research, and above all it is becoming more and more evident that we are shifting our understanding of scientific research and reconsidering the amount of responsibility of all parties involved (researchers and participants). We, the researchers, are starting to realize we cannot assume participants' responsibility of knowing their own experience (because they clearly don't as was shown in this paper) rather we first have to take the responsibility to provide the space for them to learn how to observe their experience and then give them their full responsibility back and invite them to become equal co-researchers who also become the experts in researching their experience.

SIPI clearly holds the basic features of scientific work: absence of intentionality and judgment, the observation of that which is there without trying to escape or change it. It is open-ended, thorough and systematic. By reconsidering responsibility and applying these features to examining experience, we create a meta-cognitive dimension, from which experience can be viewed almost uninterruptedly.

References

[1] Christoff, K., Smith, R., Gordon, A., Smallwood, J., & Schooler, J. (2009). Experience sampling during fMRI reveals default network and executive system contributions to mind wandering. *Proceedings Of The National Academy Of Sciences Of The United States Of America*, *106*(21), 8719-8724.

[2] Cukrowicz K., Smith, P. & Poindexter, E. (2010). The effect of participating in suicide research: does participating in a research protocol on suicide and psychiatric symptoms increase suicide ideation and attempts? *Suicide Life Threatening Behavior*, 40(6), 535–543.

[3] Bitbol, M., & Petitmengin, C. (2013). A defense of introspection from within. *Constructivist Foundations*, *8*(3), 269-279.

[4] Boss, M. (1963). Anxiety, guilt and psychotherapeutic liberation. *Review of Existential Psychology and Psychiatry,* 3(3), 173-195.

[5] Giorgi, B. (2005). Reflections on Therapeutic Practice Guided by a Husserlian Perspective. *Journal Of Phenomenological Psychology*, *36*(2), 141-194.

[6] Hurlburt, R. T. (1979). Random sampling of cognitions and behavior. *Journal Of Research In Personality*, *13*(1), 103-111.

[7] Hurlburt, R. T. (1992): *Sampling Normal and Schizophrenic Inner Experience.* Plenum Press, New York.

[8] Hurlburt, R.T. (2009). Iteratively apprehending pristine experience. *Joumal of Consciousness Studies,* 16(10-12), 156-188.

[9] Hurlburt, R.T. & Schwitzgebel, E. (2011). Methodological pluralism, armchair introspection, and DES as the epistemic tribunal. *Joumal of Consciousness Studies*, 18(1), 253-273.

[10] Hurlburt, R. T., & Sipprelle, C. N. (1978). Random sampling of cognitions in alleviating anxiety attacks. *Cognitive Therapy And Research*, *2*(2), 165-169.

[11] Kondratyuk, N., & Perakyla, A. (2011). Therapeutic work with the present moment: A comparative conversation analysis of existential and cognitive therapies. *Psychotherapy Research*, *21*(3), 316-330.

[12] Kordeš, U. (2009). How to research experience? In E. Žerovnik, O. Markič, and A. Ule (Eds.), *Philosophical insights about modern science*. New York: Nova Science Publishers.

[13] Mason, M. F., Norton, M. I., Van Horn, J. D., Wegner, D. M., Grafton, S. T., & Macrae, C. (2007). Wandering Minds: The Default Network and Stimulus-Independent Thought. *Science*, *315*(5810), 393-395.

[14] Parnas, J., Sass, L., & Zahavi, D. (2013). Rediscovering Psychopathology: The Epistemology and Phenomenology of the Psychiatric Object. *Schizophrenia Bulletin*, *39*(2), 270-277.

[15] Petitmengin, C. (2006). Describing one's subjective experience in the second person: An interview method for the science of consciousness. *Phenomenology and cognitive science*, 5, 229–262.

[16] Radovanović, K. in Kordeš, U. (2009). A bridge to the dark world – phenomenological case study research. [Most k temnemu svetu: fenomenološka študija]. *Kairos: Slovenian Journal of Psychotherapy,* 3(3-4), 19-35.

[17] Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004). Zoning Out while Reading: Evidence for Dissociations between Experience and Metaconsciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 203-226). Cambridge, MA, US: MIT Press.

[18] Varela, F.J. (1996). Neurophemonology: A methodological remedy for the hard problem. *Journal of Consciousness Studies*, 3(4), 330-349.

[19] Varela, F. J., & Shear, J. (1999). *The view from within: First-person Approaches to the Study of Consciousness.* Exeter: Imprint-Academic.

[20] Vermersch P. (1994) *L'entretien d'explicitation.* ESF, Paris.

ETHICAL CONSIDERATIONS ON SERIOUS GAMES IN CHILD PSYCHOTHERAPY

Špela Lesar
MEi:CogSci
University of Ljubljana
spela.lesar@gmail.com

ABSTRACT

Psychotherapy is a highly sensitive domain, with outcomes that can be as much positive as destructive: Before the implementation of a novel method, it is mandatory to make serious investments in attempts to anticipate possible negative outcomes and provide suitable prevention. In recent years, several attempts have been made to apply Serious Games in psychotherapy of children. The focal objective to use these computerized interventions is to exploit familiarity with the entertainment/gaming factor to mediate psychotherapy intervention. While these expectations were confirmed in pilot studies, information on ethical considerations from the application field of Serious Games in child psychotherapy still indicate high deficiencies of the field; further investigations are required to validate and justify such use. We present the domain of serious games and ethical concepts from psychotherapy practice, and then focus on ethical issues we identified in reported pilot studies that originate from the uniqueness of the novel method. With an overview on the developmental, research and application levels of pilot serious games in child psychotherapy, we conclude that ethical considerations in the domain are yet not sufficient for broader application in professional practice and further research is needed.

1 INTRODUCTION

Worldwide mental health care establishment faces several deficiencies related to the lack of sufficient number of specialists, the inefficiency of performed treatments, and the economical weight on the health budget. Reports on dropout rates, adherence and homework compliance motivate new adjuncts in psychotherapy [1]. In particular, the role of games in psychotherapy for children has been re-evaluated, where they traditionally have served as tool for establishing a inter-personal relationship, or for relaxation between therapy sessions. Today, children computer activities are accessible to the majority of the population; they also form a reference age group for the application of new technologies based on gaming. Gaming is a fun and relaxing activity that has the child's attention and is easy to maintain in the therapy session. For this reason, the development of serious games for psychotherapy has focused on childhood and the adolescent population, supposed to benefit most from the new method because of its intrinsic mechanisms of play [1].

Reports on pilot studies and preliminary results show enhancement in homework compliance, client collaboration with the therapist and adherence [2], [3]. Further, results support that Serious Games (SGs) facilitate treatment of mental health problems, ease the establishment of therapist–client relationships, and in general motivate clients to participate actively [1-4]. For example, a pilot study by Coyle at al. [5] found that in severe cases of "elective mutes"—clients that categorically refuse to communicate with the therapist and show no interest in the therapy—a SG proved a medium that changed such attitude and enabled the therapist to proceed.

Although the concept of new technological adjuncts in psychotherapy, SGs and other e.g. virtual reality tools, has been studied for over a decade, there is still a deficiency in ethical considerations regarding such technological development and related applications. We will briefly discuss the current state of the art and pilot applications of SGs for psychotherapy of children. Further, we will address application of basic ethical concepts of mental healthcare (MHC) settings in the newly established frame of SGs for psychotherapy, and will present two pilot studies of SG application in terms of a tripartite model covering *design*, *research* and *application* phases that raises several ethical issues due to the uniqueness of new method.

2 THE CURRENT STATE OF SERIOUS GAMES

Today's concept of SG originates from the emergence of the Serious Games Initiative (SGI) in 2002 [6] that led to broader awareness of the concept and exponential growth of research and development in different application areas. While the field of SG is still in its developmental phase, attempts at game taxonomies are congruent in their distinction of entertainment games and SGs. The latter represent gaming agency as also offered by entertainment components, but their primary purpose is of a more "serious" nature, reflected by applications in education, prevention, rehabilitation, or advertisement [6-9]. The wide scope can be deducted from the description of the SGI's purpose: "SGI is focused on uses for games and exploring management and leadership challenges facing the public sector. Part of its overall character is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health and public policy" [8]. One of the public sector domains addressed is healthcare, with SGs targeting specific domains in

rehabilitation (e.g., after cognitive or physical impairment), prevention, and learning (e.g., of the patient about his illness, or doctor training of medical skills acquisition [7-9]).
SGs for psychotherapy are also derived from the healthcare sector, but the precursor of gaming in MHC settings is two decades older, with discussions of computer-assisted therapeutic games for child and adolescent therapy (cf. Allen 1984 and Clark 1984 in [5]). Even though later research does not cite findings from early studies considering ecological validity and "difficulties surrounding clinical evaluations" [5:347], the conclusions reached are similar: games overall increase and further enable involvement of previously uncooperative clients. The concept of the game emphasizes positive connotations, development of problem-solving skills, and redirects clients' attention from negative attitudes towards more constructive means [5]. Mental conditions addressed in pilot studies include: panic disorder (PD), posttraumatic stress disorder (PTSD), different anxiety disorders [10], schizophrenia, attention deficit hyperactivity disorder (ADHD), and impulse-related disorders [3].
We will now discuss basic ethical concepts established by the American Psychological Association (APA) and in professional use in the context of psychotherapy.

3. ETHICS IN PSYCHOTHERAPY

The APA Council adopted a version of the APA Ethics Code in 2002 [11] that proposes general principles and several ethical standards. These guidelines are globally accepted as basic framework in psychology and/or psychiatric practice. Five general principles form the highest ethical ideals of the profession of psychologists and other therapists: *Beneficience and Nonmaleficience* direct psychologists' agency in their work practice to be beneficiary for those being worked with or cared for. *Fidelity and Responsibility* refer to the establishing of a trust relationship, in which psychotherapists act responsibly and in the best interests of whom they work with. *Integrity* refers to psychologists' accuracy, honesty, and truthfulness in their work. *Respect for People's Rights and Dignity* refers to respecting the dignity and worth of all people and also to their rights to privacy, confidentiality and self-determination. Psychologists should be aware of different bias factors that should not influence their work; e.g. cultural, individual and role differences, including age, gender, race, ethnicity, culture, religion, sexual orientation, or disabilities [12, 11].
These codes of conduct are also met by codes of the American Academy of Child and Adolescent Psychiatry [13]. Regarding research involving human participants, the concept of *principlism* originating from the Belmont report (1979) has been established [14]. The report defines three basic principles to be taken into account when conducting research with human participants: *respect of person*, *beneficience*, and *justice,* that are also included in APA's Ethic code, and further form the basis for key considerations on Independent Ethics Committees (IEC) responsible for approval, monitoring, and review of biomedical and behavior research designs involving human participants at an institutional level. In our literature research, we encountered pilot study reports of SGs application in child psychotherapy where information on ethical considerations provided in collaboration with IEC proved highly deficient [2], [5], [15].
Next, we introduce two example SGs pilot studies in child psychotherapy to justify ethical considerations beyond those from classical psychotherapy. We will address these in the context of the development and design, research, and deployment phases of a new method for SG production.

4. SERIOUS GAMES PILOTS IN CHILD THERAPY

In 2005, Coyle et al. [15] reported on a pilot application of a newly developed method based on solution focused therapy (SFT). The 3D computer game, "Personal investigator" (PI) has its theoretical fundations in play therapy and therapeutic storytelling and was designed "in an open manner", i.e., it was not designed to address any specific issue. The aims, achieved in the pilot, were to support the therapeutic relationship between therapists and adolescents, to attract and sustain the interest of the clients, and improove their ability to learn new coping strategies. The small pilot was conducted on four participants, who were referred to therapy for different reasons: anxiety and behaviour problems, attempted suicide, and social skills difficulties.
The second example pilot is Treasure Hunt, a SG developed for psychotherapy of children. An early report [2] with very scant information on participants was followed by a detailed one on the deployment of the game with more than 200 clients from different countries [15]. The design incorporates mechanisms of cognitive behavioral therapy (CBT) for the age range eight to twelve. As PI, Treasure Hunt is also not aimed at specific issues; both pilots confirmed the capacity to address different mental difficulties across ten diagnostic categories, including attention deficit hyperactivity disorder (ADHD), anxiety disorder, and post-traumatic stress disorder (PTSD). The central purpose of the design, also achieved in the pilot, was to introduce CBT mechanisms that play key roles in the understanding of the therapy process. A further aim was to promote electronic homework assignments enabling the client's rehearsal of basic psychoeducational concepts learned in sessions. These were in the first pilot trials performed in therapy session environments.
The significant efforts of both teams were rewarded with positive results and feedback. However, in terms of ethical imperatives in psychotherapy research and application, further considerations are neccessary. We will now discuss such ethical considerations from classical psychotherapy with an emphasis on those originating from the uniqueness of the applied method. The examples discussed combine those presented by the authors of the pilot studies with other important ones encountered in our literature research.

5. SERIOUS GAMES FOR PSYCHOTHERAPY: ETHICAL CONSIDERATIONS

Besides the aforementioned general principles, the APA Council [11] proposes several ethical standards derived from fields including: Competence, Human relations, Privacy and

Confidentiality, Record Keeping and Fees, Education and Training, and Research and Publication. Each of these is subdivided further and addresses different ethical aspects in more detail; some of these are covered in the next paragraphs. In addressing applied ethical considerations in psychotherapy, we refer to general principles and standards that should benefit participants, in a nonmaleficient research design. In our literature research, we looked for ethical considerations other than the established ones, as originating from the novel method of SG deployment and its features. In the developmental phase of SGs for psychotherapy, basic concepts should be defined, reflecting intrinsic necessities of the designing process and additional features originating from the combination of psychotherapy intervention and computer as a medium.

Intrinsic ones refer to the selection of the *target group*, which partly conditions the selection of the *therapeutic method/model*. Before the definition of the therapeutic model, the designers should decide upon the available *means* of the game. So far, different attempts at taxonomies differentiate between SG as: intervention tool, self-help tool, information provider, or diagnostic tool [6, 7, 9]. The two pilot studies introduced above were developed with means of *intervention*; the researchers included two different well researched and widely applied therapeutic models for the psychotherapy of children and adolescents. The methods used—or the lack of any specific methods—define the range and severity of symptoms the SGs (can) aim to address: all further phases of research and development depend on these decisions. In terms of beneficence, the applied therapeutic method conditions the *accessibility* of the game. For the two pilots, the authors emphasize that their SGs were designed as adjuncts to be used under the guidance of specialists, and therefore should not be used as self-sufficient tool. Treasure Hunt is accessible to child psychiatrists or licensed clinical psychologists only, since the guidance of the therapist is taken to be required to exploit the SG's potential [2, 17]. Regarding the accessibility, concerns of record keeping arise for both the cases, of on-/ and offline access: strict regulations in terms of privacy and confidentiality, exclusion of personal identifiers, must be obeyed. In the case of online running that would include users information, it is hard to ensure absolute security of the data.

While the authors of the pilots considered here pursued applicability of their designs to wide ranges of different conditions, other efforts were aimed at targeted computer-based designs for specific conditions, such as phobias and different anxiety disorders [1, 3]. Virtual reality Exposure Therapy (VRET), also known as Computerized Behavioral Therapy represents a related sub-unit of SG for psycho-therapy [1] that calls for additional ethical considerations. The reason is nevly employed method of *biofeedback* that involves physiological functions usually not under conscious control (the aim of biofeedback techniques is to enable patients to learn to consciously manipulate physiological functions; biological signals commonly employed include brainwaves, skin conductance, heart rate, and pain perception) [17]. In the example of PlayMancer [3], the aim of the SG is to improve emotional self-control skills of patients with impulse-related disorders. The biofeedback mechanism tracks physiological signs of emotional reactions of the player, leading to automatic response to e.g. changed heart rate that redirect the avatar and thus the player's attention to relaxed areas, with the purpose of moderation. Ethical considerations in this design model combine two aspects: the therapist's capability and knowledge to use the method, and the sensitivity of manipulated data, which in the case of wrong interpretation can lead to evoking a relapse. Such deviation from the purpose of the therapy would offend the general principle of beneficence and non-maleficence, calling for suitable preventive measures.

Apart from distinctions on the basis of the mental conditions addressed or the supplements included in the therapy, the very basis of the oxymoron Serious Games can be seen to lie in its particular gaming agency: comparing gaming agency in traditional formulation and in SG reveals several differences that urge a redefinition and evaluation of parameters in relation with gaming in SG. Obvious differences can be observed for the *purpose* of gaming, *ir/reversibility*, and *rules of play*. In traditional gaming, the aim is to win. While SG designs also include a starting point followed by several steps toward an end / accomplishment of a given task, this final point has different affordances than the raditional one. In the two example pilots considered, progress in the games is represented by growing collections of sea stars [2] and keys [15]: the accomplishment of the SGs embodies also information about the player that has an additional value that can be measured in psychological terms. As a consequence, some pilot participants focused more on mere play in the direction of collecting requested elements than on the thera-peutic concept. In the case or reversibility, a SG design concept may require the player to be able to return to previous stages or remain at a specific level for a longer time, for the purpose of allowing the player to rehearse psycho-educational material learned during the game. In contrast, the traditional competitive concept of a game does not allow to reverse and alter progress made.

SGs connect the processes of game design, development and application domain. As emphasized by Coyle et al. [15, 19], and also upheld by Wattanasoontorn et al. [19], the research groups should include professionals from the fields of MHC and human-computer interaction (HCI). Additionaly an incremental process that feeds important and required empirical information about possible positive, negative, and/or missing features of the game should be employed back to the design and development as it is acquired in early test runs. All such decisions and definitions regarding design and included therapy model are necessary to counter the threat of a SG having direct negative impact on clients or other misuse of the game. Similar responsibilities and causalities hold for all further definitions pertinent to the phases of research and deployment. The model of core components of SG development and application by Wattanasoontorn et al. [19] proposes a first phase, where the

developer team members required for the concept of "SG for health" are introduced: this includes programmers, researchers and content providers (i.e., experts in the application domain of the SG). Since the majority of specialists from MHC domain are not also specialists in computer science (and vice versa), traditionally, pilot trials are closed for HCI professionals for ethical reasons of privacy and confidentiality. As a result, the only feedback available to HCI professionals is indirect, mediated through questionnaires that form a rather poor information source, as also demonstrated by the example pilot studies considered: Questionnaires were designed for the needs of MHC professionals and clients, and in addition the overall response quality was rather poor. Another ethical consideration of direct relevance to research in psychotherapy regards research design: In research on *effectiveness* of a SG, when the control group represents healthy participants, ethical considerations preclude the inclusion of a placebo group [20]; an allowed research design alternative is given by *non-inferiority* trials [21]. Generally, any research in this newly established field should be conducted in particularly close collaboration with an ethical committee at the institutional level. Also, certification models are needed, to ensure professionalism against the threats posed by the invasion of private sector and other, e.g. economical, interests.

Before the deployment of a SG application, the MHC specialists involved should undergo training procedures aimed at ensuring optimal use of the new method and the related software. Once this condition is met, the focus can next be placed on the client: The decision of who is suited for the use of the SG hinges on various aspects, such as of the potential client's history of addictive behavior in game play and/or potential of escapism, the severity of the addressed mental condition, and the appropriateness of the SG. In either case. this decision requires comprehensive clinical evaluation. For the pilot studies covered here, all authors emphasized that the decision about the use of a SG should be made on a case by case basis. An overall central recommendation is that SG should serve as supplement to classical psychotherapy and should therefore be used in a controlled environment of psychotherapy practice, with the purpose of supporting an optimal treatment outcome [2, 15].

CONCLUSION

In spite of the early nature and scarcity in number of attempts of significant research on the application of SG in psychotherapy for children, we can already identify some unique ethical considerations that strongly advocate further analysis and evaluation.

ACKNOWLEDGMENTS

The author wishes to thank Paolo Petta, for the support and guidance provided.

References[1]

[1] R. Radkowski, H. Wilfried, D. Gitta, H. Martin, "Serious Games for the Therapy of the Posttraumatic Stress Disorder of Children and Adolescents," *Virtual Mix. Real. - Syst. Appl., LNCS,* vol. 6774, pp. 44–53, 2011. [Online]. Available: Springerlink, http://link.springer.com/book/10.1007%2F978-3-642-22024-1.

[2] V. Brezinka, "Treasure Hunt - a serious game to support psychotherapeutic treatment of children," *Stud. Health Technol. Inform.,* vol. 136, pp. 71–76, 2008. [Online]. Available: National Library of Medicine, http://www.ncbi.nlm.nih.gov/pubmed/18487710.

[3] F. Fernández-Aranda, S. Jiménez-Murcia, J. J. Santamaría, et al., "Video games as a complementary therapy tool in mental disorders: PlayMancer, a European multicentre study," *J. Mental Health*, vol. 21 no. 4, pp. 364–374, 2012. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/22548300.

[4] V. Brezinka, L. Hovestadt, "Serious Games Can Support Psychotherapy of Children and Adolescents," *Lecture notes in Computer Science*, vol. 4799, pp. 357–364, 2007. [Online]. Available: Springer, http://link.springer.com/chapter/10.1007%2F978-3-540-76805-0_30.

[5] D. Coyle, G. Doherty, and J. Sharry, "An evaluation of a solution focused computer game in adolescent interventions", *Clin. Child Psychol. Psychiatry*, vol. 14, no. 3, pp. 345–60, 2009. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/19515752.

[6] T. Susi, M. Johannesson, and P. Backlund, "Serious games: An overview," *Elearning*, vol. 73, nr. 28, pp 1–28, 2007. [Online]. Available: DIvA portal, http://www.diva-portal.org/smash/get/diva2:2416/FULLTEXT01.pdf.

[7] C. Gaudet-Blavignac and A. Geissbuhler, "Serious games in health care: a survey," *Yearb. Med. Inform.*, vol. 7, nr. 1, pp. 30–3, 2012. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/22890338.

[8] Serious Games Initiative [Online]. Available: http://www.seriousgames.org/.

[9] A. De Gloria, F. Bellotti, and R. Berta, "Serious Games for education and training," *Int. J. Serious Games*, vol. 1, nr. 1, pp 1–15, 2014. [Online]. Available: International Journal of Serious Games, http://journal.seriousgamessociety.org/index.php?journal=IJSG&page=article&op=view&path[]=11.

[10] M. G. Craske, R. D. Rose, A. Lang, et al., "Computer-assisted delivery of cognitive behavioral therapy for anxiety disorders in primary-care settings," *Depress. Anxiety*, vol. 26, nr. 3, pp. 235–242, 2009. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/19212970.

[11] (APA) "Ethical Principles of Psychologists and Code of Conduct," APA, 2011 [Online]. Available: http://www.apa.org/ethics/code/.

[1] All online material was last visited in September 2014.

[12] K. S. Pope and M. J. T. Vasquez, "Ethics in Psychotherapy and Counseling: A Practical Guide". San Francisco, Calif: Jossey-Bass, 2010.
[13] Code of Ethics. *AACAP*, 2012. [Online]. Available: American Academy of Child and Adolescent Psychiatry, https://www.aacap.org/App_Themes/AACAP/docs/about_us/transparency_portal/aacap_code_of_ethics_2012.pdf.
[14] National Institutes of Health, "The Belmont Report," *Belmont Rep. Ethical Princ. Guidel. Prot. Hum. Subj. Res.*, 4–6, 1979. [Online]. Available: U.S. Department of Health & Human Services, http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.html.
[15] D. Coyle, M. Matthews, J. Sharry et al. "Personal Investigator: A therapeutic 3D game for adolecscent psychotherapy," *Interact. Technol. Smart Educ.*, vol. 2, nr. 2, pp.73–88, 2005. [Online]. Available: Academia.edu, http://www.academia.edu/1233446/Personal_investigator_a_therapeutic_3D_game_for_adolecscent_psychotherapy.
[16] V. Brezinka, "Computer games supporting cognitive behaviour therapy in children," *Clin. Child Psychol. Psychiatry*, vol. 19, nr. 1, pp. 100–110, 2014. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/23258925.
[17] B. A. Clough and L. M. Casey, "Technological adjuncts to enhance current psychotherapy practices: a review," *Clin. Psychol. Rev.*, vol. 31, nr. 3, pp. 279–292, 2011. [Online]. Available: National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/21382535.
[18] D. Coyle and G. Doherty, "Designing adaptable technologies for talk-based mental health interventions," *Proc. Work. Technol. Ment*. April 5-10, 2008, Italy. Florence: CHI, 2008. Available: Trinity College Dublin, https://www.cs.tcd.ie/conferences/TIMH/06-Coyle.pdf.
[19] V. Wattanasoontorn, I. Boada, R. García, and M. Sbert, " Serious games for health," *Entertain. Comput.*, vol. 4, nr. 4, pp. 231–247, 2013. [Online]. Available: ScienceDirect, http://www.sciencedirect.com/science/article/pii/S1875952113000153.
[20] J. Meltzoff and M. Kornreich, "Problems and design in psychotherapy research, in: Research in Psychotherapy, Transaction Publishers, vol. 1, pp. 3-33, 2007.
[21] S. J. Head, S. Kaul, A. J. J. C. Bogers et al. "Non-inferiority study design: lessons to be learned from cardiovascular trials," *Eur. Heart J.*, vol. 33, nr. 11, pp. 1318–1324, 2012. [Online]. National Library of medicine, http://www.ncbi.nlm.nih.gov/pubmed/22564354.

Accepting different leadership roles by Slovenian and non-Slovenian participants in the contemporary Slovenian society

Dr. SLAĐANA MIHAJLOVIĆ
Partizanska 10 A
SI – 1381 Rakek
Slovenia
FACULTY OF ARTS LJUBLJANA
Mobile phone: +386 41 455 000
e-mail: drsmihajlovic@gmail.com

ABSTRACT

Accepting different leadership roles by Slovenian and non-Slovenian participants in the contemporary Slovenian society

The management guidance is covering two common factors regardless the cultural differences: independence in making decision, action and enforcement of your own abilities. The most similar are also basic aspects that dominate management: intelligence, ability of guiding others, striving for status and (self)-initiative.

I was interested into the question, if there are, between the Slovene and non – Slovene participants in my research, significant differences in readiness to accept different leadership roles in contemporary Slovene society. Comprehensive and mostly originally constructed questionnaire with different sub – questionnaires was applied.

Participants were represented by six different groups of students (economy students, mechanical engineering students, management students, law students, sociology students and psychology students), which have been included in the survey. A total of 269 students have been questioned, of which 175 have been females and 94 males, with an average age M = 22 years (SD = 1.55).

No significant differences in readiness to accept leadership roles in different Slovene groups, organizations and institutions were found, except for leadership functions in Slovene army and police, where those, declared for non – Slovenians, showed significant lower degree of readiness to accept these functions. Also significantly smaller readiness to lead association of mountaineering club was found by non - Slovenians (p = 6%).

If we summarize we could determine that there exist some kind of structure group or organizations in which our participants were less willing to accept the management or leadership roles.

According to the results of Hypothesis 1 we can detect that the mountaineering club, army and police are that kind of association or organizations which represent a segment of social structure in which Non- Slovenians do not recognize such competence as in other groups, organizations and institutions. They can not fully identify with their nationality in the management of primarily government functions, such as already mentioned - the police, the army, which require the entire loyalty, commitment and responsibility towards the country and their citizen.

Accepting the management or leadership role of the mountaineering club by Non-Slovenes represents beside these mentioned characteristics also their non-home environment which has not supported the function of mountain activities (for example: as contrary to the Alpine or. Pannonian nations). Leading mountaineering club is closer to the Slovenes as their home environment is incorporated in the Alpine-mountain tradition.

The fact can be interpreted and justify on different theoretical perspectives and views, and certainly represent the data that should be taken into account in everyday social action and socialization assumptions.

1 INTRODUCTION

The purpose of the article is mainly to introduce one of the interesting aspects of the empiric approach for the research of the selected problem. The comprehensive and exhaustive elaboration of the theoretical background is reduced in this article to the content and stylistic presentation, which is supposed to stress the tradition and the importance of the themes also to those who do not research the abovementioned issue, but which is, nevertheless, a constantly present aspect of 'psychology and sociology of their everyday life'.

Bass [1] represents leadership as focus of group processes, the matter of personality, initiate a willingness to communicate, exercise influence, a special behavior, the form of persuasion, power connection, an instrument for achieving the goals, the effect of the interaction, the distinguished role, the beginning of the structure and as yet many combinations of these definitions.

From the psychoanalytical point of view Zaleznik [2] found that leaders and managers differ in what kind of relation they act in terms of their work roles and subordinates. Leaders are charismatic, attract strong feelings with desire to be identified with them and produce intense mutual relationships.

They always send clear signals of their intended purpose and mission; However, managers are trying to be more ambitious or silent with regard to their intentions. The leaders encourage or cause the initiative, curiosity at work. Managers prefer to be seen at playing their roles, while the leaders play themselves. Leaders are more oriented to articulate and design the ideas into the image, while managers are more focus into the process. From Zaleznik point of view the leaders are more modified and transformative as managers. On the other hand the managers are practicing random reward and management by exception, with the desire to maintain a controlled, rational and fair system. While managers tolerate cosmopolitanism, leaders react on it 'as a handicap'.
Relations between the leader and the group, however, reflect in the group processes differently depending on the task, the circumstances and their origin.
We form different ideas, thoughts, realization, feelings and emotions about the groups, which we belong to. The totality of all these elements, which are experienced in the attitude towards a group, is known as group consciousness. Group consciousness connects emotions of group identity. This includes the entire collection of concepts of a group, which the individual identifies with, and which distinguishes this group from other groups of the same class. Similarly as of national consciousness, we can speak about the national identity.
We all belong to certain nations, races, social classes, religious and ethnic groups [3]. All that we 'can' say about the social psychology of groups can also be said for nation.
National identity is one of the most important 'social identities' of an individual. It should be mentioned that discussing a nation requires societal psychological approach, and it simultaneously involves one of the most important sociological groups [4, 5].
The attachment to one's nation is a basic value of each member of a certain nation. One's own *national identity* is supposed to include respect toward other nations, their rights, culture and peculiarities. A complicated phenomenon related to national identity is nationalism. There are few studies in the expert psychological literature, which discuss nationalism from the social psychological point of view. One of the exceptions is Billig [6]. Nationalism may be a special type of ideology. The study of ideology requires multidisciplinary approach [7], and so does the study of nationalism.

2 DEFINITION OF THE PROBLEM AND GOALS

The problem can be generally expressed with a question: do between the groups of Slovenian and Non-Slovenian participants in the research exist significant differences in accepting the leadership roles in various sized groups, organizations and institutions of contemporary Slovenian society.

3 HYPOTHESIS

H1: I expect that between the two groups of Slovenian and Non-Slovenian participants I will not discover significant differences in the willingness to accept leadership role (or roles which are hierarchically close, for example: principal and vice principal, director or an assistant of director) relating to groups, organizations and institutions which are included in the questionnaire.

4 METHOD

4.1 Participants in the research

The research included 269 students; i.e. 94 men and 173 women with the average age of 22 years and the standard deviation of 1.55 years (there were n = 246 Slovenians (87 men and 159 women with the average age of 22.29 years (SD = 1.89)) and 23 non-Slovenians (7 men and 16 women with the average age of 21.52 years (SD = 1.12)).
The research included the third-year students of the Faculty of Economics in Ljubljana, the Faculty of Mechanical Engineering in Ljubljana, the Faculty of Law in Ljubljana, the Faculty of Arts in Ljubljana and the Faculty of Management in the school year 2006/2007. The research was performed in March 2007.

4.2 Instruments or aids

The original questionnaire was applied for the collection of data (whose co-authors are Dr. Sladjana Mihajlovic, prof. PhD. Lesnik August, prof. ddr. Velko S. Rus), which amongst others, included the Rockeach Values Survey, the questionnaire on justice in the world (Dalbert and Montana version), the Hofstede's value questionnaire, and various scales of management standpoints. In the article, we focused on different standpoint scales, aspects and levels of management.
We applied the Mann-Whitney non-parametric test: the analysis of relation between the selected sets of perceptions and social representations (the willingness to assume various managerial functions) on the one hand and the group characteristics (Slovenians and non-Slovenians) on the other hand.

4.3 Data collection process

The questionnaires were completed by students from different faculties (the Faculty of Economics in Ljubljana, the Faculty of Mechanical Engineering in Ljubljana, the Faculty of Management in Koper, the Faculty of Law in Ljubljana, the Faculty of Arts in Ljubljana – sociology and psychology). The completion of the questionnaire took between one and one hour and a half.

The participants were first given brief instructions for the completion of the questionnaire; they understood the instructions for the most part, but they had difficulties with ranking and evaluating the level of realization of individual terminal and instrumental values. At this point, they mostly thought that there are too many values and they are difficult to rank.

5 RESULTS AND DISCUSSION

Table 1
The results of the Mann-Whitney test of differences in the dependent variable - willingness to accept various managerial functions - depending on the group of Slovenes vs. No – Slovenians

Dependent variable	Group	N	Middle rank	Mann-Whitney U	P
V234	1	246	133.43	2444.00	0.27
	2	23	151.74		
V235	1	246	133.76	2523.50	0.39
	2	23	148.28		
V236	1	246	135.35	2742.00	0.81
	2	23	131.22		
V237	1	244	132.04	2328.50	0.17
	2	23	154.78		
V238	1	244	132.22	2372.50	0.22
	2	23	152.85		
V239	1	244	132.62	2469.00	0.33
	2	23	148.65		
V240	1	246	133.60	2484.00	0.31
	2	23	150.00		
V241	1	245	134.87	2726.00	0.79
	2	23	130.54		
V242	1	245	137.07	2188.50	**0.06**
	2	23	107.13		
V243	1	245	135.74	2514.50	0.37
	2	23	121.33		
V244	1	246	135.76	2643.00	0.57
	2	23	126.91		
V245	1	246	137.76	2149.00	**0.04**
	2	23	105.43		
V246	1	226	126.28	1632.50	**0.03**
	2	20	92.13		
V247	1	243	133.84	2469.00	0.55
	2	22	123.73		
V248	1	244	135.97	2324.50	0.16
	2	23	113.07		
V249	1	246	137.05	2325.50	0.13
	2	23	113.11		
V250	1	62	35.29	75.00	**0.04**
	2	5	18.00		
V251	1	246	135.84	2623.00	0.56
	2	23	126.04		
V252	1	245	136.06	2435.50	0.23
	2	23	117.89		
V253	1	246	135.25	2766.50	0.86
	2	23	132.28		
V254	1	245	134.37	2604.00	0.79
	2	22	129.86		
V255	1	246	135.32	2750.00	0.82
	2	23	131.57		
V256	1	244	134.18	2761.00	0.90
	2	23	132.04		
V257	1	244	132.26	2381.50	0.37
	2	22	147.25		
V258	1	246	133.36	2425.00	0.24
	2	23	152.57		
V259	1	245	134.72	2763.50	0.87
	2	23	132.15		
V260	1	246	133.42	2440.50	0.27
	2	23	151.89		
V261	1	244	132.27	2383.00	0.22
	2	23	152.39		
V262	1	246	136.28	2514.50	0.37
	2	23	121.33		
V263	1	246	133.89	2555.50	0.44
	2	23	146.89		
V264	1	245	134.20	2745.00	0.84
	2	23	137.65		
V265	1	245	134.46	2806.50	0.98
	2	23	134.98		
V266	1	246	136.21	2532.00	0.40
	2	23	122.09		
V267	1	245	135.43	2589.50	0.52
	2	23	124.59		
V268	1	246	134.93	2812.50	0.97
	2	23	135.72		
V269	1	246	133.95	2570.00	0.46
	2	23	146.26		
V270	1	246	134.43	2689.50	0.69
	2	23	141.07		
V271	1	243	134.40	2576.00	0.53
	2	23	124.00		
V272	1	246	136.67	2417.50	0.24
	2	23	117.11		
V273	1	245	134.29	2765.50	0.88
	2	23	136.76		
V274	1	241	133.09	2628.50	0.68
	2	23	126.28		
V275	1	45	25.03	43.50	0.28
	2	3	16.50		

Notes: Group: 1 = Slovenes; 2 = Non-Slovenians

Notes: Individual variables are related to the variable: what is important in the acceptance of managerial roles - the level of readiness for the management of specific target groups
(not at all ready /a = 1, ..., 5 = fully, completely ready / a):

234 / primary school headmaster;
235 / secondary school headmaster;
236 / to manage your own private educational organization;
237 / chairman of the Board of parents in the school;

238 / amateur sports club;
239 / professional sports association;
240 / cheerleading group at sporting matches;
241 / athletic coach, if I had an opportunity to do so;
242 / mountaineering society;
243 / scouts;
244 / scouts;
245 / officers' rank in the Slovenian Army;
246 / officers' rank in the Slovenian police;
247 / different cultural associations;
248 / choir;
249 / fire brigade;
250 / other (what? _____);
251 / leader of the elite clubs if I was chosen or would have a possibility (Lions, Rotary, etc.).
252 / religious group;
253 / district community;
254 / house council
255 / municipality;
256 / region;
257 / Employers' Chamber of Commerce (Chamber of Commerce);
258 / parliamentary club of a political party;
259 / regional club of a political party;
260 / union;
261 / regional union officers;
262 / general manager of working organization/company;
263 / financial manager;
264 / human resources manager;
265 / marketing manager;
266 / head of development department;
267 / head of medical institutions - health center - medical center;
268 / head of private practice;
269 / financial director;
270 / human resources director;
271 / selected therapeutic group;
272 / nursing home;
273 / safe house;
274 / institute for children with special needs;
275 / other (what? _____);

I accepted the null hypothesis in the case of almost all dependent variables with the exception of four, namely: the willingness to lead Mountaineering Society ($p = 6.6\%$), acceptance of leadership or management functions in the Slovenian police and army ($p < 0.05$), and leadership or management functions in the "other" groups, which were not named and also not included in the list of other variables (groups) in the questionnaire. Non-Slovenians are less willing to take a leadership functions (roles) in the mountaineering society, likewise in the Slovenian police and the army.

6 CONCLUSSION

We came to the conclusion that the survey is one very rare in the Slovenian research area, which has undertaken an analysis of the relationship between national loyalty and willingness to accept management or leadership roles in various Slovenian organizations. The key fact is that the participants of the research were mostly Slovenian students, and therefore the obtained results are even more interesting.
They are indicating however, that there exist some kind of "matrix" in groups or organizations in which our participants were less willing to accept the management or leadership roles.
The results of Hypothesis 1 actually point the fact that the mountaineering club, army and police are that kind of association or organizations (institutions) which represent a segment of social structure in which Non-Slovenians do not recognize such competence as in other groups, organizations and institutions.
The interpretation of mentioned facts could have been based on different theoretical perspectives and views, and certainly represent the data that should be taken into account in everyday social action and socialization assumptions.

References

[1] B. M. Bass. Handbook of leadership (theory, research, and managerial applications*)*. Third edition, London. The Free Press, Collier Macmillan Publishers. London. 1990.
[2] B. M. Bass. Handbook of leadership (theory, research, and managerial applications*)*. Third edition, London. The Free Press, Collier Macmillan Publishers. pp.386. London. 1990.
[3] H. Tajfel. The social psychology of minorities. Minority Rights Group. London. 1978.
[4] A. Giddens. Sociology. Cambridge: Polity. 1993.
[5] D. Peabody. National characteristics. Cambridge: Cambridge university press. 1985.
[6] M. Billig. Banal nationalism. Thousand Oaks - London; Sage – New Delhi. 1995.
[7] Tenu A. van Dijk. Ideology: a multidisciplinary approach. Thousand Oaks – London; Sage- New Delhi. 1998.

The Effects of Intention on Motor Performance

Ruben Perellón Alfonso[1,2], Stephan Lechner[1,2], Indre Pileckyte[1,2], Miroslav Henry Heriban[1,3], Jure Bon[1], Maja Kojović[1], Nejc Šarabon[4], Blaž Koritnik[1]
[1]Laboratory for Cognitive Neuroscience, Department of Neurology, University Medical Centre Ljubljana, Slovenia
[2]University of Vienna, Austria
[3]Comenius University in Bratislava, Slovakia
[4]S2P, Ljubljana, Slovenia
e-mail: ruben.palfonso@gmail.com

ABSTRACT

This paper presents the results of a transcranial magnetic stimulation (TMS) study in which the interaction between a high level cognitive function (intention) and a low level motor function was explored. By instructing the subjects to either resist or assist a subsequent TMS elicited flexion of the wrist, we observed that the amplitude of the evoked movement was modulated in accordance to the task in the agonist-antagonist pair of muscles involved in the movement. The inclusion of a control condition, where no motor preparation was required, provided a wider picture than in previous studies of how this cognitive and motor interaction takes place. The results suggest that when the intention to assist the movement is present, the agonist muscle is facilitated while the antagonist is inhibited. This behavior is inverted when the intention is that of resisting the movement.

1 INTRODUCTION

1.1 Transcranial Magnetic Stimulation

Transcranial magnetic stimulation (TMS) is a non-invasive technique, which uses a rapidly changing electric current to generate a changing magnetic field, which in turn is capable of inducing an electric current in the underlying tissue. By harnessing these basic electromagnetic principles through a coil it is then possible to depolarize or hyperpolarize the neurons contained in the cortical superficial area under the coil. When applied over the primary motor cortex (M1), TMS produces short muscle twitches that can be recorded using electromyography (EMG) as "motor evoked potentials" (MEPs) by placing pairs of electrodes on the muscles that are associated with the respective brain area receiving the magnetic stimulation.

1.2 The influence of intention on motor performance and cortical excitability

Several experimental protocols have been used to test the influence of prior instructions on voluntary and involuntary (elicited by TMS) movements by examining the corticospinal excitability during the preparatory phase of an action. The most common protocol is the "stop-signal" paradigm [1] which tests for the effects of instructed intention on movement performance. Subjects are asked to move a finger after being presented a start cue, however, in some trials, this is followed by a stop cue which tells the subject to abort the already initiated movement. By changing the intervals between the start-cue and stop-cue, experimenters are able to test for the stop-signal reaction time (SSRT), which is associated with response inhibition of the already prepared movements. SSRT has been found to be altered in various diseases, like Parkinson's disease [2] and schizophrenia [3], reflecting impaired inhibitory processes.

Coxon, Stinear and Byblow [4] used a slight variation of this protocol, asking subjects to press a key while looking at an analogue clock on the edge of which a light dot moved with one revolution per second. They were then instructed to release the key at a certain point (8 o'clock) after the start cue was presented. In some trials, however, the dot stopped at different times (between 245 and 155 ms) before reaching the position designated to elicit the key lift reaction. In these trials, subjects were instructed not to release the finger from the key. These different stop times were used to determine the influence of the temporal domain on the ability to inhibit the planned response. It was found that the closer to the designated point the dot stops, the more difficult it is for subjects to inhibit their response. This is in line with findings of prior studies done with the protocol developed by Slater-Hammel [1]. Additionally, Coxon and others performed single-pulse and paired-pulse transcranial magnetic stimulation (TMS) at different times before the required response [4]. Single pulse TMS revealed that cortical excitability is reduced for stop-trials when compared to trials where no stop-cue was present.

One drawback of the stop-signal paradigm is that it can only assess behavioral and physiological features of voluntary movements. To overcome these limitations, several TMS studies [5, 6, 7] were designed to dissociate the influence of

cognitive processes from that of motor processes in the modulation of corticospinal excitability. In the latest of these type of studies [8], subjects were asked to either resist or assist a movement elicited by single pulse TMS, by mentally preparing for either of the two instructions. This procedure allows testing the effect that mental motor preparation might have on cortical excitability. MEP responses on the agonist muscle were found to be decreased and cortical silent period (CSP) was generally longer in the resist condition as compared to the assist condition. Notably, in this study the assist condition was assumed to be a sort of baseline state for cortical excitability. This assumption was established in a previous study by the same authors [5], where the condition was first termed "let-go". Another study [6] on different muscles than the previously used pair of flexor carpi radialis (FCR) and extensor carpi radialis (ECR), reported only significant changes in MEP amplitude for negative imaginary with respect to the baseline when compared to positive imaginary.

In our study we used the experimental paradigm designed by Bonnard and others [8] but with three substantial modifications: 1) The addition of a true control task where no motor imaginary was required; 2) The unspecificity of the instructions given to the subjects on how to perform each of the three different conditions; 3) The inclusion of a qualitative questionnaire to gather data on the realization and perception of the mental task from the participants.

2 METHODS

2.1 Experimental setup

12 healthy subjects (all right-handed, 8 females) participated in the experiment.

Subjects sat comfortably in a fully adjustable chair with their right wrist partially immobilized on the arm rest. Each trial started with the presentation of a fixation cross, upon the appearance of which subjects were instructed to align their hand horizontally with their forearm. 4 seconds after, a colored circle appeared for 500ms instructing the subjects to start mentally preparing for the pulse according to the condition in each case. After 3 seconds a TMS single pulse was delivered, then subjects were asked to maintain their hand aligned until the fixation cross was extinguished 2s after the pulse. For 2 seconds the subjects had to rest their arm. Then the fixation cross reappeared, marking the beginning of a new trial (Figure 1).

In each trial the subjects were asked to mentally resist or assist a subsequent flexion of the wrist produced by a TMS single pulse to the M1 area. These two conditions were interspersed in a fully randomized fashion, together with a control condition in which a TMS pulse was delivered without previously requiring any mental task. The timeline for each trial follows exactly the same procedure developed by Bonnard [8] (Figure 1).

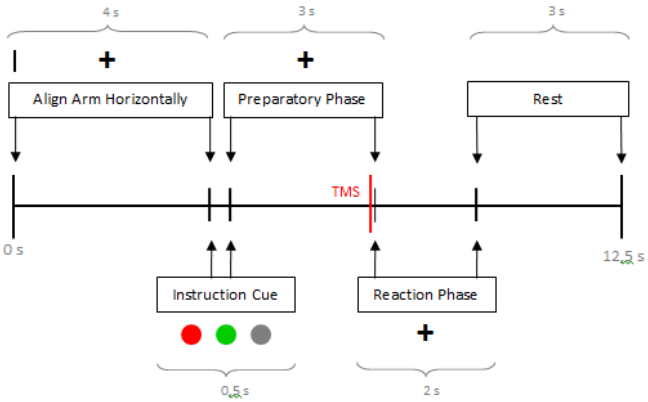


Figure 1: *Experimental protocol for each trial. The whole experiment consisted of 9 blocks of 30 trials each. After each block the subjects were allowed to rest for a period of at least 5 minutes.*

2.2 TMS single pulse stimulation

We used a Magstim 200 stimulator (Magstim Co., Whitland, UK). The coil was placed tangentially to the scalp with the handle pointing backwards and laterally at a 45° angle away from the midline. In this way, the current induced in the neural tissue was directed approximately perpendicular to the line of the central sulcus, which is believed to be optimal for transsynaptical activation of the corticospinal pathways [9, 10]. An EEG cap, without electrodes and rings on the left side was placed over the scalp, then a 10x15 cm grid drawn on a linen sheet was taped over the motor area on the cap with transparent tape. The coil was moved in steps of 0.5 to 1cm, following the cells on the grid until the optimal point for eliciting a MEP in both FCR and ECR muscle was found, the point was marked on the grid with a permanent marker pen. Resting motor threshold (RMT) was determined by decreasing the intensity in steps of 5% of maximum stimulator output (MSO) until no MEP response was observable, the intensity was then increased in steps of 1% MSO, until MEPs of at least 50 microvolts were elicited in the FCR muscle in 3 out of 6 trials. The intensity used throughout the experiment was adjusted at 120% of RMT.

To ensure that the coil placement was kept as stable as possible throughout each experimental block, a knee joint fixation arm attached to the chair was used to hold the coil in place over the hot spot. The coil position was readjusted between blocks.

2.3 Data acquisition and analysis

EMG data was recorded from two pairs of Ag-AgCl electrodes. Each pair was placed over the FCR and ECR muscles respectively approximately 1-2 cm apart from each other. The ground electrode was placed over the forehead.

EMG data was amplified 1000 times, band pass filtered at 20Hz-2000Hz, sampled at 5 kHz and recorded continuously using Spike2 software (CED, United Kingdom).

Preliminary data analysis was done using Matlab 2012b (The MathWorks, Inc., Natick, Massachusetts, United States). EMG data was first epoched for each trial from 6000ms before the TMS pulse till 1000ms after it.
All trials in which the background EMG activity during the last 200ms before the TMS pulse significantly differed from the activity during the last 200ms before the condition presentation, for at least one muscle, were excluded from further analysis. This was done to ensure that the mental task was never accompanied by any additional muscle activity.

EMG data was normalized by transforming each subject´s MEP data into z-scores independently. Normality and variance of the data was checked using Kolmogorov–Smirnov's test and Levene's test. Since the data failed the tests, various transformations were applied (square root, and logarithmic) but without positive results. Therefore, non-parametric statistics were used. Multiple comparisons of conditions were done using Kruskal-Wallis with Bonferroni correction. Effect size was calculated by obtaining the z statistic using Mann-Whitney U test, and dividing it by the square root of the total number of observations.

3 RESULTS

MEP amplitude was generally decreased during the resist condition as compared to the assist condition for the FCR muscle, while the amplitude during the control condition was similar to that of the assist condition, this is in accordance with what has been previously observed in literature [5, 6, 8]. The ECR muscle however, seems to exhibit a mirror behavior when compared to FCR; the amplitude was significantly increased during the resist condition compared to the assist and control conditions (Figure 2).

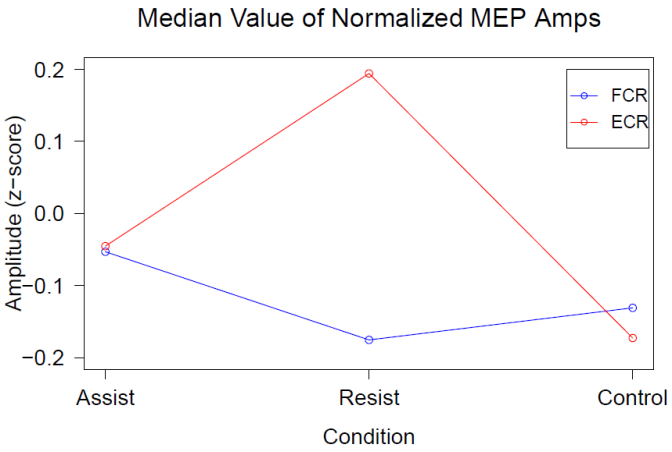


Figure 2: *Median value of normalized MEP amplitudes for each condition and muscle.*

4 DISCUSSION

Our results regarding MEP amplitudes suggest that during mental motor preparation tasks the agonist muscle is facilitated while the antagonist is inhibited.
It is also worth noticing that the discrepancy of our results when compared to those showed by Bonnard [8], may not be understood as a contradiction but rather as a widening of the picture presented in this previous study. This has been presumably achieved by the introduction of a control condition where no mental motor preparation was involved, and hence representing a true baseline for intracortical inhibition in mental motor preparation tasks.
However, the fact that we encountered significant differences also in ECR is somewhat a surprise with respect to what was reported by Bonnard and others [8]. The reason for this discrepancy might be due to the freedom given to the subjects when performing the task, which probably ensured that they employed the mental strategy that was optimal for them to perform the task successfully.

To conclude, the results of this study further indicate that high level cognitive functions can in fact modulate motor performance, In addition our results suggest that this modulation may result in simultaneous facilitation of the agonist muscle and inhibition of the antagonist.

References

[1] Slater-Hammel, A. T. (1960). Reliability, accuracy, and refractoriness of a transit reaction. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *31*(2), 217-228.

[2] Gauggel, S., Rieger, M., & Feghoff, T. A. (2004). Inhibition of ongoing responses in patients with Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry*, *75*(4), 539-544.

[3] Huddy, V. C., Aron, A. R., Harrison, M., Barnes, T. R., Robbins, T. W., & Joyce, E. M. (2009). Impaired conscious and preserved unconscious inhibitory processing in recent onset schizophrenia. *Psychological medicine*, *39*(06), 907-916.

[4] Coxon, J. P., Stinear, C. M., & Byblow, W. D. (2006). Intracortical inhibition during volitional inhibition of prepared action. *Journal of Neurophysiology*, *95*(6), 3371-3383.

[5] Bonnard, M., Camus, M., De Graaf, J., & Pailhous, J. (2003). Direct evidence for a binding between cognitive and motor functions in humans: a TMS study.*Journal of cognitive neuroscience*, *15*(8), 1207-1216.

[6] Sohn, Y. H., Jung, H. Y., Kaelin-Lang, A., & Hallett, M. (2003). Excitability of the ipsilateral motor cortex during phasic voluntary hand

movement. *Experimental Brain Research*, *148*(2), 176-185.

[7] Camus, M., Pailhous, J., & Bonnard, M. (2004). Cognitive tuning of corticospinal excitability during human gait: adaptation to the phase. *European Journal of Neuroscience*, *20*(4), 1101-1107.

[8] Bonnard, M., Spieser, L., Meziane, H. B., De Graaf, J. B., & Pailhous, J. (2009). Prior intention can locally tune inhibitory processes in the primary motor cortex: direct evidence from combined TMS-EEG. *European Journal of Neuroscience*,*30*(5), 913-923.

[9] Brasil-Neto, J. P., Cohen, L. G., Panizza, M., Nilsson, J., Roth, B. J., & Hallett, M. (1992). Optimal focal transcranial magnetic activation of the human motor cortex: effects of coil orientation, shape of the induced current pulse, and stimulus intensity. *Journal of clinical neurophysiology*, *9*(1), 132-136.

[10] Kaneko, K., Kawai, S., Fuchigami, Y., Morita, H., & Ofuji, A. (1996). The effect of current direction induced by transcranial magnetic stimulation on the corticospinal excitability in human brain. *Electroencephalography and Clinical Neurophysiology/Electromyography and Motor Control*, *101*(6), 478-482.

INTERPLAY OF COGNITIVE EFFICIENCY, COGNITIVE ABILITY AND MOTIVATION

Bruna Pikš
MEi:CogSci
University of Ljubljana
e-mail: bruna.piks@gmail.si

ABSTRACT

The current body of research often focuses on the problem of cognitive decline through ageing. People adapt to these changes of cognitive resources by using brain reserve. Results of different studies on how cognitive abilities of elderly people decline are contradicting but it has been shown they can be as good as or even better than younger participants in specific domains. This implies that among others personal meaningfulness of a situation can be a strong factor when assessing cognitive abilities.
One of the aims of the paper was to point out the importance of the factor of participant's subjective view on the researcher. In the pilot study we tried to eliminate the factor of laboratory setting and check how cognitive efficiency and abilities change in relation to motivation. We used a proverb interpretation task for this purpose. The results showed that participant's subjective view on the researcher correlated with the adequacy in proverb interpretation. This motivational reserve of the brain is worthwhile of research since it plays a role in assessing cognitive abilities and pathologies that affect the results of neuropsychological tests.

1 COGNITIVE DECLINE AND ADAPTIVE ASPECTS OF BEHAVIOR

Cognitive decline often accompanies normal ageing, however not all cognitive functions seem to decline at the same rate nor simultaneously (Godde, 2009). On one hand, increasing impairments through ageing are seen in fluid intelligence which is mostly biologically and genetically determined. On the other hand, crystalline intelligence can not only stay stable with age but may even improve. Since this knowledge is able to compensate for decline in the cognitive pragmatics, cognitive decline has little impact on everyday life. However, still differences in performance between young and elderly increase with task complexity (Salthouse, 1992), especially in laboratory and academic settings.

One of components of adaptive functioning within the context of social cognitive functioning is selectivity in allocation of cognitive resources (Hess, 2006). Baltes (1997) gave an example of a general theory of life span development. Metatheory *Selective optimization with compensation* (SOC; P. B. Baltes, 1997) represents a general model of effective adaptation to biological, psychological and socioeconomic changes in life. Adaptation of an individual depends on sociocultural context, individual resources, and personal preferences. In advanced age this adaptation and balance between gains and losses could be achieved by the three component processes: selection of domains important to an individual, optimization of resources and aids that facilitate success in those domains, compensation of the losses in those domains. However, despite contribution to successful ageing it becomes difficult for older adults to engage in SOC strategies due to resource decline (Ouwehand, de Ridder, and Bensing, 2007).

Another theory is *selective engagement hypothesis* (Hess, 2006) which argues that there is more selectivity in older adults' engagement of cognitive resources. Selectivity is determined by personal relevance, meaningfulness of a situation – that is, older adults would allocate more cognitive resources into tasks with more personal meaning. In their research of varying personal relevance Hess, Rosenberg and Walters (2001) concluded that older adults' thinking reflected a type of heuristic processing which reflects selective engagement in the task and not necessarily reduction in resources and skills. They have also shown that inconsistency effect in recall of older adults is associated with their resource-consuming elaborative processing of behaviors incongruent with expectations.

2 SELECTIVITY IN COGNITIVE RESOURCES ENGAGEMENT AND MOTIVATIONAL RESERVE

Hess (2006) highlighted the studying of cognitive functioning from a social cognitive perspective. He presumed energy consumption affects/mediates older adults' engaging in effortful processing. Resource-demanding social judgment processes depend on shifting goals of the resources and are not a mere consequence of variations of these cognitive resources. Changes in personal resources influence intrinsic motivational factors that are associated with everyday behavior and higher personal need for structure (Hess, 2001).

It was repeatedly observed that the degree of brain pathology is not directly related to the clinical manifestation of that damage which gave rise to the idea brain reserve (Stern, 2006). Brain reserve is also used by healthy individuals who cope with demanding tasks. A type of brain

reserve is motivational reserve which reflects motivational abilities that enable an individual to surpass neuropathological damage to some extent (Forstmeier, and Maercker, 2008) in order the subject to function as before the damage. They include variables important for the implementation of personal goals (Forstmeier, Maercker, Maier, van den Bussche, Riedel-Heller, Kaduszkiewicz, Wagner, …, 2012) such as action planning and goal orientation (Forstmeier, and Maercker, 2008). It has been assumed that due to the motivational abilities the number of synaptic connections increases and thus strengthens pathways that compensate for the disrupted brain networks. In the pilot study we wanted to examine how motivation influences subjects' cognitive efficiency and abilities with the use of proverb interpretation task.

3 PROVERB INTERPRETATION

Age-related decline is seen in cognitive abilities such as executive functions (EF) (West, 1996), abstract reasoning being one of its subcomponents (Oliveira, Sanches Yassuda, 2011). A recognized instrument to evaluate abstract reasoning is the test of proverbs that also confirmed previous findings in our research.

In human speech we often use non-literal expressions and the ability to interpret their meaning is essential if one wants to engage in successful interactive social communication. Direct literal interpretation would lead to misunderstanding. To test understanding of the non-literal expressions proverbs are used in a clinical test where subjects are asked to interpret the meaning of the proverb. Goldstein characterized this abstract attitude where "we transgress the immediately given specific aspect or sense impression; we abstract from particular properties. We detach ourselves from the given impression, and the individual thing represents to us an accidental or representative of a category." (as cited in Gorham, 1956). Non-literal understanding of figurative expression might demand a suppression of the literal interpretation (Yamaguchi, Maki, and Yamaguchi, 2011) which demands more cognitive engagement and motivation.

3.1 Method

3.1.1 Study sample and design

Participants in the pilot study were not aware of the real subject of the study however, they agreed to participate in a test of proverb interpretation, pretext under which the test was presented. Participants were assigned to two age groups: adults (A) and older adults (OA). Exclusion criteria for OA - retired participants, was incapability of living independently. Only independent retired adults who live on their own, outside retirement homes, were included in the research. In group A, only those who were employed at the time of testing were included in the research. The mean number of years of education for group A was 14.8 (range 12 to 21). This group consisted of 24 subjects (10men and 14 women) aged 26 to 67 years (M=46.5, SD=10.18). The mean number of years of education for group OA was 13.4 (range 8 to 21). This group consisted of 24 subjects (2 men and 22 women) aged 57 to 77 years (M= 64.2, SD=5.50).

3.1.2 Stimulus selection and proverb interpretation task

Task where proverbs had to be interpreted was created by the author and it comprised 20 items. Ten were part of Slovenian cultural heritage and the remaining 10 were from foreign origin (English, Latin, Indian, etc.). Proverbs with at least one metaphorical expression were included with aim that the demand on the ability to provide an abstract interpretation of figurative language would be maximized. The aim was to choose proverbs of mixed familiarity, thus in the test proverbs used often in media were included as much as proverbs which are not often found in everyday usage and some were even of foreign origin. In this way we tried to vary the difficulty of the interpretation so that participants would be forced to engage more in solving the task.

The proverb interpretation task consisted of three parts. First part of the task assessed interpretation of each proverb. A short explanation was necessary to show understanding of the figurative language. We marked as correct all answers that exhibited correct interpretation whether in one sentence or one phrase, since sometimes a proverb could be paraphrased in a single word. Subjects were instructed to write non-literal meaning by themselves, no response alternatives were offered.

The second part of the task assesses familiarity and agreement ratings for each proverb. For this purpose ranging in a shape of a five point-response scale ranging from 1-"I have never read or heard this proverb before" to 5-"I have frequently read or heard this proverb and I use it in my everyday life" was used. For agreement rating the same scale was used, five-pint-response scale rating marked 1-"I cannot connect to the proverb's message and I don't agree with it" to 5-"I completely agree with the proverb and I can find connections to my life". Subjects also had to complete the odd number sequence and pass a task checking heuristic thinking.

3.2 Results

A categorical system for scoring similar to Hertler, Chapman and Chapman (1978) was created to assess the quality of interpretations of the proverbs. Scoring principles for literalness in responses ranged from 0 to 2 points for a proverb correctly explained.

All subjects in the group A filled in the number sequence correctly, and the mean adequacy score for the OA group was 0.79 (SD=0.42). The analysis found that group OA had statistically significantly lower level of success in completing the number sequence ($t(23) = 23.000$, $p = 0.022$).

Both groups A and OA scored the same number of correct answers (2 subjects in A and 2 subjects in OA group) in heuristic's thinking task.

Proverb comprehension was graded form 0 to 2 points, therefore 40 was the highest number of points possible to assess. In group A the mean score for all the proverbs was 17.4 (SD=8.61) and the mean score for the group OA was 11.7 (SD= 7.11). The t-test comparing the scores of A and OA group was significant (t=2.488, p=.017), suggesting that the A group produced more adequate responses than the OA group. This might account for the fact that the A group outscored the OA group in years of education.

Familiarity with the proverbs was graded on a five-point-rate scale and thus the total amount of points was 100. Analysis of the ranging of the familiarity of the proverbs found the mean score of the group A was 44.46 (SD=9.95) while for the group OA it was 51.04 (SD=12.56). The t-test comparing the scores was significant (t=-2.013, p=0.05), implying that the OA group was more familiar with the proverbs than the group A.

Agreement with the proverbs was graded on a five-point-rate scale with the total amount of possible points being 100. For the group A the mean score was 57.46 (SD= 13.89) and for the group OA the mean score was 64.21 (SD=13.06). The t-test showed a significant difference in agreement scale between the two groups (t=-1.734, p=0.09), suggesting that the OA group agrees significantly more with the proverbs than the group A.

3.2.1 Relation to the researcher

Considering ratings of relationship of the experimenter to the subject there was no statistically significant differences. In group A the analysis showed that 11 subject rated the experimenter being friendly while other 13 participants in this group stated experimenter acting strictly professional. In OA group the same number of participants rated the researcher rather friendly and strictly professional. None of the variables (age, sex, education, employment) had an effect to relation. However, participants' subjective opinion correlated with the adequacy in proverb interpretation. Elderly, who rated the researcher rather friendly, could pass the proverb interpretation task as well as the younger participants.

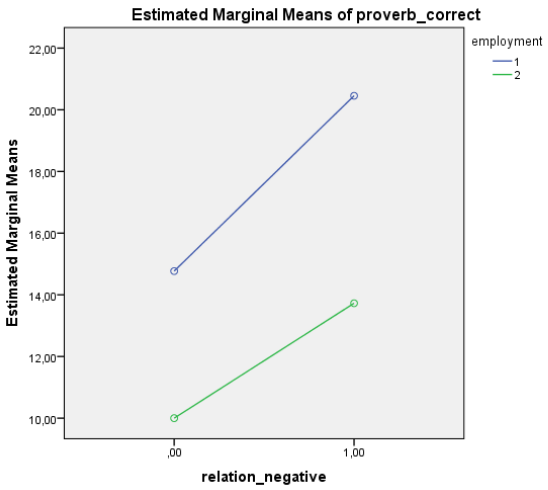


Figure 1: *Adequacy of proverb interpretation of the two groups of participants (1-employed, 2-retired) in raltion to their subjective relation to the researcher (0-professional, 2-friendly)*

4 DISCUSSION

The present study aimed to asses different effects on proverb comprehension with potential contributions of relation to the researcher, agreement with the proverb and proverb familiarity and executive function abilities.

The scoring system used in this study appears to be a useful tool however there might be so disadvantages. In cases when subjects failed to provide an abstract interpretation, it is difficult to interpret what they were doing. The problem with the proverb test is also its complexity and it involves hypothesized cognitive processes (Brundage, Brookshire, 1995). Providing inadequate interpretation of proverbs may happen due to various reasons. Subjects may not have recognized the proverb or had speech production problems. Familiarity in some cases did not play a role in successful interpretation; it occurred that subjects rated high familiarity with the proverb and failed to provide an adequate interpretation and vice versa, they rated being unfamiliar with the proverb and provided an adequate interpretation.

The pilot study shows the participants did better in the test when they perceived the researcher as friendly rather than strictly professional. This influence should be taken into account when assessing the individual's cognitive abilities in order to achieve better ecological validity.

.

References

[1] Baltes, P. B. (1997). On the Incomplete Architecture of Human Ontogeny: Selection, optimization and compensation as foundation of developmental theory. *American Psychologist*, (4), 366–380.

[2] Brundage, S. B., Brookshire, R. H. (1995). A System for Scoring Proverb Interpretations Provided by Non-Brain-Damaged Adults and Aphasic Adults. *Clinical Aphasiology* (23), 165-177.

[3] Dempster, F. N. (1992). The Rise and Fall of the Inhibitory Mechanism : Toward a Unified Theory of Cognitive Development and Aging, *Developmental review*, *75*, 45–75.

[4] Duval, C., Piolino, P., Bejanin, A., Eustache, F., & Desgranges, B. (2011). Age effects on different

components of theory of mind. *Consciousness and cognition*, *20*(3), 627–42. doi:10.1016/j.concog.2010.10.025

[5] Forstmeier, S., & Maercker, A. (2008). Motivational reserve: lifetime motivational abilities contribute to cognitive and emotional health in old age. *Psychology and aging*, *23*(4), 886–99. doi:10.1037/a0013602

[6] Forstmeier, S., Maercker, A., Maier, W., van den Bussche, H., Riedel-Heller, S., Kaduszkiewicz, H., … Wagner, M. (2012). Motivational reserve: Motivation-related occupational abilities and risk of mild cognitive impairment and Alzheimer disease. *Psychology and Aging*, *27*(2), 353–363. doi:10.1037/a0025117:

[7] Freund, A., M., & Baltes, P. B. (1998). Selection, optimization, and compensation as strategies of life management: correlations with subjective indicators of successful aging. *Psychology and aging*, *13*(4), 531–43. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9883454

[8] Godde, B. (2009). Cognitive Impairment. In *Encyclopedia of Neuroscience*. (pp. 791-794). Springer Berlin Heidelberg. doi: 10.1007/978-3-540-29678-2_1107

[9] Gorham, D. R. (1956). Use of the proverbs test for differentiating schizophrenics from normals. *Journal of consulting psychology*, *20*(6), 435–40. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/13376774

[10] Hertler, C. a, Chapman, L. J., & Chapman, J. P. (1978). A scoring manual for literalness in proverb interpretation. *Journal of consulting and clinical psychology*, *46*(3), 551–5. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/670497

[11] Hess, T. M., Rosenberg, D. C., & Waters, S. J. (2001). Motivation and representational processes in adulthood: The effects of social accountability and information relevance. *Psychology and Aging*, *16*(4), 629–642. doi:10.1037//0882-7974.16.4.629

[12] Hess, T. M. (2001). Aging–related influences on personal need for structure. *International Journal of Behavioral Development*, 25(6), 482-490. Doi: 10.1080/01650250042000429

[13] Hess, T. M. (2006). Adaptive Aspects of Social Cognitive Functioning in Adulthood: Age– Related Goal and Knowledge Influences. *Social Cognition*, 24(3), 279–309. doi:10.1521/soco.2006.24.3.279

[14] Oliveira, T. B. de, & Sanches Yassuda, M.. (2011). The interpretation of proverbs by elderly with high, medium and low educational level; Abstract reasoning as an aspect of executive functions. *Dement Neuropsychol*, *5*(1), 31–37.

[15] Ouwehand, C., de Ridder, D. T. D., & Bensing, J. M. (2007). A review of successful aging models: proposing proactive coping as an important additional strategy. *Clinical psychology review*, *27*(8), 873–84. doi:10.1016/j.cpr.2006.11.003

[16] Persad, C. C., Abeles, N., Zacks, R. T., & Denburg, N. L. (2006). Measures of Attention and Memory, *J Gerontol B Psychol Sci Soc Sci* (2002), *57*(3), 223-232. Doi: 10.1093/geronb/57.3.P223

[17] Rothermund, K., & Brandtstädter, J. (2003). Coping with deficits and losses in later life: from compensatory action to accommodation. *Psychology and aging*, *18*(4), 896–905. doi:10.1037/0882-7974.18.4.896

[18] Salthouse, T. A. (1992). Why Do Adult Differences Increase With Task Complexity? *Developmental Psychology*, 28(5), 905-918.

[19] Spearman, C. (1904). "General intelligence", objectively determined and measured. The American Journal of Psychology, 15(2), 201-292.

[20] Stern, Y. (2006). Cognitive reserve and Alzheimer disease. *Alzheimer disease and associated disorders*, *20*(3 Suppl 2), S69–74. Retrieved from http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3691784&tool=pmcentrez&rendertype=abstract

[21] Yamaguchi, H., Maki, Y., & Yamaguchi, T. (2011). A figurative proverb test for dementia: rapid detection of disinhibition, excuse and confabulation, causing discommunication. *Psychogeriatrics : the official journal of the Japanese Psychogeriatric Society*, *11*(4), 205–11. doi:10.1111/j.1479-8301.2011.00370.x

[22] West, R. L. (1996). An application of prefrontal cortex function theory to cognitive aging. *Psychological bulletin*, *120*(2), 272–92. Doi: 10.1037/0033-2909.120.2.272

THE (NEURO)SCIENTIFIC, ETHICAL, LEGAL AND SOCIETAL ASPECTS OF COGNITIVE ENHANCEMENT WITH TDCS DEVICES

Toni Pustovrh
Centre for Social Studies of Science
Faculty of Social Sciences, University of Ljubljana
Kardeljeva pl. 5, 1000 Ljubljana, Slovenia
Tel: +386 1 5805282
E-mail: toni.pustovrh@fdv.uni-lj.si

ABSTRACT

The paper provides a short overview of transcranial Direct-Current Stimulation as a possible method for enhancing cognitive capabilities in healthy individuals. It also discusses some of the (neuro)ethical, legal and societal implications of such a practice, pointing to issues that especially require further research and investigation, from a neuroscientific as well as a social sciences and humanities perspective.

Key words: tDCS, transcranial direct-current stimulation, cognitive enhancement, neuroenhancement, attention, memory, neuroscience, neuroethics, ELSA

1 INTRODUCTION

Human Enhancement, the idea that the physical and mental capabilities of healthy people can be increased through direct technological interventions into the body, especially the brain, has become a subject of increasing discussion and investigation in the scientific community over the course of the last two decades [1, 2]. A subfield of such interventions is Cognitive Enhancement, aimed at improving human cognitive capabilities in healthy individuals, such as attention, memory and executive function [3], usually through the use of prescription pharmaceuticals. While Pharmaceutical Cognitive Enhancement (PCE) has been the main focus of research and debate in this subfield [4], newer methods for potentially enhancing cognitive capabilities have opened new possibilities and new dilemmas in recent years. These methods are enabled by non-invasive brain stimulation (NIBS) devices, such as Transcranial Magnetic Stimulation (TMS) and Transcranial Current Stimulation (TCS), the latter most notably as transcranial Direct-Current Stimulation (tDCS) [5]. Such tools promise to be less invasive and without as many systemic side effects as in the case of PCE, while still facilitating similar enhancement effects. For the time being, TMS remains costly and complex due to its hardware requirements, while tDCS with its technically simple, readily available and cheap hardware has been rapidly adopted in scientific and medical research and clinical trials, and has also quickly spread among the amateur community of Do-It-Yourself (DIY) technology enthusiasts and neuroenhancement (self)experimenters [6, 7]. And although there are still many open and pressing technical (pharmacological) [8], ethical, legal and societal issues connected with PCE [9], some of which are shared by tDCS use, the latter brings with it its own issues and challenges.

2 COGNITIVE ENHANCEMENT AND TDCS

Cognitive Enhancement in the context of Human Enhancement usually refers to attempts to increase human cognitive abilities or functions that are already considered to be in the normal or healthy range, through the use of technological means that directly target the underlying neurophysiological mechanisms. The targeted cognitive abilities encompass perception, attention, memory, motor abilities, language skills, visual and spatial processing, and executive functions [3], although some definitions entail a broader scope of mental states and functions, including emotions, mood and non-ordinary states of consciousness.

tDCS devices themselves are technically simple, composed of a battery-powered device that delivers the electrical current and two electrodes (one positive and one negative), which are placed on specific areas of the head, whereupon a weak direct current is sent through the cortical brain matter for a short time. This leads to increases or decreases of neuronal excitability in the target area, and to changes in the functioning of the underlying mechanisms [5]. Although the precise functioning and structure of the mechanisms involved in various cognitive functions are not yet fully known, this is not necessary for eliciting enhancing effects, which can be gauged through experimentation. While the technique of transcranial electrical stimulation itself has a long history [10], with widespread unregulated commercial use between 1740 and 1930 in depressive patients and in various attempts to increase wellbeing and enhance performance, tDCS has only been rediscovered as a research tool in neuroscientific investigation and a therapeutic method for various disorders and diseases in the last decade. Its applicability as a tool for cognitive enhancement has only come to be recognized

over the past few years, with the discovery of enhancing effects in healthy individuals [11].

The cognitive enhancement effects from medical and neuroscientific research include improvements in attention [12], memory [13], facilitation of insight in problem solving [14], improvement of numerical abilities [15], enhanced learning of novel and challenging motor skill tasks [16], and of language acquisition skills [17]. In many instances, tDCS seems to increase the learning capability of the brain, and is especially effective when stimulation is combined with training and learning activities. Regarding mood, tDCS did improve (positive) emotional processing, but did not influence subjective emotional states in healthy people [18]. While the duration of such enhancing effects is usually short-lasting, they can be increased through greater time length and current intensity of the stimulation. It should also be noted that improvements in one capability or faculty often lead to the diminishment in another [19], and that improvements in processing in one hemisphere often impair processing in the other [9], therefore the trade-off nature of such enhancements needs to be taken into account.

Apart from use in the research and clinical setting, such devices are now commercially available for purchase over the internet [20, 21], and their potential enhancement use and benefits, in no small part driven by the DIY tDCS community, have become popular and often strongly magnified in the media [22]. In this way, the trend of amateur enhancement and experimentation use of tDCS can be predictably expected to continue and grow in the coming years.

3 ETHICAL, LEGAL AND SOCIETAL ASPECTS

There are numerous open ethical, legal and societal issues connected with the various aims and means of improving human performance in the context of Human Enhancement [23]. In the scope of tDCS used for cognitive enhancement purposes, as with other technologies, the primary considerations are safety and efficacy. The application of tDCS use is generally considered safe, having been conducted in thousands of subjects, usually with only mild, benign and transient side effects [24]. Thus it appears to be safe within established research protocols, although long-term and persistent use could have unwanted side-effects, especially when greater duration and intensity of stimulation is used, which is a salient concern in the DIY and amateur use of such devices. Also, enhancement uses should require a higher safety threshold than more clearly therapeutic uses, and tDCS seems to fulfill this requirement, in contrast to most current PCE substances. Thus it might prove to be a safer (and less expensive) alternative to at least some psychopharmaceuticals currently used (off-label) for cognitive enhancement. Further safety concerns pertain to considerations of tDCS application on children and teenagers, as it might have completely unknown physiological and psychological effects on developing brains that were not present in healthy adults, and potential enhancement use opens many questions concerning the rights and obligations of parents [25].

The studies listed in the previous section show that the cognitive enhancement effects of tDCS, although transient, are tangible. Nevertheless, the outcomes are not always consistent, even when identical protocols are used. This variation seems to be due to anatomical differences between individuals, especially those with atypical brains [26], and would need to be considered in future research and application. Given that a firm and defensible normative distinction between therapy and enhancement uses remains elusive [8], much of the debate about the ethical, legal and societal implications of tDCS enhancement use will revolve around its costs and benefits.

The potential positive implications for individuals and societies could for example entail societal savings from decreased numbers of accidents and errors at work and in personal life due to enhanced attention, decreased costs and losses due to better memory and increased social productivity due to enhanced cognitive capabilities [27]. Especially important might be decreases in costs due to the reduction of the time and resources needed for learning, education and acquisition of skills and knowledge, as well as reduced personal costs and frustration involved in difficult and unsuccessful learning attempts.

The weight of potential benefits strongly depends on extensive further study of the enhancement effects in healthy adults, with proper and rigorous interpretation of empirical data, leaning strongly on the optimization of research frameworks and stimulation protocols and standards, as well as results from the study of therapeutic uses. Unrealistic expectations of enhancement effects, often overhyped by the media and enthusiastic amateur users, especially need to be moderated by such empirical investigations.

Further important questions are concerned with the impact of tDCS use on personal identity, autonomy and authenticity. Enhancement through tDCS could result in changes in personal identity, and questions of whether these are ethically acceptable, especially if they foster a sense of wellbeing and autonomy [28]. Authenticity has been often discussed in PCE, especially whether they constitute a form of cheating, and there are good arguments that enhanced minds can be authentic [29]. The notion of cheating is closely tides to issues of distributive justice and access, which are, due to the inexpensiveness and simplicity of TDCS devices, which can easily be assembled at home from inexpensive components, much less of a concern than in the case of expensive pharmaceuticals and other emerging neurotechnologies. Significant benefits to users and wide societal acceptance usually entails indirect coercion even of those who would otherwise not choose to use the technology, in order to stay competitive at the workplace or in school. The availability of proven and safe methods for cognitive enhancements also leads to considerations of expanding duties for specific professions where increased cognitive capabilities are important, such as pilots, surgeons, firemen, etc., leading to arguments that such professionals might have a duty to engage in cognitive enhancement [30].

Some authors have suggested that emerging neurotechnologies could also be used to promote virtuous behavior, increase happiness and suppress vice [31], thus enabling individuals to more easily attain desired personal characteristics or enable society to produce better citizens, which again opens many questions concerned with autonomy, authenticity and coercion. Further, tDCS might be used to elicit non-ordinary or mystical experiential states, including euphoric experiences. This raises questions of whether states elicited by tDCS are qualitatively comparable to "naturally" elicited ones and whether such shortcuts carry their own costs. They might also raise questions connected with drug policy, especially if the triggering of euphoric states has negative neurophysiciological effects and changes comparable to those of illicit drugs, or if it proves to be less harmful. The ability of tDCS to trigger behavioral changes in individuals, such as reducing the propensity to punish unfair behavior [32] or influencing compliance with socially constituted sanctions [33], poses strong concerns regarding the abuse potential of triggering (nonconsensual) manipulative changes in individual behavior.

The implications for public policy in regard to tDCS use for cognitive enhancement entail considerations of whether access and use by healthy individuals should be supported and possibly encouraged for specific uses by specific populations, or even generally, whether governments might impose certain restrictions, as well as how vulnerable groups and populations that would be unwilling to engage in such practices could be protected from harm. In this regards, the DIY or amateur self-experimentation use poses some pressing challenges for regulation, and some experts have called for regulatory frameworks that would regulate commercial tDCS devices as medical devices, ensuring quality and safety standards, and use by skilled operators, in order to prevent threats to public health and vulnerable populations [34]. Such considerations would of course need to be supported by expert ad stakeholder opinions and by empirical research data in order to produce a well-informed and evidence-based policy. A good policy would ultimately engage regulators, scientists and the DIY community in crafting policy proposals that ensure public safety while supporting (DIY) tDCS innovation [35].

4 CONCLUSION

Much of the debate concerning cognitive enhancement has until now been focused on the off-label use of prescription pharmaceuticals, but the growing body of knowledge and experience with tDCS, as well as its DIY spread, is showing the need to discuss such issues with a focus on tDCS. A balanced policy promoting safety and innovation will need to consider both the requirement of ensuring public health and protection of vulnerable groups, and the fact that adults will employ such easily accessible neurotechnologies in pursuit of their own goals regardless of regulation. In this regard, DIY tDCS users might consider that the enhancement uses of tDCS could be employed strategically, to complement other techniques and approaches according to ones goals and needs at specific times, while following tested protocols and guidelines. They should also keep in mind the comparative cognitive enhancement effectiveness and additional benefits of more traditional and established non-invasive interventions, such as proper nutrition, exercise, sleep, rest, relaxation, mind-training, meditation, etc. [36].

References

[1] J. Savulescu, R. ter Meulen, G. Kahane (Eds.). *Enhancing human capacities*. Wiley-Blackwell. 2011.

[2] C. Coenen, M. Schuijff, M. Smits, P. Klaassen, L. Hennen, M. Rader, G. Wolbring. *Human enhancement*. Brussels: European Parliament, DG Internal Policies STOA. 2009.

[3] N. Bostrom, A. Sandberg. Cognitive enhancement: Methods, ethics, regulatory challenges. *Science and Engineering Ethics* 15(3), pp. 311–341. 2009.

[4] H. Greely, B. Sahakian, J. Harris, R.C. Kessler, M. Gazzaniga, P. Campbell, M.J. Farah. Towards responsible use of cognitive enhancing drugs by the healthy. Nature 456, pp. 702–705. 2008.

[5] M.A. Nitsche, L.G. Cohen, E.M. Wassermann, A. Priori, N. Lang, A. Antal, W. Paulus, F. Hummel, P.S. Boggio, F. Fregni, A. Pascual-Leone. Transcranial direct current stimulation: State of the art 2008. *Brain Stimulation* 1(3), pp. 206-223. 2008.

[6] E. Strickland. The Latest DIY Craze: Brain Hacking Home experimenters are building rigs to send currents through their heads. *IEEE Spectrum*. Avilable at http://spectrum.ieee.org/geek-life/reviews/the-latest-diy-craze-brain-hacking (1st September 2014). 2014.

[7] *DIY tDCS*. Available at http://www.diytdcs.com/ (2nd September 2014). 2014.

[8] M.E. Smith, M.J. Farah. Are Prescription Stimulants "Smart Pills"? The Epidemiology and Cognitive Neuroscience of Prescription Stimulant Use by Normal Healthy Individuals. *Psychological Bulletin* 137(5), pp. 717-741. 2011.

[9] T. Pustovrh, F. Mali. Exploring some challenges of the pharmaceutical cognitive enhancement discourse: users and policy recommendations. *Neuroethics* 7(2), pp. 137-158. 2014.

[10] F. Duecker, T.A. de Graaf, A.T. Sack. Thinking caps for everyone? The role of neuro-enhancement by non-invasive brain stimulation in neuroscience and beyond. *Frontiers in Systems Neuroscience* 8: 71, pp. 1-4. 2014.

[11] R. Cohen Kadosh. Brain stimulation has a long history. *Nature* 500, pp. 529. 2013.

[12] J.T. Nelson, R.A. McKinley, E.J. Golob, J.S. Warm, R. Parasuraman. Enhancing vigilance in operators with prefrontal cortex transcranial direct current stimulation (tDCS). *NeuroImage* 85(3), pp. 909-917. 2014.

[13] B.A. Coffman, V.P. Clark, R. Parasuraman. Battery powered thought: enhancement of attention, learning, and memory in healthy adults using transcranial direct current stimulation. *Neuroimage* 85: 3, pp. 895–908. 2014.

[14] R.P. Chi, A.W. Snyder. Facilitate Insight by Non-Invasive Brain Stimulation. *PLoS ONE* 6(2), e16655.
[15] R.C. Kadosh, A. Dowker, A. Heine, L. Kaufmann,, K. Kucian. Interventions for improving numerical abilities: present and future. *Trends in Neuroscience and Education* 2(2), pp. 85–93. 2013.
[16] J. Reis, H.M. Schambra, L.G. Cohen, E.R. Buch, B. Fritsch, E. Zarahn, P.A. Celnik, J.W. Krakauer. Noninvasive cortical stimulation enhances motor skill acquisition over multiple days through an effect on consolidation. *PNAS* 106(5), pp. 1590-1595. 2009.
[17] A. Flöel, N. Rösser, O. Michka, S. Knecht, C. Breitenstein. Noninvasive Brain Stimulation Improves Language Learning. *Journal of Cognitive Neuroscience* 20(8), pp. 1415-1422. 2008.
[18] M.A. Nitsche, J. Koschack, H. Pohlers, S. Hullemann, W. Paulus, S. Happe. Effects of frontal transcranial direct current stimulation on emotional state and processing in healthy humans. *Frontiers in Psychiatry* 3: 58, pp. 1-10. 2012.
[19] T. Iuculano, R.C. Kadosh. The Mental Cost of Cognitive Enhancement. *The Journal of Neuroscience* 33(10), pp. 4482-4486. 2013.
[20] *Foc.us*. Available at http://www.foc.us/ (1st September 2014). 2014.
[21] *BrainStimulator*. Available at http://thebrainstimulator.net/ (1st September 2014). 2014.
[22] K. Loria. Humans Are Heading Down A Path That Will Allow Us To Supercharge The Brain. *Business Insider Australia*. Available at http://www.businessinsider.com.au/brain-hacking-will-make-us-smarter-and-more-productive-2014-7 (1st September 2014). 2014.
[23] J. Savulescu, N. Bostrom (Eds.). *Human Enhancement*. New York: Oxford University Press. 2009.
[24] A.R. Brunoni, M.A. Nitsche, N. Bolognini, M. Bikson, T. Wagner, L. Merabet, D.J. Edwards, A. Valero-Cabre, A. Rotenberg, A. Pascual-Leone, R. Ferrucci, A. Priori, P.S. Boggio, F. Fregnin. Clinical research with transcranial direct current stimulation (tDCS): Challenges and future directions. *Brain Stimulation* 5(3), pp. 175–195. 2012.
[25] R. Cohen Kadosh, N. Levy, J. O'Shea, N. Shea, J. Savulescu. The neuroethics of non-invasive brain stimulation. *Current Biology* 22(4), pp. 108-111. 2012.
[26] J.-H. Kim, D.-W. Kim, W.H. Chang, Y.-H. Kim, K. Kim, C.-H. Im. Inconsistent outcomes of transcranial direct current stimulation may originate from anatomical differences among individuals: Electric field simulation using individual MRI data. *Neuroscience Letters* 564, pp. 6-10. 2014.
[27] A. Sandberg, J. Savulescu. The Social and Economic Impacts of Cognitive Enhancement. In *Enhancing Human Capacities*, J. Savulescu, R. Meulen, G. Kahane (Eds.), pp. 92-112. Wiley-Blackwell. 2011.
[28] F. Jotterand, J. Giordano. Transcranial magnetic stimulation, deep brain stimulation and personal identity: Ethical questions, and neuroethical approaches for medical practice. *International Review of Psychiatry* 23(5), pp. 476-485. 2011.
[29] H. Maslen, N. Faulmüller, J. Savulescu. Pharmacological cognitive enhancement—how neuroscientific research could advance ethical debate. *Frontiers in Systems Neuroscience* 8: 107, pp. 1-12. 2014.
[30] F. Santoni de Sio, N. Faulmüller, N.A. Vincent. How cognitive enhancement can change our duties. *Frontiers in Systems Neuroescience* 8: 131, pp. 1-4. 2014.
[31] J. Hughes. Using Neurotechnologies to Develop Virtues: A Buddhist Approach to Cognitive Enhancement. *Accountability in Research* 20(1), pp. 27-41. 2013.
[32] D. Knoch, M.A. Nitsche, U. Fischbacher, C. Eisenegger, A. Pascual-Leone, E. Fehr. Studying the Neurobiology of Social Interaction with Transcranial Direct Current Stimulation—The Example of Punishing Unfairness. *Cerebral Cortex* 18(9), pp. 1987-1990. 2008.
[33] C.C. Ruff, G. Ugazio, E. Fehr. Changing Social Norm Compliance with Noninvasive Brain Stimulation. *Science* 342 (6157), pp. 482-484. 2013.
[34] H. Maslen, J. Savulescu, T. Douglas, N. Levy, R. Cohen Kadosh. Regulation of devices for cognitive enhancement. *The Lancet* 382, pp. 938-939. 2013.
[35] N.S. Fitz, P.B. Reiner. The challenge of crafting policy for do-it-yourself brain stimulation. *Journal of Medical Ethics*. Available at http://jme.bmj.com/content/early/2013/05/20/medethics-2013-101458.full (2nd September 2014). 2013.
[36] M. Dresler, A. Sandberg, K. Ohla, C. Bublitz, C. Trenado, A. Mroczko-Wasowicz, S. Kühn, D. Repantis. Non-pharmacological cognitive enhancement. *Neuropharmacology* 64, pp. 529-543. 2013.

FRAMING TAIQUAN EXPERIENCE

Jernej Sever

Faculty of Arts, Ljubljana,

Center Premik d.o.o.

e-mail: jernej.sever@premik.si, m:+38631612529

Abstract:

One of the main problems encountered in teaching and understanding of complex knowledge and experiences which includes experience of TJQ, are the limitations imposed by the linguistic and symbolic nature of our language. Complex experiences are usually described with abstract and metaphorical meanings, which can be formed in different cultural contexts that allow many different interpretations. In this paper we will try to show how we can use first and third person perspective to analyze and research complex experiences. And how can we form a frame where there is a big possibility that desired experience will happen. On the basis of years of work in the field of martial arts we concentrated on analyzing the basic principles of TJQ. TJQ has one big advantage compared to other complex experiences, which are usually achieved through meditation. The ideal experience in TJQ is connected with exact result on the level of interaction with fighting partner.

1. **Introduction**

Taijiquan (TJQ) is a Chinese martial art, in the West known primarily as a stand-alone version of moving meditation, which includes slow and controlled movements, usually practiced through defined exercise sequence, known as a TJQ form. The stand-alone version of TJQ was developed primarily on the experience of martial art. The main goal of TJQ as martial art was to control our and the opponent's balance and is trained through exercise in pairs. The basis of the exercise in pairs is keeping constant contact with the fighting partner. By pushing, pulling and reflecting the participant tries to manipulate the relationship between the center of mass (COM) and the base of support (BOS) of his fighting partner (Sever, 2012). The ideal of effectiveness in TJQ is to control the opponent's balance, with as little force as possible and can be described with well-known metaphor that "4 ounce can defeat 1000 ounce "(Ching, 1985; Wile, 1996). This metaphor usually stands for a special effect in TJQ called *fajing.* We talk about *fajing* effect when we prepare our partner to lose balance, or to bounce themselves to maintain his balance, with very little force on our part.

To analyze the *fajing* effect we asked ourselves two main questions. The first question is: Is it possible to produce a *fajing* effect, or is the effect a result of unconscious co-operation between master and his student? The second question is: If we can produce a *fajing* effect, which neurophysiologic conditions must be satisfied for it to happen? Our objective was to describe and investigate these conditions, based on the concepts of movement and postural control, which are used in the fields of kinesiology and neuroscience (Latash, 2006; Woollacott, 2012).

To design proper experiments we had to understand the TJQ experience on the level of first person. This was the only way to find the proper meaning for metaphors that are usually used when describing the TJQ experience. After the first person analysis we tried to design experiments which would help us to investigate these principles in controlled environment.

We have developed an innovative method for measuring stability, which allows us to observe our body reactions, in a controlled environment, similar to those happening in contact with a partner. A pilot (Sever, 2013) and extensive study was made on this topic. We will present some of the results in this paper. We have also developed an innovative massage technique JMV (joint modulation with vibration), where we use slight vibration and three dimensional modulation of joints, to produce the effect of *fajing* in 15 to 20 minutes. In this way we were able to show that the effect of *fajing* can appear based on changes in neurophysiologic mechanisms.

2. Analyzing TJQ from first person perspective

If we wish to research TJQ on the level of first person successfully, we need an adapted phenomenological method, which includes exercise in pairs. In its traditional form practicing in pairs contains some of the main components of phenomenological approach. As it was stressed out by Sokolowski (2000), one of the main guide lines of phenomenological research is to observe our involvement in the world and our interaction with things in it. "Our belief, doubt, certainty and perception, are still our intentionality. We are just the ones who are able to observe them"(Sokolowski, 2000). In the pair - exercise we encountered a very similar situation.

To understand TJQ experience we must first understand classical Chinese concepts of TJQ. We can try to understand traditional metaphoric and abstract meanings that are used to describe the experience. Authenticity of the experience can be also confirmed with a recognized TJQ teacher. When you approach the experience, when you feel it, you can try to analyze, describe it in different ways and expose conditions that define it. Analysis of TJQ experience is happening in a concrete situation by perception of responses that happen in the process of interaction with fighting partner, and ultimately changing the usual response with a new one (Figure 1).

Figure 1: First person analysis in TJQ

The method that we used in describing the TJQ experience is similar to *descriptive experience sampling* method, which was introduced by Hurlburt and Heavey (2006). In this method, the participant must, at random intervals, freeze current experience and write down a brief description of experiences to notebook. By analyzing TJQ, freezing occurs based on the perception of muscle tension or stiffness of the body that happens in the process of interaction between fighting partners. In our case we did not write down the experience. In TJQ we have to concentrate especially on *sensory awareness* and on the experience of muscle stiffness. In our case, we focused not on stiffness itself, but more on how to change the reaction.

On the basis of mechanisms and response awareness that are necessary to produce *fajing* effect, we tried to create experiments, which would allow to measuring exposed responses. Our research from third person perspective went in three directions, researching stability, joint mobility and proper alignment. Some of the results of the first two fields are represented in this paper.

3. **Main experiments – third person perspective**

3.1. Stability test

After the pilot study (Sever, 2013) an extensive study researching responses after sudden release of load in a horizontal direction was designed (Figure 2). The participants were divided in two groups. TJQ group (TJQ-G) and control group (CO-G). Both consisted of 10 participants. We selected the parts of the body that are associated with sparring, namely the height of the hips, shoulder height and load through the hands at shoulder height. We monitored the movement of COP, ground reaction forces in vertical (Fz) and horizontal direction (Fy), and movement of knees, hips, shoulders and hands after a sudden release. We made 20 measurements for each person and position.

Figure 2: System for sudden release of load in horizontal

direction

The CO-G consisted of athletes whose practice didn't include close contact with a fighting partner. The results indicated that the group, which practiced TJQ, produced smaller amplitude of vertical ground force (Fz) than the control group. Amplitude was represented as percentage of body weight (%BW) for each participant. Difference at the level of hips was 11,59 %BW ± 2,06 vs. 19,62 %BW ± 5,54, p=0,003 (Figure 3). Similar differences were found in the sudden release of force in the loading through the arms 14,06 %BW ± 4,24 for TJQ-G vs. 23,31 %BW ± 8,45 for CO-G, p=0,023. Because of high standard deviation the difference at the height of shoulders, where the load was applied directly to the body, the difference 19,92 %BW ± 6,93 for TJQ-G vs. 25,10 %BW ± 7,64, for CO-G, p=0,125, was not statistically significant.

On the basis of these results we concluded that the TJQ group, which practiced TJQ sparring, had less intense responses after the sudden release of load than the control group. The results of Fz amplitude were connected with movement strategy after the sudden release.

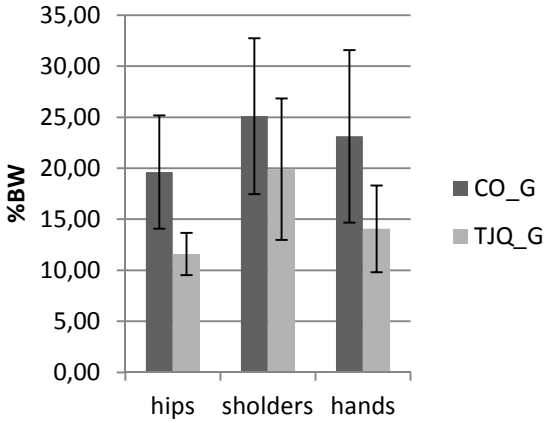


Figure 3: Maximal amplitude comparison of vertical force (% body weight), between control group (CO-G) and taijiquan group (TJQ-G),

We recorded two positions after the sudden release of load. The position was observed at 1 s and 0,5 s after the sudden release of the load. We defined the starting point before the sudden release as zero. In the case of the sudden release in the height of the hips statistically significant differences were found in the position of hips and knee (Figure 4). Half a second after the release the differences between the two groups at the position of the knee was 27,21 mm ± 14,75 TJQ-G against 13,81 mm ± 9,81 p=0,0140 CO-G. A second after the release the difference is 27,47 mm ± 27 TJQ-G against 2,76 mm ± 12,036 p=0,0093 KO-G (Figure 4). At the hip position the differences are 39,43 mm ± 9,58 against 28,82 mm ± 8,56 p=0,025 at 0,5 s after the release and 37,11 mm ± 21,68 against 18,01 mm ± 9,51 p=0,0093

On the basis of the results we concluded that TJQ group had better postural control after sudden release of the load. The TJQ group produced smaller Fz amplitudes and shifted the whole body simultaneously forward after the release. The CO-G, on the contrary, locked the knee, therefore leaned forward with upper body and produced higher Fz amplitudes.

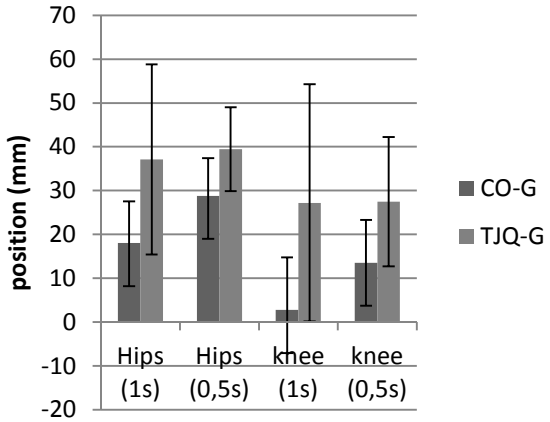


Figure 4: Hip and knee position comparison between control group (CO-G) and taijiquan group (TJQ-G) at 1 s and 0,5 s after the release.

3.2. Effects of JMV intervention

We designed an experiment where we try to study what the effect of the JMV intervention is on our muscle anticipation and reflex responses. The experiment was designed based on practical verification of the effects of the JMV method, producing *fajing effect* in very short time. This experiment was made in the pilot version. Five participants were involved and measured before and after the JMV intervention. They had to finish two trials (before and after) and in each trial there were 30 measurements. The participants of this experiment had to use both arms to work on different tasks. They used one arm to move the computer mouse and the cursor on a computer screen and try to catch a marker on the screen as fast and as accurately as possible. The other arm was interfered with constant steady movement forward - backward in the lateral direction. On the

interrupted arm we preformed a JMV intervention for 15 minutes. We measured accuracy of movement before and after the intervention. It turned out that the participants were more accurate in performing their task, after the JMV intervention than before it. The precision was calculated based on relation of the shortest possible route and the completed route to catch the marker on the screen. Before the JMV intervention the accuracy was 0,443 ± 0,058 after the massage it improved to 0,498 ± 0,053 , statistical significance was calculated by two-way T- test and was p <0,01 (Figure 5). After the JMV intervention the participants had less difficulty to follow the constant lateral movement, the arm didn't resist the movement, and consequently they were better in performing the tasks.

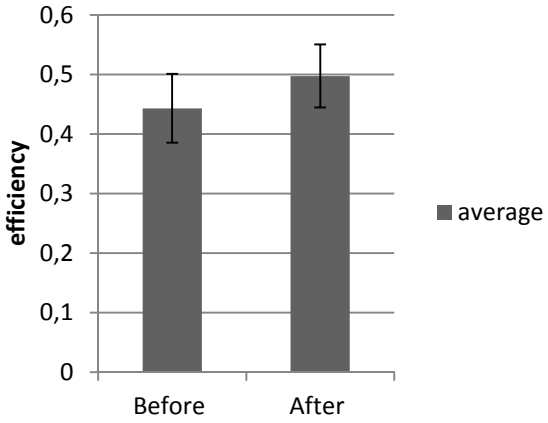


Figure 5: Comparison of movement efficiency before and after the JMV intervention.

4. Conclusion

On the basis of these experiments, we can conclude that the *fajing effect* is closely connected with our postural control, balance strategies, anticipations and responses to external stimuli. The effect *of fajing* is produced when a fighting partner is in the moment of losing his balance, and reflex muscle synergies are triggered to protect him from falling. In this moment the opponent can be pushed out with small force, but with a big effect.

Of course, this doesn't describe the whole experience of TJQ. With these experiments we just set a measurable basis on which we can begin to explore other concepts we encounter in TJQ, such as correct body alignment, proper purpose and attention, and others. In this way we can gradually frame the TJQ experience and find more effective and more universal ways how to teach and achieve it.

Acknowledgments:

This study was supported by European Union, European social Founds (Contract number P-MR-10/31).

1. Cheng Man Ching (1985). *Zheng Tzu's Thirteen treatises on taiji quan*. Berkely . Blue snake books.

2. Gibbs, R. W. (2006). *Embodiment and Cognitive Science*. Cambridge: Cambridge University Press.

3. Gallagher, S., Zahavi, D. (2008). *The Phenomenological Mind: An Introduction to Philosophy of Mind and Cognitive Science.* London, New York. Rautlage.

4. Hurlburt, R. T., & Heavey, C. L. (2006). *Exploring inner experience*. Amsterdam.

5. Latash, M. L. (2008). *Neurophysiological Basis of Movement*, The Pennsylvania State University, Pannsylvania, Human Kinetics.

6. Sever, J. (2012). *Empirične in fenomenološke razsežnosti utelešenja in umeščenosti v okolje v tradiciji Taiji quana*. Analiza, 2012/3, 43-57.

7. Sever, J. (2013). *Vpliv nenadne razbremenitve sile v vodoravni smeri na stabilnost pri Taijiquanu*. Revija Šport, 2013/3-4, 105-110.

8. Sokolowski, R. (2000). *Introduction to Phenomenology*. Cambridge University Press.

9. Woollacott, M. H., Shumway - Cook, A. (2012*). Motor control. Philadelphia*. Wolter Kluwe/Lippincott Williams&Wilkins.

10. Wile, D. (1996). *Lost T'ai-chi Classics from the Late Ch'ing Dynasty*. New York: State University of New York Press, Albany.

CONTEMPLATING WORK VS. VACATION: AN fMRI STUDY

Anka Slana[1], Eva Boštjančič[2], Martina Starc[1], Kristijan Armeni[1], Grega Repovš[1]*
[1]Mind & Brain Lab, Faculty of Arts, University of Ljubljana
[2] Department of Work and Organizational Psychology, Faculty of Arts, University of Ljubljana
*E-mail: anka.slana@psy.ff.uni-lj.si

ABSTRACT

Contemplation engages a multitude of cognitive processes from imagery, emotional processing, planning, rumination, etc., which can be reflected in the pattern of brain activity across diverse brain regions, systems and networks. In our study we wanted to test to what extent differences in contemplation of work vs. contemplation of vacation might be identified by the observed brain activity. Twenty-five participants were asked to contemplate work and vacation during functional brain imaging. The results revealed that contemplation engages multiple brain systems—perceptual, motor, memory, evaluative, and cognitive control. Direct comparison, however, suggested that contemplation of vacation was more cognitively engaging, involved a higher degree of emotional processing, and recollection of autobiographical memories, whereas contemplation of work involved semantic memory processes and reflection upon one's own personality traits to a larger extent.

1 INTRODUCTION

It is in the human nature to contemplate upon topics that are of great importance in our daily lives. Contemplating entails manipulating a number of thoughts—a set of mental representations of objects and events. These can be a result of our perceptual processes, memory retrieval, planning, or mental imagery, they can span different modalities and be imbued with emotional valence. The subject of this study was to assess how contemplating work vs. vacation might differ in processes it engages by monitoring the underlying brain activity. In that respect the study represents a novel example of the so-called brain reading research.

Whereas it is not (yet) possible to identify the exact mental representation a person is having at a given moment while thinking freely as in everyday life, some progress in this direction has been made. By monitoring brain activity with brain imaging techniques, such as functional magnetic resonance (fMRI), and using appropriate analyses, it is now possible to decode the coarse components of one's mental representations, such as cognitive processes they are based on (e.g. memory retrieval or emotional processing) and modalities they are represented in (e.g. auditory vs. visual). Moreover, it is possible to recognize a specific brain activity pattern that is prototypic and specific to a certain category of mental representations and by this to deduce—usually among a limited number of mental representation categories—what one had in mind. For example, it is possible to infer whether a person was presented with an image of an object or an image of a face (O'toole et. al, 2005), or distinguish between patterns of brain activity related to performing motor or spatial-navigation imagery task (Owen et. al, 2006).

In the quest for defining the "brain map" of mental representations and its components, studies carried out so far mostly dealt with identifying brain activity patterns related to well-defined categories and modalities of mental representations by designing experiments in which participants were given detailed and specific instructions in regards to mental representations they were asked to make. In contrast to those studies, our approach was rather the opposite—to identify the (differences in) component processes subjects engaged in while contemplating work and vacation based on the observed brain activity patterns. To achieve that we avoided giving specific instructions regarding what mental representations to form, but instead instructed participants to freely think about two different topics—work and vacation—without further restrictions as to what specific categories or modalities of mental representations they should try to evoke. By monitoring the underlying brain activity and relating it to the activity patterns identified in previous research that can serve as markers of specific features and components of mental representations and processes that generate them, our goal was to infer the nature of thoughts when subjects engage in thinking about work or vacation.

It seems plausible that contemplation of work and vacation includes a series of different mental representations, however, it is at the same time highly probable that contemplation of the two contents considerably overlaps in the categories of mental representations it evokes, such as representations of people, objects and actions, as well as in involved sensory modalities. Thus, if we are able to distinguish between the patterns of brain activity related to work and vacation, such differences might reflect the more general differences in cognitive processing of the given contents. For example, the contemplation of work might involve developing a work activity plan and may induce a certain amount of emotional stress, whereas the

contemplation of vacation might include ruminating on past vacation and re-experiencing pleasant emotions. Such differences in engagement of cognitive processes should be reflected in differential activation of specific brain regions and networks, including default mode network (DMN), which is associated with rumination and memory recall, brain areas related to emotional processing, and regions which play significant roles in planning and other executive functions.

Hence, by using an exploratory approach, the goal of the presented study was to assess, to what extent the differences in cognitive processes engaged by contemplating work and vacation can be identified by observing the pattern of related brain activation.

2 METHOD

2.1 Participants

25 neurologically healthy individuals (mean age 36.7 [range 24-69], 17 females) took part in the study. The participants were recruited with the help of Si.mobil® as a part of a larger study. All participants were full-time employed at the time of the study and gave a written informed consent to participate in a 1.5-hour experimental session. The study was approved by the Faculty of Arts Ethical Committee.

2.2 fMRI scanning

Participants took part in an fMRI recording between 7-14 days prior to their summer vacation. Neuroimaging data were acquired with Philips Achieva 3.0T TX scanner. One T1-weighted (236 sagittal slices, matrix = 336 × 336, voxel size = 0.7 mm × 0.7 mm × 0.7 mm, TE = 5.7 ms, TR = 12 ms, flip angle = 8°) and one T2-weighted (236 sagittal slices, matrix = 336 × 336, voxel size = 0.7 mm × 0.7 mm × 0.7 mm, TE = 414 ms, TR = 2500 ms, flip angle = 90°), high-resolution, whole-brain anatomical scans were acquired. Whole-brain functional volumes (BOLD) were acquired with a T2*-weighted echoplanar imaging sequence (48 axial slices, voxel size = 3 mm × 3 mm × 3 mm, matrix = 80 x 80, TR = 2.5 s, TE = 27 ms, flip angle = 90° SENSE factor 2) in two task bold runs, each consisting of 197 frames.

2.3 Task

During the acquisition of functional scans, the participants took part in a task in which two different visual cues—indicating the content which the participants were instructed to contemplate about—were shown. An image of a *paper clip* indicated a block in which participants were instructed to contemplate work (work block) and an image of a *sandal* instructed the participants to contemplate vacation (vacation block). No further instructions regarding work and vacation blocks were given. Cues were shown in a randomized order across two bold runs, so that each cue was presented three times in the course of one bold run. Before and after each cue, a fixation cross indicating rest in which participants were instructed to observe and focus on their breathing in order to prevent them from thinking about work or vacation, was shown. Work and vacation blocks each lasted 45 s, while rests were 30 s in duration.

2.5 Data preprocessing and analysis

The initial functional data preprocessing, followed the standard preprocessing pipeline using in-house tools. Specifically, (1) functional images were temporally aligned within each brain volume to compensate for slice-dependent time shifts; (2) odd/even slice intensity differences due to interpolated acquisition were eliminated; (3) images were realigned within and across the runs to compensate for rigid body motion; (4) image intensity was normalized to a whole brain mode value of 1000; (5) T1 and T2 structural volumes were registered to the atlas representative template in the Talairach coordinate system (Talairach and Tournoux, 1988) using a 12-parameter affine transform; (6) functional volumes were co-registered to the structural images and transformed to atlas space using a single affine 12-parameter transform, maintaining a 3-mm cubic representation; finally (7) functional images were spatially smoothed with a Gaussian filter (6 mm FWHM) before statistical analysis.

Using FIDL software and voxel-wise GLM approach we estimated beta weights for regressors representing critical events for each of the subjects. Separate regressors for full duration of work and vacation blocks were included in the model, along with regressors for baseline and linear drift. All events were modeled with an assumed shape by convolving with a single-gamma hemodynamic response function (Boynton, Engel, Glover & Heeger, 1996).

To compute group level results, the resulting beta weights were entered in a second-level analysis with subjects as random factor. First, regions active during each contemplation block type ("work" and "vacation") were identified by whole brain one sample t-tests. Finally, the activity during each block type (“work” vs. “vacation”) was compared using whole brain paired t-tests. To control for multiple comparison, only contiguous clusters of minimum 17 voxels and Z of 3 were considered statistically significant, matching whole-brain corrected $p < .05$.

3 RESULTS

First we focused on identifying brain regions significantly activated by the contemplation of either work or vacation when compared to rest. Statistical analyses revealed extensive overlaps between identified regions (Figure 1). Contemplating both work and vacation activated large parts of the left medial prefrontal cortex and left pre-motor and motor area, however, the activity in the corresponding regions of the right hemisphere was less extensive. An increased activity related to both contemplation blocks was observed also in the left and right primary somatosensory and visual cortex.

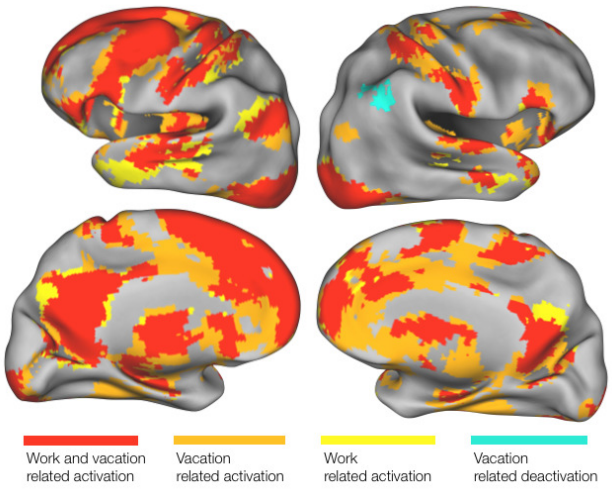


Figure 1*: Brain regions showing significantly different activation during the contemplation of work and vacation compared to rest.*

Contemplation of vacation activated nearly entire left and right cingulate cortex, significant activation was also found in parahippocampal gyrus (PHG). In comparison, the contemplation of work activated more posterior parts of the left and right cingulate cortex, more extensive activation was also found in inferior temporal gyrus. The contemplation of work was also related to the increased activity in both left and right precuneus. The one brain area showing deactivation, the right temporo-parietal junction (rTPJ), was related to the contemplation of vacation.

Next, we assessed the differences in brain activity related to the contemplation of work and vacation (Figure 2). A significantly higher response in the brain activity related to the contemplation of work vs. vacation was observed in both left and right precuneus, left inferior temporal gyrus and left middle temporal gyrus. Higher activity related to the contemplation of vacation vs. work was found in left and right PHG, left and right anterior cingulate cortex (ACC), as well as right posterior cingulate cortex (PCC).

4 DISCUSSION

Results revealed that the contemplation of vacation as well as work activates a wide array of brain areas, suggesting involvement of a number of cognitive and perceptual processes. While we cannot point to specific processes underlying the observed activity, we are able to infer the general processing mechanisms present. These include

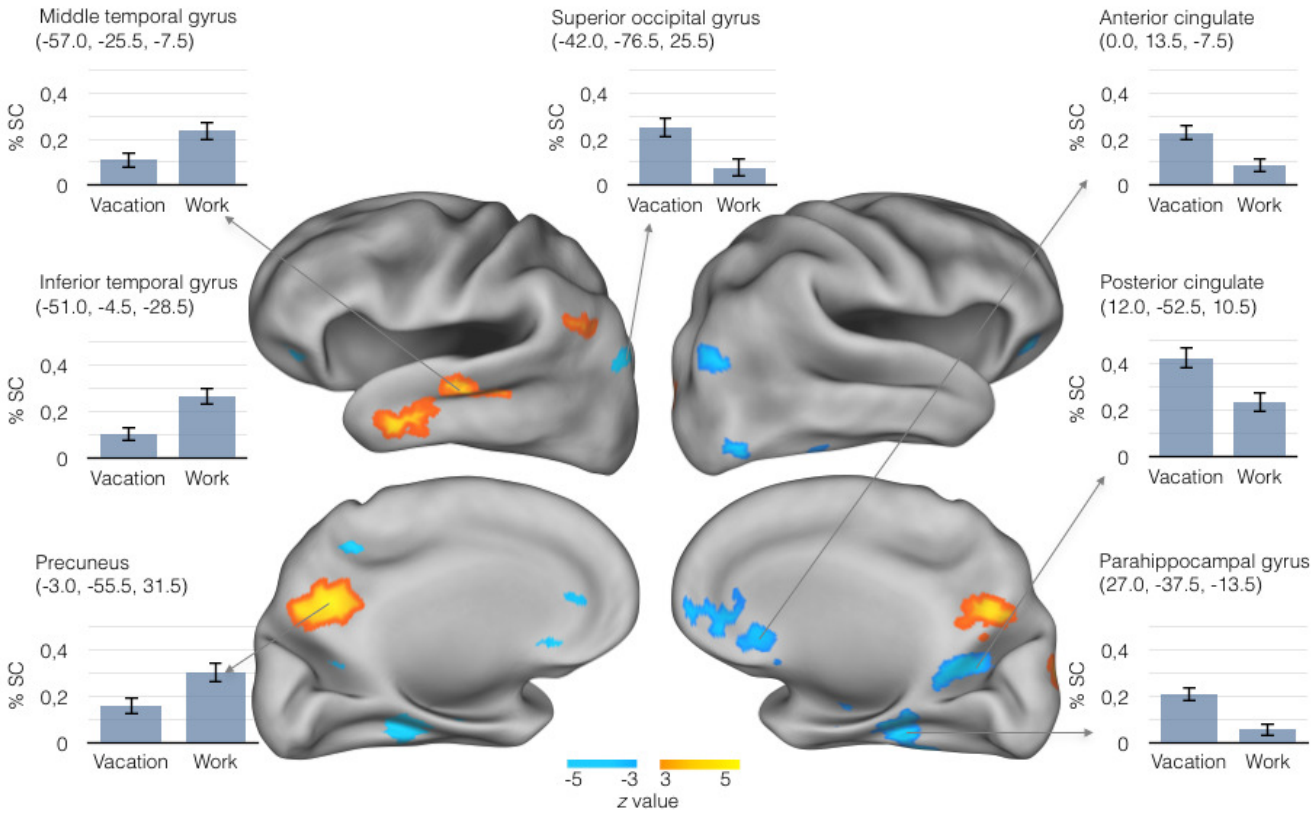


Figure 2: *Brain regions showing significant differences in activation when comparing the contemplation of work vs. vacation (orange - stronger activation when contemplating work; blue - stronger activation when contemplating vacation). Graphs show percent signal change (SC) in activity of the selected brain regions during the contemplation. Coordinates shown in graphs correspond to Talairach coordinate system and indicate a central position of the selected brain area.*

perceptual processing of various modalities—auditory, visual and somatosensory as indicated by the activity of the primary auditory, visual and somatosensory cortex respectively—as well as motor planning and imagery associated with the activity in motor and pre-motor areas. The activity observed in the DMN regions, precuneus and PCC in particular, suggests that contemplation is internally directed and involves rumination and memory retrieval (Buckner et al. 2008). Activation of the subgenual ACC during the contemplation of vacation further indicates processing of emotional content (Maddock et al., 2003).

Interestingly, the one brain region showing deactivation, the rTPJ, is related to the contemplation of vacation. The activation of the rTPJ, a part of ventral attention system, is associated with stimulus-driven attention. However, the suppression of the rTPJ, often deactivated along with the DMN (Anticevic et al., 2010), highly correlates with effortful cognitive engagement and is related to engagement of the dorsal (task-driven) attention system (Todd et al., 2005). Hence, rTPJ inhibition seems to play an important role in maintaining focus in face of external distraction. The suppresion of rTPJ during the contemplation of vacation could thus reflect strong focus and attentional engagement.

Assessing the differences in the brain activity when contemplating work vs. vacation revealed higher activity of the PCC during the contemplation of vacation. The activation of PCC, one of the core nodes of the DMN, suggests that the participants were more involved in autobiographical memory retrieval during the contemplation of vacation vs. work (Maddock et al., 2001). This hypothesis is further supported by higher activity in PHG and ACC—regions densely connected to PCC—which along with PCC form a network involved in the retrieval and representation of naturally acquired memories. These findings strongly suggest that in comparison with the contemplation of work, the contemplation of vacation engages to a larger extent autobiographical memory retrieval, reward anticipation, and assessment of emotional salience, both related to the activity of the ACC (Bush et al, 2002, Maddock et al., 2003).

The contemplation of work in comparison with the contemplation of vacation led to stronger activation of precuneus, the second core node of the DMN related to mental imagery concerning the self. This region is especially active when reflecting on one's own personality traits (Kjaer et al, 2002). Higher activity related to the contemplation of work was also observed in the middle and inferior temporal gyri associated with visual object processing and recognition as well as semantic memory processing.

5 CONCLUSION

The aim of this study was to assess the mental processes involved in the contemplation of work and vacation by observing the underlying brain activity. As shown, the contemplation of both work and vacation engages many processes, from imagery to memory retrieval and rumination. However, in our sample, the contemplation of vacation seemed to be more cognitively engaging, engaged a higher degree of emotional processing, and a recollection of autobiographical memories, whereas the contemplation of work involved semantic memory processes and a reflection upon one's own personality traits to a larger extent.

References

Anticevic, A., Repovs, G., Shulman, G. L., & Barch, D. M. (2010). When less is more: TPJ and default network deactivation during encoding predicts working memory performance. *Neuroimage*, *49*(3), 2638–2648.

Boynton, G. M., Engel, S. A., Glover, G. H., & Heeger, D. J. (1996). Linear systems analysis of functional magnetic resonance imaging in human VI. *Journal of Neuroscience*, 16, 4207–4221

Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network. *Annals of the New York Academy of Sciences*, *1124*(1), 1–38.

Bush, G., Vogt, B. A., Holmes, J., Dale, A. M., Greve, D., Jenike, M. A., & Rosen, B. R. (2002). Dorsal anterior cingulate cortex: a role in reward-based decision making. *Proceedings of the National Academy of Sciences*, *99*(1), 523–528.

Kjaer, T. W., Nowak, M., & Lou, H. C. (2002). Reflective self-awareness and conscious states: PET evidence for a common midline parietofrontal core. *Neuroimage*, *17*(2), 1080–1086.

Maddock, R. J., Garrett, A. S., & Buonocore, M. H. (2001). Remembering familiar people: the posterior cingulate cortex and autobiographical memory retrieval. *Neuroscience*, *104*(3), 667–676.

Maddock, R. J., Garrett, A. S., & Buonocore, M. H. (2003). Posterior cingulate cortex activation by emotional words: fMRI evidence from a valence decision task. *Human brain mapping*, *18*(1), 30–41.

O'toole, A. J., Jiang, F., Abdi, H., & Haxby, J. V. (2005). Partially distributed representations of objects and faces in ventral temporal cortex. *Journal of Cognitive Neuroscience*, *17*(4), 580–590.

Owen, A. M., Coleman, M. R., Boly, M., Davis, M. H., Laureys, S., & Pickard, J. D. (2006). Detecting awareness in the vegetative state. *Science*, *3*13(5792), 1402–1402.

Talairach, J., & Tournoux, P. (1988). *Co-planar stereotaxic atlas of the human brain. 3-Dimensional proportional system: an approach to cerebral imaging.* Stuttgart: Thieme.

Todd, J. J., Fougnie, D., & Marois, R. (2005). Visual short-term memory load suppresses temporo-parietal junction activity and induces inattentional blindness. *Psychological Science*, *16*(12), 965–972.

PUPIL SIZE INDEXES SPATIAL WORKING MEMORY PRECISION

Martina Starc, Grega Repovš
Department of Psychology
Faculty of Arts, University of Ljubljana
Aškerčeva 2, 1000 Ljubljana, Slovenia
Tel: +386 1 241 1175
e-mail: martina.starc@psy.ff.uni-lj.si

ABSTRACT

Compared to EEG and fMRI, pupillometry provides a relatively accessible option to track working memory (WM) processes with high temporal resolution. While pupil size has been shown to predict WM capacity, no such attempts have been made for the quality of WM representations. We aimed to verify whether pupil size can also be used as an index of spatial WM (SWM) precision.

30 participants (15 female, aged 19–31) remembered the position of circular pictures presented at various locations along a hidden radial grid. After a delay they indicated the remembered position with a joystick providing a parametric measure of trial-to-trial accuracy. During the task participants' eye movements and pupil size were recorded.

Pupil size predicted SWM precision but only after controlling for angular bias. More effort in early encoding, late retention and early response phases led to more precise responses ($r \cong 0.10$), indicating the role of early preparation and sustained attention in WM precision.

The results also show the need to consider participants' strategy in the interpretation of results, as these findings largely held only for participants who exhibited less angular bias overall. For these participants bias only seems to emerge if their attention slips in the later stages of retention, leading to an increase in task stress and the adoption of alternative strategies. In contrast, early activation at encoding and responding and participants' continued involvement with the task leads to precise responses.

In conclusion, pupil size seems to offer new insights into mental effort and strategy use and is useful as an index of SWM precision.

1 INTRODUCTION

Working memory (WM)—the ability to temporarily store and manipulate limited amounts of information—is a complex system consisting of several stores and processes (1). While the field of WM has a strong basis in behavioural research, behavioural data alone often cannot provide temporally detailed information on which particular stages of WM (encoding, maintenance, recognition/recall) are affected by experimental manipulations. Several successful attempts to isolate psychophysical correlates of WM have been made using single cell recordings in live animals (2) and EEG and fMRI in humans (3). While these methods clearly provide valuable insights into physiological mechanisms of WM, their practical, temporal and spatial constraints often limit researchers to relatively simple experimental designs. In contrast, pupillometry—continuous measurement of pupil diameter—can be accomplished with relatively little additional discomfort for participants and can complement complex behavioural designs with detailed psychophysiological data.

Pupil dilation during cognitive tasks is largely interpreted as reflecting cognitive load or intensity of mental activity (4) and several previous studies have established pupil size as a valid indicator of WM capacity (5; 6). With increasing numbers of items held in WM, cognitive load and thus pupil size tends to increase. We aimed to establish whether pupil size can also be used as an index of WM precision e.g. representation quality.

We chose to focus on spatial WM (SWM)—the ability to temporarily maintain information about the positions of objects. Due to the nature of spatial information we can collect parametric measurements of trial-to-trial precision in SWM tasks by requiring participants to indicate the remembered position using a mouse or a joystick, moving their eyes or finger-pointing instead of making all-or-nothing decisions of match-nonmatch tasks.

Additionally, SWM may be especially suitable for pupillometry, due to its connection to the process of covert attention. Maintenance of spatial representations in WM can be achieved by sustaining spatial attention on the position of the target (7). While pupil size changes for several very different reasons (luminance, emotional arousal or cognitive effort), neurally, pupil size seems to track neural gain (8). Higher gain results in a narrower focus of attention which should lead to more precise responses in the context of a SWM task. Thus we predict that pupil size will correlate with the precision of stored SWM representations—the more dilated the pupils the less error in responses.

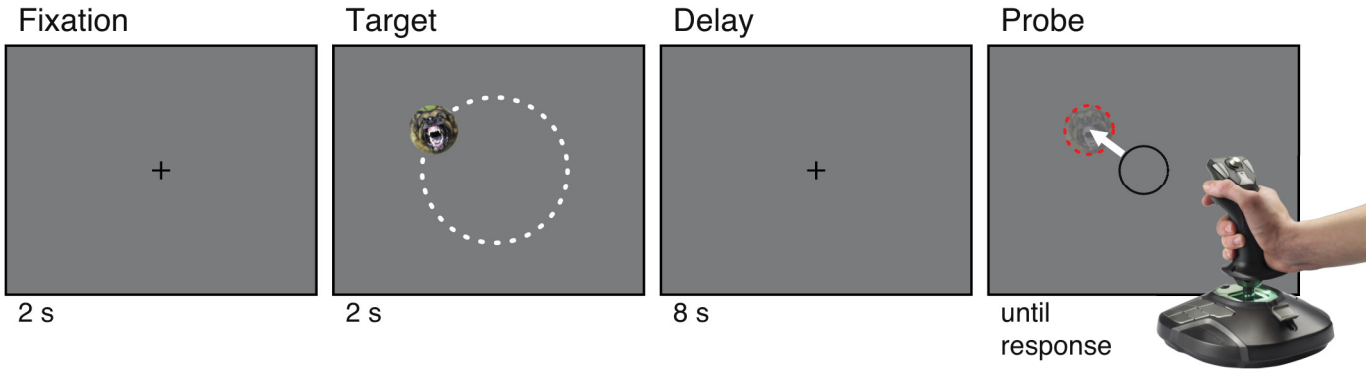


Figure 1: ***Experimental design.*** *Participants were asked to remember the position of circular pictures that were presented at various angles along a hidden radial grid (shown here with a white dotted circle that was not present in the actual task). After a delay a high-sensitivity joystick was used to indicate the remembered location, providing a parametric index of accuracy.*

2 METHODS

2.1 Participants

30 students (15 female) aged between 19 and 31 (M=20.6, SD=2.45) participated in the study. All had normal or corrected-to-normal eyesight. They manipulated the joystick with their dominant hand (1 was left-handed).

2.2 Equipment

Eye-tracking was performed with the EyeLink 1000 system, which tracks the eyes using the pupil and corneal reflection recorded with an IR camera. Nine-point calibration was used. Gaze direction and pupil size of the right eye were recorded with a frequency of 500 Hz.

2.3 Stimuli

Stimuli were 96 pictures from the International Affective Picture System (9), cut to a circular shape and resized. In addition, 24 pictures were scrambled (10) and included as a control. The pictures varied in valence scores, however, emotional effects were not included in the present analysis and will be presented elsewhere.

The pictures with a 200 px diameter (4.5° visual angle) were always presented at a distance of 300 px from the center of the screen (1280 x 1080 px) along a hidden radial grid (13.4°) but at randomly chosen angles.

2.4 Procedure

We used a head-rest to position participants' eyes 70 cm from the screen. Eye-tracker calibration was performed and the task explained to the participants. A picture was shown in each trial and participants remembered its position. After a delay they used a joystick to move a grey circle to the correct position on an empty screen (Figure 1). Their choice was confirmed by clicking a joystick button, and the last position before the click was recorded as their response. Participants preformed 10 practice and 120 test trials (6 blocks of 20).

2.5 Data preprocessing

Raw pupil size data were exported from EyeLink DataViewer and cleaned in MATLAB. By computing a mean over a sliding window of 100 ms quick changes in pupil size were detected and excluded as blinks or artefacts. Undetected blinks and noisy data were additionally excluded by visual inspection. Resulting missing values were replaced by linear extrapolation of bordering points. For ease of analysis the data were decimated to a sampling frequency of 50 Hz. To control for individual differences in pupil size, all analyses were performed on z values. Further analyses of eyetracking data and behavioural measures were performed in the R environment.

2.6 Measures of SWM precision

Participants' behavioural responses were recorded as x,y positions on the screen. We defined error as the Euclidian distance of the response from target position (distance in pixels). However, to conform with the ring architecture of the task, participants' responses were also coded as an angle (disregarding the distance from the center of the screen). We defined angular error as angular displacement of the response angle from the target angle. A non-random pattern of responses was found in regard to angular error—participants exhibited a tendency to move away from the target and towards the nearest 45° angle (quadrant prototype). We defined angular bias by recoding angular error such that positive values indicated a shift toward the nearest 45° angle and negative values a shift away.

To eliminate the effects of angular bias on distance results we computed a bias function for each participant by modelling the relationship between the distance of target angles from the nearest 45° angle (1–44°) and measured angular bias with a second degree polynomial. Predicted angular bias values were computed for each target angle and subtracted from response angles. Resulting response positions were used to compute corrected Euclidian distances in order to produce a purer measure of SWM precision that is more likely due to sustained attention rather than the use of quadrant prototypes.

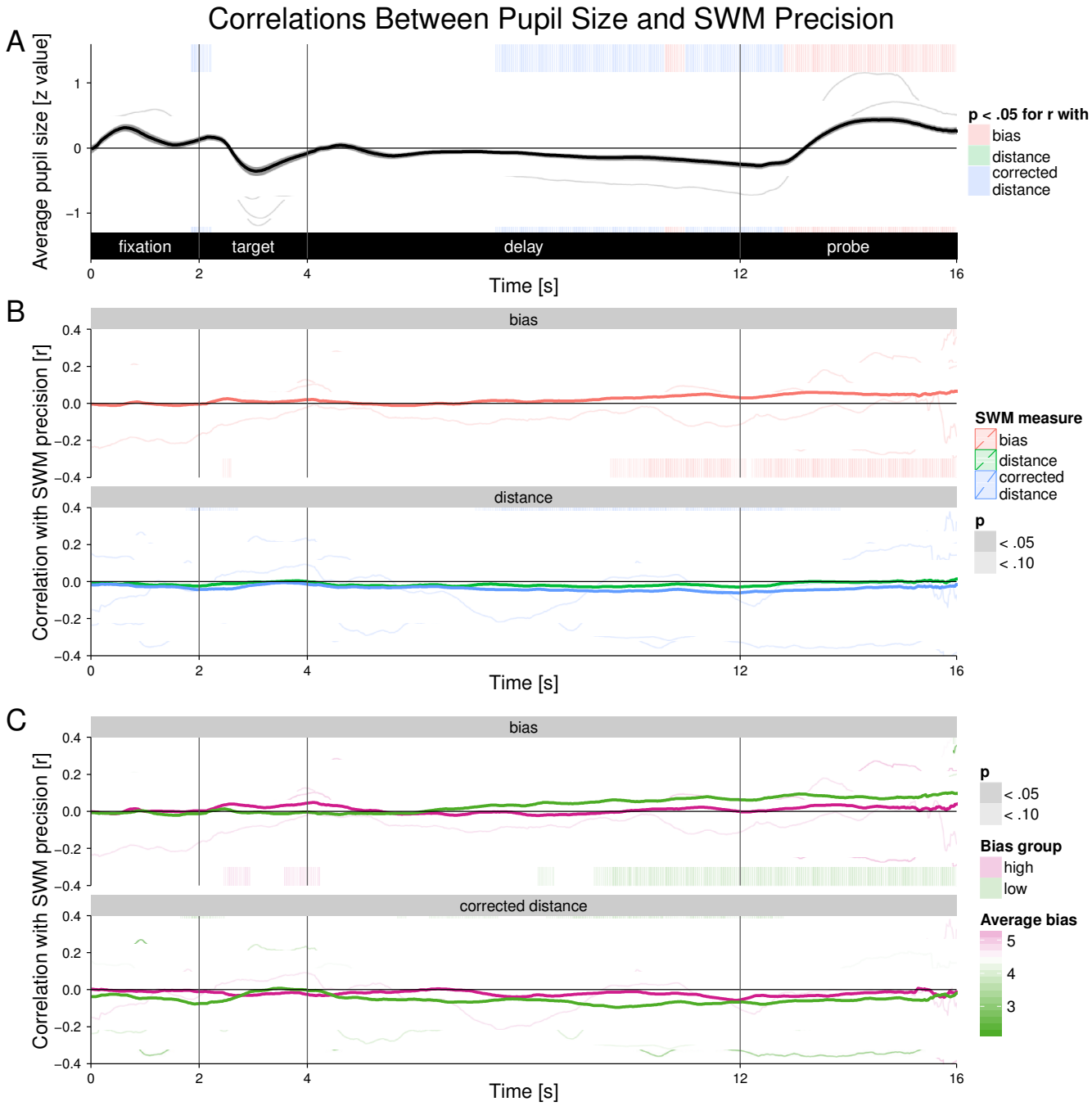


Figure 2: ***Correlations between pupil size and SWM precision. A.*** *Average time course of changes in pupil size. Pupil size starts to increase in anticipation slightly before the presentation of the target stimulus, followed by a drop during stimulus presentation. It returns to baseline level at the beginning of the delay period, followed by a steady decrease into early response phase, rising again for the response as the most effortful phase. Shaded areas denote time points that significantly correlate with behavioural measures of SWM precision (angular bias, distance and corrected distance).* ***B.*** *Average correlations between pupil size and SWM precision.* ***Top panel*** *shows the relationship between pupil size and angular bias—a tendency to shift responses from the target towards the nearest 45° angle. Correlations are strongest in the late stage of retention and throughout the response phase.* ***Bottom panel*** *shows the relationship with SWM error—distance from the target. Uncorrected distances (green line) are not significantly related to pupil size. However, a relationship emerges after correcting for angular bias (blue line). Increased effort predicts precise responses especially in the early encoding, late retention and early response phase.* ***C.*** *Median split of the participants based on their average bias scores. Previously described relationships between pupil size and SWM measures rely mostly on participants who exhibit less bias overall (in green).*

3 RESULTS

We were interested in how pupil size changes during an average SWM trial and particularly how those changes relate to SWM precision. We computed time courses of pupil size changes by averaging across trials for each participant and across participants for the grand average (Figure 2A). Greatest increases in pupil size can be seen in the fixation and response phases indicating preparation and recall as the most effortful phases.

To assess the relationship with SWM performance, we computed correlations between pupil size and measures of SWM precision (angular bias, distance, corrected distance) and performed t-tests at each time point (20 ms) for each participant. The pattern of individual correlations as well as across-participants averages can be seen in Figure 2B. In general, the correlations are low ($r < .10$), but significant at several time points during the trial. Increased pupil size is related to larger angular bias in the late retention and throughout the response phase, while distance effects only emerge after correcting for bias and occur earlier—at the transition from fixation to target presentation, in the second half of the retention phase and in early response phase. Dilated pupils predict less error i.e. more precise WM.

Since angular bias seems to be most strongly related to pupil size and participants differ in their tendency to adopt this strategy, we checked whether these relationships differed for high and low bias participants. We used participants' average angular bias scores to perform a median split and computed average correlations and t-tests for each group separately (Figure 3C). High bias participants exhibit only a few borderline significant ($p < .10$) correlations. Low bias participants, however, seem to be responsible for the overall pattern of results with bias effects in late retention and throughout the response phase and corrected distance effects during transition from fixation to target presentation and during late retention and early response phases.

4 DISCUSSION

Our aim was to validate pupil size as a valid index of SWM precision. We correlated participants' responses with pupil diameters at each time point in the trials and discovered several temporal epochs that significantly predict both angular bias and corrected distance. This indicates that pupil size tracks SWM precision to some extent. After correcting for bias, pupil size shows a stable, albeit low, relationship with distance from target. This seems to indicate mental effort as beneficial throughout the trial, however, its effects are most apparent in early encoding and recall phases and in late retention. Participants invest effort into all stages in most trials; what separates more precise from less precise trials is early preparation, sustained attention even in later stages of maintenance and early responsiveness at recall. Thus, pupillometric evidence provides additional insights into WM precision that behavioural data alone cannot afford.

Nevertheless, because pupil size tracks not only precision but also bias, pupillometric results can be hard to interpret without considering behavioural responses as well. These indicate that participants most likely use a dual strategy when encoding spatial information in ring SWM tasks. The maintenance of spatial attention on the location of the target is a spatially specific strategy, which is precise but demanding and likely prone to distractions. A less taxing memorization can be achieved by approximating target position with quadrant prototypes (45° angles). Quadrant encoding—perhaps achieved in the phonological loop— is spatially non-specific and crude but stable and relatively automatic as 75% of responses exhibit a tendency to shift away from the target and towards the quadrant prototype.

Participants varied in their propensity to use these strategies. We propose that high bias participants tend to use the quadrant strategy all the time with little spatially specific deployment of attention. This is reflected in the median split data—all the relationships with pupil size hold only for low bias participants who are more likely to use attentional strategies and only fall back to quadrant approximation if their attention slips. Thus, the positive relationship of pupil size with bias can be explained as task stress due to attentional failure in some trials which leads to the adoption of alternative strategies and higher bias scores.

5 CONCLUSION

Our results indicate that pupillometric data can provide useful insights into the time course of SWM and also highlight the need to consider participants' strategies when interpreting SWM results.

References

1. Repovš G, Baddeley AD (2006): The multi-component model of working memory: explorations in experimental cognitive psychology. *Neuroscience* 139: 5–21.
2. Funahashi S, Bruce CJ, Goldman-Rakic PS (1989): Mnemonic coding of visual space in the monkey's dorsolateral prefrontal cortex. *J Neurophysiol* 61: 331–349.
3. Luck SJ, Vogel EK (2013): Visual working memory capacity: from psychophysics and neurobiology to individual differences. *Trends in Cognitive Sciences* 17: 391–400.
4. Laeng B, Sirois S, Gredebäck G (2012): Pupillometry A Window to the Preconscious? *Perspect on Psych Science* 7: 18–27.
5. Johnson EL, Miller Singley AT, Peckham AD, Johnson SL, Bunge SA (2014): Task-evoked pupillometry provides a window into the development of short-term memory capacity. *Front Psychology* 5. doi: 10.3389/fpsyg.2014.00218.
6. Piquado T, Isaacowitz D, Wingfield A (2010): Pupillometry as a measure of cognitive effort in younger and older adults. *Psychophysiology* 47: 560–569.
7. Awh E, Jonides J (2001): Overlapping mechanisms of attention and spatial working memory. *Trends in Cognitive Sciences* 5: 119–126.
8. Eldar E, Cohen JD, Niv Y (2013): The effects of neural gain on attention and learning. *Nat Neurosci* 16: 1146–1153.
9. Lang PJ, Bradley MM, Cuthbert BN (2008): International affective picture system (IAPS): Affective ratings of pictures and instruction manual. *Technical Report A-8.* University of Florida, Gainesville, FL.
10. Sadr J, Sinha P (2004): Object recognition and random image structure evolution. *Cognitive Science* 28: 259–287.

ZAKAJ *GESTALT* IN NE *LIK*

Julijana Stojan
Rimska cesta 8, 1000 Ljubljana, Slovenia
Tel: +386 1 6209972
e-mail: lucka.stojan@guest.arnes.si

POVZETEK

V slovenskem prostoru je med predstavniki različnih področij še vedno vsaj po inerciji prisotno hotenje sloveniti termin »gestalt« s terminom »lik«. Skrb vzbuja dejstvo, da so oporo za to našli v uradno poklicani stroki: ob SSKJ nas je o tem znova prepričala izdaja Slovenskega pravopisa 2001 in novega Slovarja tujk 2002, kjer termin *gestalt* ponovno preprosto umanjka. /1/ Izpostaviti želim nekaj razlogov, ki postavljajo hotenje sloveniti *gestalt* z *likom* v senco dvoma. /2/ Hkrati opozarjam tudi na neprevedljivost in s tem nezamenljivost slovenske besede *lik*.

Gestalt vstopi kot ključni pojem v teoretski diskurz v navezi z gestaltpsihologijo. Prvi je termin uporabil Christian von Ehrenfels leta 1890 v članku *U'ber Gestaltqualitaeten*, v katerem je nasproti takrat aktualnemu atomističnemu razumevanju kompleksnih senzacij E. Macha kot na avtonomno razpoznavno svojstvo opozaril na konfiguracijo elementov, ki jo ti zavzemajo v danem prostoru - notranjo organiziranost obravnavane instance ne glede na medij, ki jo nosi. Sam se je posvetil predvsem analiziranju zvočnih oziroma tonskih gestaltov. /3/ Pojmovanje kompleksne vzajemnosti nastopajočih instanc, ki kot enota presega seštevek svojih delov, se je ne glede na produktivno notranje razlike v okviru različnih šol oziroma usmeritev tako v Evropi kot v Ameriki ustalilo kot temeljna interdisciplinarna paradigma kognitivno naravnanih znanosti.

To, kar označuje *gestalt*, je torej dinamična topološka konstelacija: so-postavljenost elementov v danem prostoru, kakršnemkoli že in karkoli naj že ti pomenijo, ki razpolaga z določenim vztrajnostnim notranjim razponom. Dejavna skozi formalne premike, ki jih nosi, se vzpostavlja po naravi internih razmerij med svojimi deli – zasedenimi mesti v danem polju. Učinkuje - sporočilna je položajnost *per se*: formalno prepoznan kon-figurirani zastavek kot tak je že označevalno dejaven. Četudi ne do kraja definiran, je gestalt zgolj po svoji formalni kvaliteti že nosilec določenih kontekstualnih–mentalnih sugestij.

Razumljen na ta način gestalt ni vezan na dejanskost. Ni nujno, da je vizualno udejanjen oziroma dejansko opredmeten. Nasproti temu označuje lik izdelan fenomen ali predstavo in (z izjemo literarnih ali športnih likov) je praviloma vezan na vizualni medij. Ker obravnavamo oba izraza kot potencialna pendanta, ostajamo v okviru te domene.

Gestalt ne referira nekaj, kar bi bilo enoznačno opredeljivo, vzpostavljajo ga prej okolice kot točke: konfiguracija konstitutivnih elementov se ne zaustavi na točno določenih mestih, temveč je pretočna znotraj določenih tolerančnih intervalov. V okviru istega gestalta tako v konkretnih primerih govormo o že drugem liku ali likih. Posledično to pomeni, da je toleranca gestalta do deformacij mnogo večja, kot če imamo opravka z likom; gestalt je bolj odporen na spremembe. Lik je vpet v konturni rob, četudi je ta samo imaginaren. Apliciran na naravne oblike konkretni lik, ki je sam po sebi prazen, z deformacijami hitro prestopi v drugo identiteto, saj je prepoznavna predvsem ali samo njegova kontura. Nasprotno ima gestalt kot odprta, pretočna in hkrati relativno nasičena instanca mnogo večjo notranjo fleksibilnost in ostaja vselej nezaključena možnost za nov in-formativni prenos.

Na primer, oblike, s katerimi je Jacopo Bellini praviloma predstavil gore na krajinskih ozadjih svojih del, nas spominjajo na konvolutni stožec. Pomislimo, da je bil v njegovem času, to je ob izteku pozne gotike v renesanso, zelo priljubljena estetska forma accolado – zaviti oklepaj pod različnimi sovpadnimi koti. Posegel je v vse, od okvirjev slik, zlasti oltarnih, do fasadnih arhitekturnih členov, strukture obokov in se seveda polastil ornamenta. /4/ (sl.3,5,6) Če rotiramo to obliko okoli njene osi v zamišljeni 3-D prostor, je to, kar dobimo, konvolutni stožec. V času, ko konfiguracija krajine v polju slike še ni dosegla iluzorne prepričljivosti, temveč se je formirala po privzetih, z vidika optične verodostojnosti nepreverjenih šablonah, je bila izhodna instanca za goro po vsej verjetnosti pred-refleksivno prisoten pretočni *gestalt* in ne konkretni *lik* accolada, do prepoznavnosti artikulirana in vendar ne docela dorečena mentalna paradigma, nasploh aktualna v tedanji vizualni zavesti. Kot taka se je lahko samodejnno investirala v generiranje reprezentacije z gorskimi vedutami ne da bi jo bilo treba retrogradno prilagajati oziroma de-formirati aktualni likovni predstavi ustrezno. Skozi artistični proces se je progresivno brusila v izbrano - eno izmed mnogih možnih finalnih rešitev. Če bi *gestalt* neposredno enačili z *likom* oziroma z asociativnim razponom, ki ga glede na leksikalne reference pokriva

slednji, geneze artefakta na ta način sploh ne bi mogli obravnavati, oziroma bi morali *liku* pripisati nove kvalitete, ki jih *gestalt* že ima. S tem bi v temelju predefinirali *lik* in mu odvzeli njemu lastno označevalno ostrino.

Poglejmo si primer še z diahrone plati: reprezentacija gore se je iz izhodnega gestalta, antitetičnega prevojnega vzpona, ki je najprej označeval simetrični figurni vzpon (največkrat živali) k osni vertikali, reducirala na kvazisimetrično prevojno konturo, ki ustreza najpogostejši silhueti vzpetine. (sl.1,2) Iz orientalne dediščine je bila ta prevzeta v antično izročilo in je od tod prestopila v okvire bizantinske manire, kjer je doživljala oblikovne preobrazbe - na stisnjenih poljih ikon najpogosteje v vzorec stopničasto prirezanih, postrani zavihanih stožcev, morda stiliziranih oblik Sinaja, ki jih srečamo na evropskih tleh sicer že v zgodnjekrščanskem obdobju, kot kažejo mozaiki v Ravenni in, ki obveljajo vse do Giotta. (sl.4) Reprezentacija je v splošnem nihala od dovolj nazorno posredovane prevojne paradigme do manieristično stopnjevanih rešitev, v katerih se je značaj izhodne forme začel drobiti in izgubljati svojo prepoznavnost. Vendar se z izpostavljenim nagnjenjem do accolada v času prehajanja srednjega veka v renesanso cepitev izvorne paradigme ne le zaustavi, artikulacija antitetičnega prevojnega vzpona se z njegovim dominantnim nastopom prepozna v svoji najbolj razvidni obliki, se ozavesti in poimenuje. Dominantni gestalt pikturalne imaginacije se v liku accolada na določeni časovni točki prešije v zavest, preteče kot privilegirana forma vse možne aplikativne vrednosti, da kot imanentno prisotna zakonitost kadrirane likovne aktivnosti nato znova zdrsne v spontano pikturalno snovanje. Z *likom* accolada se izhodni *gestalt* ustali kot vodilna instanca, dominantena paradigma klasične kompozicije, ki bodisi s svojimi fragmenti ali relativno povezano gradi (pravokotni) kader v značilno celoto, poimenovano tudi klasična kompozicija.

Kako ločiti med variacijami na isti gestalt in prestopom v drugega? Ugotovili smo, da je to, kar izraz označuje, dinamični topos, ne konkretna izvedba: dano oblikovno zasnutje s pretočno konturo. Njegova identiteta se zastavlja potencialno, kot (pred)nabor določenih formalnih možnosti, ki se realizirajo po predvidenem zornem kotu opazovalca. Identiteta gestalta torej v načelu ni enoznačna in ni dokončno vnaprej odločljiva, kar identiteta lika v načelu je. Razpoznanje istovetnosti neke mentalno prisotne formalne zasnove ni isto kot prepoznanje lika, v veliko večji meri kot slednji je nasledek konkretne intermedialne in kolektivne aktivnosti ter sprotne hic et nunc kognitivne situacije, v kateri je gestalt obravnavan identitetno, dokler ohranja za gledalca isto zaznavno kvaliteto. Posledično je njegov identitetni razpon bistveno večji kot pri liku. V perceptivnem procesu, katerega dinamika vselej ohranja določen nerealiziran, potencialni presežek, ni nobenega algoritma, ki bi vnaprej definiral identitetni prag, ki je pri liku v bistvu začrtan z njegovo konturo. Identiteta lika je načelno enoznačna kvaliteta, posebno, če je dejansko konstruiran v realnem prostoru. Liki so mišljeni, da nastopajo ločeno, ali se prekrivajo, se med seboj razlikujejo in so kot tako predloženi v obravnavo. Iz temeljne trikotne položajnosti na primer izhajajo tri osnovne možnosti, ki vodijo v dovršitev, artikulacijo različno definiranih oblik – *likov*. Vsak od njih na svoj način retrogradno določi po sebi nedorečeno temeljno konstelacijo - *gestalt*, ki predstavlja skupno izhodišče:

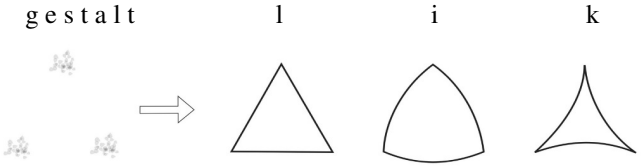


Fig. 1

Drug, konkreten primer je predvsem za krščansko ikonografijio značilna mandorla, svetlobno polje največkrat z likom Kristusa ali Marije v svoji sredi. Izvorno gre za vesico piscis, ribji mehur oziroma krožni presek, ki pa je večkrat realiziran kot oval ali elipsa - lahko celo kot romb, trikotnik ali kvadrat, vendar bi v tem primeru že ugotovili prestop v drugo gestaltno identiteto. (Fig.2a,b)

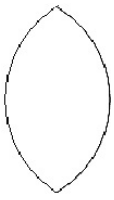


Fig. 2a

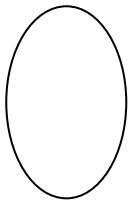


Fig. 2b

Svojo trditev oblikujemo bolj precizno, če ob zgornjem zgledu rečemo: “V tem primeru gre za različna lika”, kot če bi rekli: “V tem primeru gre za različni obliki”, ali shemi, formi,.. Zadnja alternativna izraza, ki bi bila v danem primeru uporabljena v drugih jezikih, imata vsak svoj asociativni krog, ki je obravnavani referenci manj priličen kot naša beseda *lik*. *Lik* je jezikovna prednost slovenskega jezika in nesmiselno bi se ji bilo odreči. Bodisi da govorimo o slikarskem snovanju in abstracto ali če analiziramo konkretna dela, prihajamo v situacije, ko rabimo tudi razliko med terminoma *gestalt* in *lik.* V primeri z gestaltom je lik v večji meri individualno opredeljen, čeprav je hkrati lahko tudi bolj abstrakten. Odvisno je od tega, kaj reprezentira in kako je uporabljen. Individualnost gestalta je tranzitivna, pomeni zagotovljeno izhodno ozadje in domet kreativnega pretoka – udejanja se kot konstitutivni odriv, do določene mere artikuliran oblikovni predlog. Vzdržuje in sproti razvija ga aktualna zaloga asociativnih vrednosti, ki je v igri, pripravljena, da s svojo dinamiko proži prehodno oblikovane poteze v nadaljnje procesiranje.

Enega nasproti drugemu lahko torej opredelimo z ugotovitvijo, da je lik izvršena, navznoter praviloma prazna stvar z večjo označevalno ostrino, medtem ko je gestalt

oblikovalno in vsebinsko dejaven kot formalno zasnutje z relativno širokim notranjim razponom. Neposredno vsebinsko angažiran se sproti prilagaja konceptualnim oziroma mentalnim projekcijam, ki jih sproža. Na kratko bi razlikovanje lahko povzeli z opredelitvijo, da je lik *lik nečesa*, medtem ko je gestalt *gestalt za* nekaj. Njegova identiteta je zdrsna, medtem ko je identiteta lika obstojna.

Poleg tega, da gestalt ni do konca opredeljiv, je lahko disociiran: posamezni v njem nastopajoči elementi med seboj niso nujno povezani, lahko so celo samo fragmenti. V prepoznan gestalt jih veže formalna kvaliteta medsebojnih nanašanj kot tudi aktualna perceptivna drža gledalca, njegova asociativno/motivalcijska razpoložljivost v danem času.

Medtem, ko je *lik* praviloma vezan na dvodimenzionalno vizualno zajetje in je najbolje prepoznaven uzrt frontalno, *gestalt* kot mentalno zasnutje ni razsežnostno opredeljen; pregiben je v n-dimenzionalnem prostoru in ne predpostavlja apriorne privilegirane projekcije. Če *lik* ni frontalno izpostavljen, je v dvodimenzionalni projekciji deformiran in rezultira v drug lik. Po drugi strani, kot smo pokazali, posamezen *gestalt* praviloma generira več *likov*.

Ločimo tudi objektne gestalte od gestaltov poti med izpostavljenimi pozicijami/objekti/liki, ki naseljujejo pikturalni prostor. Težko bi termin *lik* uporabili v primeru, ko se instanca vzpostavlja kot sprotni izid soaktivnosti z vizualno dejavnostjo perceptorja - ta z bolj ali manj priučenim vidom v svoji aktualni razpoloženosti lušči obliko iz medprostorja med manifestiranimi pikturalnimi vnosi v danem kadru. Gre za proces kreativnega zaznavanja, ki so-generira predmet svoje pozornosti v procesu avtopoietične dinamike. *Gestalt* se iz-vaja iz predloženega tkiva, na *lik* nasprotno zadenemo kot na izdelan fenomen bodisi v perceptivnem polju ali v umu.

Opozoritmo tudi na to, da se gestaltna zasnova ne doreče nujno v lik. Posebno v slikarstvu je zlasti od predhodnikov impresionizma dalje to odprto vprašanje: po eni strani kreativne motivacije avtorja po drugi formalne motivacije izbranega pikturalnega pristopa samega, ki se skozi proces nastajanja slike uveljavlja kot avtohtono izbiranje med različnimi v danem horizontu prisotnimi možnostmi. Slika, ki postavlja v ospredje potenco geste oziroma nanosa in posebno še moderna slika, ki zavrača aluzivno vsebino, se lahko zaustavi pred dorečeno motivno realizacijo, v njej konkretno izpeljani liki niti ne pridejo na vrsto.

Četudi persistira kot formalno nezaključen, je gestalt kot konfigurirani zastavek tudi že označevalen, nosilec določenih vsebinskih implikacij - prednostnih potencialnih vnosov. Ti se v procesu notranje selekcije ter po selekciji in preoblikovanju zunanjih impulsov kon-formirajo naprej. Da se neka zasnova vzpostavi kot forma, posledično lik, mora sled, ki jo preteče impuls, obstati. Dlje kot impuls vztraja in več priložnosti, ko njegova sled prevzame za naložbo, večja je odpornost vzpostavljene oblike in širši je njen sugestivni obseg. V tem smislu bi lahko *gestalt* razumeli kot predstavljeni okvirni modul za (serijske) realizacije v določenem razponu, izpise, ki vključijo tudi izdelani lik. Prisoten kot prostor v prostoru, kot zastavljena dinamična in ne dorečena formacija, gestalt artikulira okolje s svojo notranjo pregibnostjo, ga spreminja v aktivno polje s selektivnim nagnjenjem do prav določenih položajev - pogojev, ki nastajajo sproti z njegovo lokalno zgodovino, v kateri se vsebina koimplikativno poraja. Četudi podvržen intenzivnostnim nihajem vendarle deluje obstojno, kot neke vrste atraktor v procesu morfološke asimilacije vpisujočih se formalnih entitet - ko-indikativnih hkrati vsaka zase, svojemu specifičnemu rangu ustrezno. *Gestalt* s tem ohranja kontinuiteto prenosa skozi pretečene kontekste oziroma zaznave ter omogoča transfer med prostori, ki so kakorkoli pritegnjeni v igro. Nasprotno je *lik* že izvzet iz procesiranja, izdelan fenomen ali predstava oziroma definirano dejstvo. Kot takega ga okolna dinamika zadeva le do določene mere, prej njegovo pozicijo ali velikost in barvo, manj ali skoraj nič pa njegovo notranjo pregibnost. Tudi, če ni dejansko realiziran, zgolj kot mentalna predstava je lik razmeroma statično dejstvo in, v kolikor je udejanjen, je njegov učinek na okolje veliko bolj opredeljen in predviden.

Samo, če kot operativno instanco predpostavimo neko prepoznavno kohezivno konfiguracijo zasedenih mest v danem prostoru z določeno stopnjo samo-definiranja, ki predhodi in presega aktualno stanje stvari, in ki je kot taka pred-disponirana za določen obseg tako likovnih kot semantičnih naložb, lahko raz-lagamo in razlagamo vizualne fenomene še posebej v slikarstvu kot nasledstveni niz v zaporedju morfoloških premen; lahko raz-ločimo neko logiko generiranja, preoblikovanja, prestopanja ali izzvenevanja predstavljene formalne strukture po sebi in/ali v vztrajanju z drugimi vnosi v polje. Operiranje z likom, ki je konturno dorečen in navznoter prazen, reducira pikturalno polje na dokončno razpoznavnost – ki je iluzija, ki eo ipso vzpostavlja instanco ireduktibilnega presežka. Koimplikativno dogajanje med vključenimi gestalti in v njih samih je prekrito z izpeljanimi liki in njihovimi medprostori. Mreža likov je veliko bolj redka kot mreža gestaltov. Je tudi bolj transparentna. Produktivno ozadje formalno nedorečenih paradigem tako vedno pronica skozi rešetko izdelanih oblik ter opozarja na svojo konstitutivno prisotnost in šele z razločevanji, ki jih uvede pojem gestalta, jo lahko poskusimo oblikuovati v diskurz.

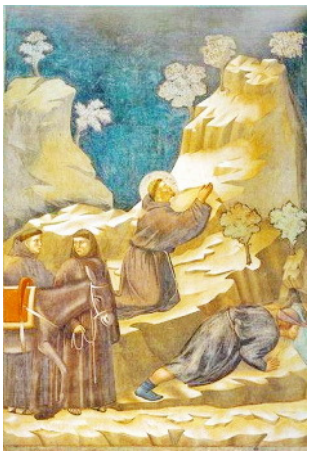
Povzetek
V obstoječih interdisciplinarnih diskurzivnih poljih pokriva gestalt notranje aktivni prostor z identitetnim razponom, ki je mnogo širši in hkrati drugačen od tega, ki pripada liku. V kolikor želimo dinamiko notranje procesne so-odvisnosti posredovati s slednjim, smo v pomenski obseg lika vpeljali neko odprto pulziranje, ki mu izhodno ne pripada, in ki ga glede na etimološki start in prehojeno pot pokriva gestalt.

To, kar nas veže na neprevedeni termin, je njegov notranji konstitutivni in asociativni razpon. Domena njegovega diskurzivnega obsega se je oblikovala skozi dekade aplikativnega in teoretskega dela in ne pripada dozdevnemu slovenskemu ekvivalentu. Če se odločimo zamenjati enega z drugim, to oropa oba njune lastne vrednosti. Kajti tudi lik ima svoj ireduktibilni obseg, ki ga v drugih jezikih ne srečamo in je kot tak nezamenljiv. Gestalt referira generični niz, je "podoba", dejavna skozi čas. Lahko se realizira kot izdelan lik in v tem primeru je lik njegova konkretna instanca.

1

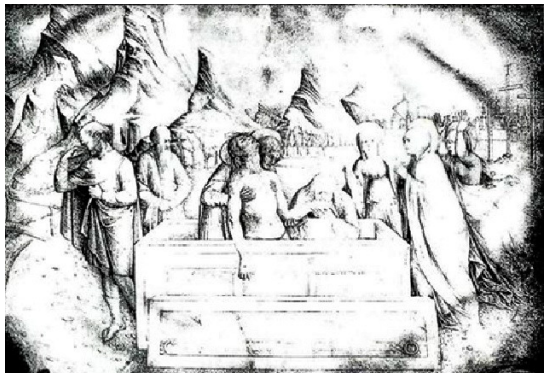
2

3



4

5



6

Literatura:

1/ Slovar slovenskega knjižnega jezika, 2.knjiga, Ljubljana SAZU 1975, s.605. V enaki meri je predmet čudenja tudi dejstvo, da *gestalta* ni najti v nobenem od petih slovenskih slovarjev tujk. Ali je od tod je možen sklep, da je bil izraz med avtorji vedno že do te mere udomačen, da jim ni več deloval kot tujka? Predpostaviti, da v njihov horizont nikoli ni niti vstopil, je toliko manj verjetno.
Slovenski pravopis, Ljubljana SAZU 2001 omenja gestalt samo kot področno zloženko v navezi z Gestaltpsihologijo, sicer naj bi pomenil *lik*: ss.590, 821
2/ Argument slovenskih filozofov, ki se zavzemajo za prevajanje gestalta v lik je Vebrovo enačenje obeh izrazov. Vendar je treba upoštevati, da je Veber začel s pisanjem tozadevnih tekstov v tridesetih letih, ko se je gestalt tudi v zahodnem miselnem horizontu šele vzpostavljal kot interdisciplinarni teoretski termin in je bilo njegovo pomensko zaledje v slovenskem prostoru še lahko spregledati. Poleg tega so bili njegovi spisi do nedavna relativno zaprt žep, ki se šele zadnji desetletji odpira širšemu vedenju, in kot taki v aktualni diskurzivni praksi niso imeli možnosti opredeljevati mentalno zaledje posameznih ključnih terminov.
3/Christian von Ehrenfels, Uber Gestaltqualitaeten, Viertelsjahrschrift fuer wissenschaftliche Philosophie 14/III 1890, s.249-49
4/ Jacques Mesnil, Masaccio, La Haye, M.Nijhoff 1927, s.44/5 - v op.1 poleg ovala izpostavi accolado kot ključno obliko vizualnega snovanja v času prehoda pozne gotike v renesanso.

Oblikovanje Fig.1: Ljudmila, Ljubljana

Priložene slike:

1- detajl stenske poslikave grobnice T100 Hierakonpolis Egipt c3200 BC
2- Stranica sarkofaga iz Hagie Sophie, Kreta c1400 BC
3- Primera poznogotskih oltarnih okvirjev, Porenje 14.st.
4- Giotto, Čudež z vrelcem, Sv Frančišek, Assisi 1306-11
5- isti, Beg v Egipt, CapScrovegni 1305, Padova
6- *Jacoppo Bellini, Polaganje v grob, list iz Kataloga risb*

IS SUBJECTIVISM THE MOST SCIENTIFICALLY SUPPORTED PHILOSOPHICAL THEORY ON COLOUR? NEUROPHYSIOLOGICAL EVIDENCE

Andraž Stožer[1,2], Janez Bregant[3]
[1] Faculty of Medicine, [2] Centre for Open Innovations and Research, and [3] Faculty of Arts
University of Maribor
Slomškov trg 15, 2000 Maribor, Slovenia
Tel: +386 31 659 254
e-mail: andraz.stozer@um.si

ABSTRACT

In this article, the three possible philosophical theories of colour, i.e., physicalism, dispositionalism, and subjectivism are presented and set against the results of latest neurophysiological research on colour perception with the aim to demonstrate that subjectivism is the theory best supported by empirical evidence.

1 INTRODUCTION

The cognizer faces a two-horned dilemma with regard to colour: the first considers colour as a real part of the world because of its phenomenology, whereas the second denies colour any reality on the basis of scientific investigation, at least in the ordinary sense of the word. Let us call it *the colour dilemma*.

2.1 Physicalism

If we think that colour is nothing but a property of objects appearing in appropriate circumstances, we defend the first, i.e. the *phenomenological horn* of the dilemma, which defines colour with the help of the primary/physical properties of objects, e.g. red is nothing but atoms and molecules composing the surface of a red object. Such a view is called *physicalism*, or (full) *realism*. It is divided into *reductionism*, or *objectivism*, arguing for the identity of colour and the reflectance profile, which makes colour an objective and genuine property of the world [1], and *anti-reductionism* or *primitivism*, arguing merely for the dependence of colour on the reflectance profile, which makes colour an objective but not genuine property of the world [2].

2.2 Subjectivism

If we believe that colour is not in objects but solely in our brain, we advocate the second, i.e. the *scientific horn* of the dilemma, which supposes that colour does not actually exist in the outside world (or in objects), as naïve perceivers mistakenly think, but is merely a production of their visual mechanisms and exists only in them. Such a position is called *eliminativism*, or *subjectivism*. It is separated into *projectivism,* claiming that colour is only a projection of our internal sensations to external objects [3], and *reductionism,* saying that colour is nothing 'over' and 'above' brain processes [4].

2.3 Dispositionalism

Finally, there is a middle path between Scylla and Charybdis, a view that on the one hand does not neglect a naïve cognizer and her phenomenology, but on the other hand retains as much science as possible, thus avoiding the weaknesses of the above theories. This is called *dispositionalism*, or *response-dependence,* and conveniently states that colour is slightly objective, i.e. it is in objects, and slightly subjective, i.e. it is also in our brain [5].

These theories represent a standard philosophical taxonomy of colour[1] and can be graphically illustrated as follows:[2]

[1] A similar taxonomy is proposed by Byrne and Hilbert [6], a slightly different version by Maund [7], and a more complex one by Cohen [8].

[2] Defenders of described theories could be found also in the history of philosophy, e.g., Reid (objectivism) [9], Aristotle (primitivism) [10], Locke (dispositionalism) [11] and de Condillac (projectivism) [12].

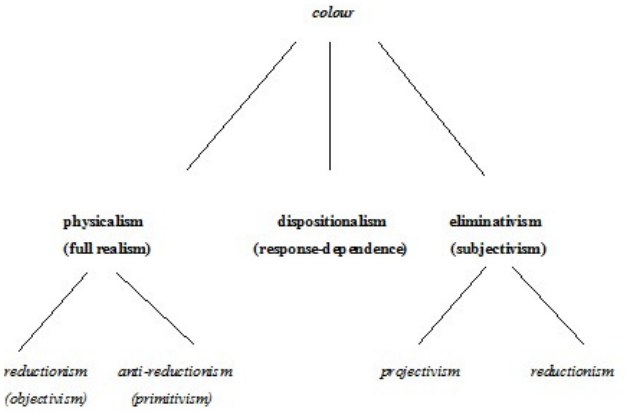


Figure 1: *Standard philosophical taxonomy of colour.*

Interestingly, dispositionalism is also taken to be a realistic theory about colour. However, we do not speak here about full realism as in the case of physicalism, but about a realism of a weaker sort.

3. NEUROPHYSIOLOGICAL RESEARCH ON COLOUR PERCEPTION

3.1 The experiment

In an elegant study, Murphy and coworkers employed blood oxygenation level dependent functional magnetic resonance imaging (BOLD fMRI), electrode recording and stimulation to study the matching between subjective colour perception and its neurophysiological correlates in a subject who had an electrode implanted in the anatomical location of the anterior colour centre (V4α) [13]. This colour centre is believed to be involved in many aspects of colour vision [14-16].

3.2 The results

When the investigators presented the subject with blue-purple colour in the middle of his visual field, his subjective perception was blue purple, and a response in the neurons surrounding the electrode was detected by the BOLD fMRI response (increased blood flow through this area) and by the local field potentials detected via the electrode. These findings demonstrated that neurons around the electrode were responsive predominantly to the blue-purple colour.

Upon injecting short pulses of electrical current via the electrode in the absence of external visual stimulation, a reproducible perception of the blue-purple colour near the centre of the visual field was evoked in the subject. This finding demonstrated that a direct electrical stimulation of neurons sensitive to blue-purple stimuli is sufficient to produce perception of blue-purple colour [13].

4 RESEARCH SPEAKS IN FAVOR OF SUBJECTIVISM

Physicalism identifies colour with the external stimulus, and dispositionalism holds that the external stimulus, standard circumstances, and the subjects are necessary for colour perception. Since the results of the described experiment suggest that a direct electrical stimulation is sufficient to produce a colour perception, subjectivism seems to be the philosophical theory best supported by current neurophysiological research.

5 CONCLUSION

Using the results of the latest neurophysiological research on colour perception, we demonstrated the fallibility of physicalism, as well as any kind of response-dependence theory of colour, making them unsuitable to explain its nature.

References

[1] Harman, G. (1996/1997). »Explaining Objective Colour in Terms of Subjective Reactions«. In Byrne, A., & Hilbert, D. R. (Eds.), *Readings on Colour, Volume 1: The Philosophy of Colour*. Cambridge: The MIT Press, pp. 247–261.

[2] Campbell, J. (1993/1997). »A Simple View of Colour«. In Byrne, A., & Hilbert, D. R. (Eds.), *Readings on Colour, Volume 1: The Philosophy of Colour*. Cambridge: The MIT Press, pp. 177–190.

[3] Boghossian, P. A. (2008). *Content and Justification*. Oxford: Oxford University Press.

[4] Hardin, C. L. (1997). »Reinverting the Spectrum«. In Byrne, A., & Hilbert, D. R. (Eds.), *Readings on Colour, Volume 1: The Philosophy of Colour*. Cambridge: The MIT Press, pp. 289–301.

[5] Johnston, M. (1992/1997). »How to Speak of the Colours«. In Byrne, A., & Hilbert, D. R. (Eds.), *Readings on Colour, Volume 1: The Philosophy of Colour*. Cambridge: The MIT Press, pp. 137–176.

[6] Byrne, A., & Hilbert, D. R. (Eds.) (1997). »Introduction«. *Readings on Colour, Volume 1: The Philosophy of Colour*. Cambridge: The MIT Press.

[7] Maund, B. (2014). »Colour«. *The Stanford Encyclopedia of Philosophy,* http://www.plato.stanford.edu.

[8] Cohen, J. (2009). *The Red and the Real*. Oxford: Oxford University Press.

[9] Reid, T. (1801/2014). *Inquiry into the Human Mind*. A version is available at www.earlymoderntexts.com.

[10] Aristotle (1987). *De Anima (On the Soul).* London: Penguin.

[11] Locke, J. (1689/2014). *An Essay Concerning Human Understanding*. A version is available at www.earlymoderntexts.com.

[12] De Condillac, E. B. (1746/2001). *Essay on the Origin of Human Knowledge*. Cambridge: Cambridge University Press.

[13] Murphey, D. K, Yoshor, D., Beauchamp, M. S. (2008). »Perception matches selectivity in the human anterior color center«, *Current Biology*, 18, pp. 216–220.
[14] Beauchamp, M. S., Haxby, J. V., Jennings, J. E., DeYoe, E. A. (1999). »An fMRI version of the Farnsworth-Munsell 100-Hue test reveals multiple color-selective areas in human ventral occipitotemporal cortex«, *Cerebral Cortex*, 9, pp. 257–263.
[15] Zeki, S., Bartels, A. (1999). »The clinical and functional measurement of cortical (in)activity in the visual brain, with special reference to the two subdivisions (V4 and V4 alpha) of the human colour centre«, *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 354, pp. 1371–1382.
[16] Morita, T., Kochiyama, T., Okada, T., Yonekura ,Y., Matsumura, M., et al. (2004. »The neural substrates of conscious color perception demonstrated using fMRI«, *NeuroImage*, 21, pp. 1665–1673.

THE TURING TEST ON COGNITIVE ENHANCEMENT

Tomaž Strgar, Ljubljana, IX/2014.
email: strgart@hotmail.com

ABSTRACT

Facing the information overload age in its forced march, an investigator of broader issues finds himself in an impossible position: how to cope with an abundance of information on the subject, which on the top of it grows faster than one can possibly follow? Cognitive enhancement, one of the key topics in neuroethics, would be needed. But, how far should we pursue this?

Instead of endorsing or refuting a currently propulsive line of the argument, or making up a new one, this contribution is focusing on finding a way to bridge the gap between discipline-specific research approaches, terminologies and viewpoints on neuro-technologies by uniting them upon their common ethical problems. Instead of asking *'how should we'* address these important questions and trying to promote or discard the seemingly most promising solutions, we will engage ourselves in systemizing all possible answers to the question *'how can one'* deal with them.

This would normally result in chains of lists of facts, findings and problems from contributing scientific fields and their inter-disciplinary combinations etc., which should then be put all together into an appealing narrative form to present a consistent picture upon which one should then decide. The problem of such an approach is that a constant flow of new knowledge and yet untried combinations is to be expected, so to capture them all in advance seems to be impossible. However, empirical evidence that trying to grasp over the whole of a particular complex subject matter within a single short list may finally turn out to be successful is striking. Regarding the question 'Can machines think ?', Turing did it. We are following his steps.

A. INTRODUCTION (The Imitation Game)

I propose to consider the question of 'taking a normal healthy person with normal cognitive abilities and making them even better'.[1] This should begin with the definition of the meaning of the terms 'normal' and 'better'. The definitions might be framed so as to reflect so far as possible the general public opinion on a particular issue, but this attitude is dangerous. In the name of the 'normal', Turing had to consent to chemically castrate himself not so long ago in the middle of the civilised world only to make himself 'better' in the eyes of the society. Advancements in neuro-technology may soon provide us with the means to achieve similar and other effects through direct brain interference. Long treatments and possible nasty psychophysical side effects of the drugs would thus be left to the history. Turing could have then been instantly 'cured'. Besides gaining public approval, he could perhaps score better even on some 'personal fulfillment' tests. But this is absurd.

In his Mind paper from 1950, the *Computing Machinery and Intelligence*, most famous for *The Imitation Game*, Turing proposed to try to program machines in a way that they could fool some humans to believe that they are human too. It seems that we are now trying to 'enhance' ourselves to the extent where we would perform like machines.

In our modified version of the game, the contestants – a cognitively well enhanced human and an appropriately programmed machine – should both pretend to be machines, while the interrogator should point out the true pretender. When the appropriate percent of the interrogators should fail to make the correct identification after some time, the contestants would qualify as thinking machines. As opposed to the 1950's context of Turing's proposition, we are now mostly apt to believe that a positive outcome of such an experiment is possible at least in principle. But in both cases the 'test' only serves as a background for the discussion and is of no theoretical importance.

Along with the alleged test, Turing described and dealt with 'all the major arguments against artificial intelligence raised since'[2] in nine consecutive steps. As the article at hand was one of the most heavily discussed contributions in the general history of digital computing, one could hardly expect to find something new there, and even less to add something initially left out. However, the structure of these arguments and objections remained mostly unnoticed. And it is precisely this structure that in our opinion enabled not only the factual covering of all already raised contrary views on the possibility of machines thinking, but guarantees to embrace every possible view on the subject. We are utilizing it to cover the debate on cognitive enhancement.

[1] The proposition is from the opening of an excellent coverage of our subject matter, "*Cognitive Enhancement" with Martha J. Farah, PhD*, available online. Although her lecture mostly deals with the use of cognitive enhancement drugs, her treatment equally well addresses the possibilities and problems of machine interference with brains, or minds, which serve as the background for this discussion.

[2] Wikipedia, *Turing test*, IX/2014.
Wikipedia as a reference in scientific texts may present a certain problem. We use it as a representative source of the educated public opinion. Anyhow, to prove Wikipedia wrong in regards to our case, a contrary example should be provided by the opponent.

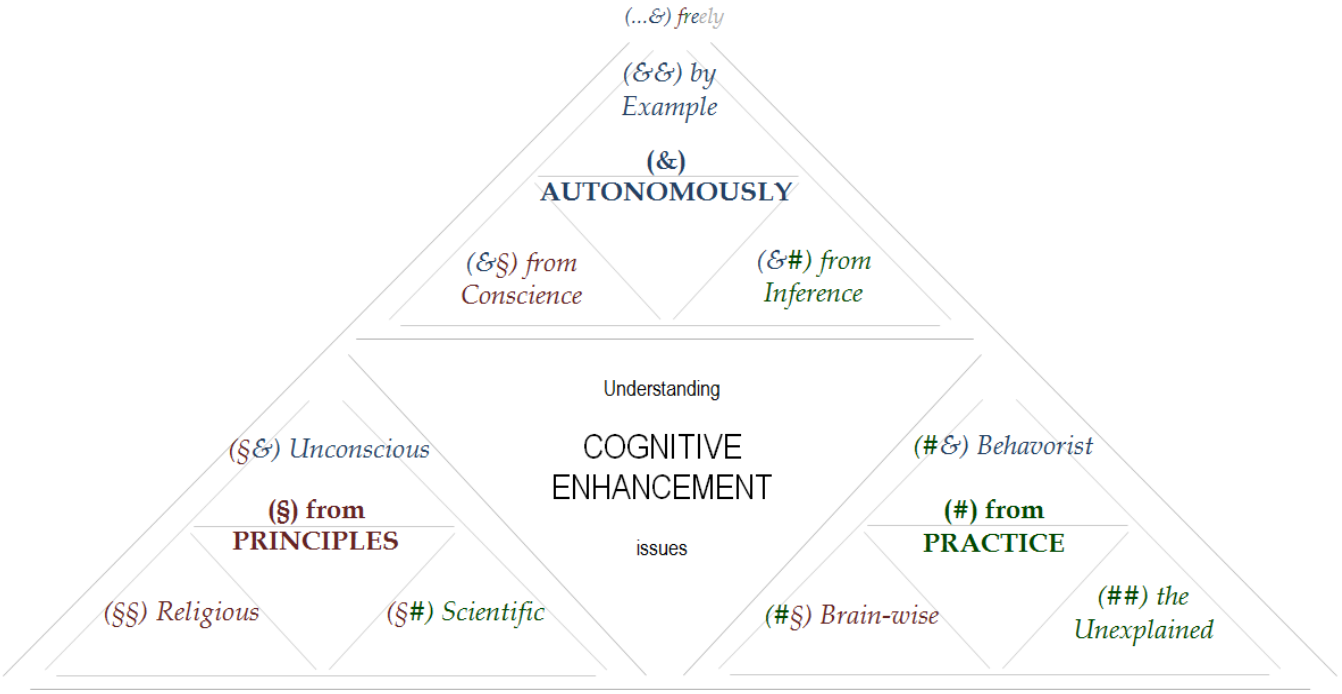


Figure 1. Turing's triadic semantical mapping applied on cognitive enhancement issues

B. THE STRUCTURE

Turing structured possible views on the question that he proposed into three distinctive groups of three distinctive grounds, from which all possible objections and arguments against his own views stem. Furthermore, each of these groups is internally structured according to a logical distribution, corresponding to the initial division of the whole, but within a respective subordinated semantical space. The principle can be mathematically described as a semantically grounded Sierpinsky triangle.

By modifying Turing's letter, but keeping its spirit, we are mapping[3] the grounds of understanding cognitive enhancement issues correspondingly. Its outline is presented in *Figure 1.* above. The proposed structure should comprise all possible grounds from which specific attitudes towards our subject matter stem. An online interactive version of the attempt is to be available at *http://www.recon.si/turingethics/* and should be considered as an enhancement to this paper.

Principles (§), Autonomy (&) and Practice (#) are the keywords, that should cover every possible grounds for the ethics of cognitive enhancement. This may not sound very persuasive, but if we read these top-down from their plane layout, the ideal formula pops out: decisions should be made Autonomously from Principles and Practice. (&(§#))

There is a well known issue in such general statements: they may sound nice, but some of their parts tend to be corrupted. In Kant's categorical imperative, for example, one is expected to figure out what would be best for everyone all by himself. In complex situations this turns out to be impossible for a rational agent to perform. When needed, one must jump to conclusions. This holds equally true for machines, humans, and enhanced humans.

In our case, we may question all three elements. In fact, they all turn out to be possibly corrupted: autonomy might only be a delusion, some principles could be simply wrong, practice has perhaps gone bad. Instead of messing with the principles too soon, trying to determine which are best and which should be abandoned, we are taking another look on our plane argument layout first.

Bottoms up reading of *Figure 1.* is a bit more complex. This way, *Principles* and *Practice* come first. Principles can be of *religious* or *scientific* provenience, but they usually turn out to be a somewhat obscure blend of both. There is also no doubt about many *unconscious* factors interfering with our *conscience* and conscious decisions.

A similar line of thought can be drawn *from Practice*. The reader is encouraged to try it. *Conscience* and *inference* then provide the bridges to *Autonomy* from the *unconscious* on the *principle*, and from *behavior* on the *practice* side. The symmetry over the vertical centre line, reflecting *religious* in the *unexplained* etc. should also be mentioned, but we must now proceed with the sequential layout of the argument.

[3] Contextual fun-fact: the Chinese spell Turing upon characters denoting the concepts of 'map' and 'spirit'. Apparently, Turing is providing us with a connection.

(§) from Principles

Cognitive enhancement techniques may provide us with spectacular possibilities for manipulating with our brains, minds and bodies in the near future. Things like a criminal offender pledging not guilty on the grounds of 'enhancement malfunction' could happen soon. Who shall then be blamed?

The principles that presumably underly every legislation can in principle be categorized as religious or scientific. In practice, they are mostly something in between. Some of them may even be unwritten and are, when needed, referred to as the civilizational norms of a certain society. These may change within decades, but some of them seem to persist fromever throughout the most diverse cultures.

Contemporary world religions are mostly grounded in moral issues and revealed truths. Science, at least in its purest form, should in principle refrain from being subordinated to any moral principles: if something has been proved true, no authority whatsoever should be allowed to declare it false. But we now know: like no religion has yet succeeded to prove the existence of its God, or something, no science will ever be able to prove all of its truths.

(§§) Religious *(1. The Theological Objection)*

Making the blind see and the deaf hear used to be a miracle, proving divine interference with earthly laws. Only saints and above could do this. There is a certain allurance in recognizing a certain impossible operation to be performed by man alone, preferably a non-enhanced one, but the technological support seems much more promising at this time. At least for the wealthy enough.

An implant for faith, helping one to perceive the truth, preferably a specific religious one, could be an other point of interest. Or a drug or device to at least help one to sin less. Even heavens are getting competition. The idea of uploading our minds to a sufficiently complex machinery is usually accompanied by a promise for one to be able to return to an enhanced body after some time. This covers the concept of reincarnation. But since we all experience more or less regular inconveniences with bodies, why bother with incarnation at all? With an additional enhancement, the technology could provide the uploaded ones with only pleasurable thoughts and feelings for eternity. Or at least until the supporting machinery functions properly.

Among such a variety of more or less bizzare options, a (wo)man of science is sometimes inclined to ignore religious arguments completely. I nevertheless believe that at least some of them must be carefully listened to as well.

(§&) Unconscious

'The consequences of making human machines would be too dreadful. Let us hope and believe that we cannot do so.'

A critical mind should, however, recognize, that we are well headed this way already. The image of human in the eyes of science, combined with productivity issues in global economy can provide the background. However, it is utterly hard to grasp the whole meaning of these developments, so we presumably all have some unconscious inclinations, upon which our conscious preferences for this or that ethical stance towards a certain neuroethical issue stem.

These inclinations, of course, cannot be known to the inclined, since they would thus cease to be unconscious. But in knowing that we all have unconscious thoughts to support our conscious views, our precious beliefs can become at least a bit more open to debate and change.

Once conscious, they can roughly be recognized as rooted mostly in religious grounds or in scientific findings, but the majority in between is explored further within the paragraph *(&) Autonomously* below.

(§#) Scientific

3. The Mathematical Objection - as Turing entitled the corresponding chapter of his treatment - seems to function as a refuge trench for hard scientists, that would prefer not to grant the human ability to think to machines. Their reluctance could perhaps be traced back to the appearing fact of science being the product of thought. If machines could think all by themselves, only the cognitively best enhanced humans could possibly hope to be able to compete with them in these purely intellectual fields.

That no field of science will ever be able to prove all of its truths must now be regarded as a fact. Mathematics – representing also the ultimate grounds of every strictly scientific approach to cognitive enhancement issues – is burdened with the same problem as theology: it can not prove mind-independent existence of its object, exactly as theology can not prove the existence of god.

Like law is built upon civilizational norms, science operates upon generally accepted presumptions and mathematics. Mathematics is built upon mathematical truths. Some of them, basically the self-referential ones, can not be proven. Gödel proved this. Turing constructively concurred. But by asking 'Can machines think ?' and proposing *The Imitation Game* as a background for the discussion, Turing was tacitly addressing a much deeper issue of our existence: *"Is it a mere machine what I is? A heap of cells that only history is playing with?"* With progress of neuroscience, the question is becoming more and more acute.

(&) Autonomously

Autonomous is literally "the one who gives oneself one's own law", but is usually considered to be a rational individual with the capacity "to make an informed, un-coerced decision".[4] In other words, provided with adequate information on the subject matter, the autonomous decision should be conscious, free, and rational.

Some of the above concepts have been heavily discussed throughout the history of Cognitive Science and are still far from clear. Since there are serious indications that we could soon be called to take autonomous positions upon various cognitive enhancement issues, science should organize its findings in a way, which would enable one to infer from observed facts and choose in accord with conscience.

[4] Wikipedia, *Autonomy*, IX/2014.

(&§) from Conscience

Conscience, in a way, represents the gateway from the unconscious to the conscious mind. "Commonly used metaphors for conscience include the 'voice within' and the 'inner light'."[5] The concept can be traced back to Socrates' *daimon* and beyond. Although its scientific background is very scarce, most of us treat it as should-be-normative at least in principle. Even one's free will should conform.

(&&) by Example

Besides conscience, many other human properties, or their possibly enhanceable features come to mind. I offer Turing's selection from his (*5) Arguments from Various Disabilities*. Slightly modified to better fit within our context:

'Be more kind, resourceful, beautiful, friendly, have more initiative, have a better sense of humor, be able to tell right from wrong correctly, make less mistakes, fall in love more passionately, enjoy strawberries with cream, make some one fall in love with one's enhancement, better learn from experience, use words properly' etc.

The list can potentially extend to infinity, but there is an obvious limitation to all options: one's free will should be left intact. Or else severe juridical problems, pointed out in the (§) section above could arise.

(&...&) free

There are many views on when, if ever, one's will can be considered as free, but there are just three distinct linguistic forms of the notion in the European branch of Indo-European languages: Romance, Germanic and Slavic.

(1) 'liberty' became global through Late Latin 'libertas', i.e. 'freedom, independence'; Ancient Greek 'eleutheros', 'the free, unbound', often used as for 'the free Greek people (as against slaves and barbarians)', together with many modern Germanic and Slavic words for 'people, humans (in general)' and the related are related. (2) 'freedom' stems from an other ancient notion for the 'dear, beloved', or similar; e.g. 'friend' is from the same root, echoing throughout the Germanic and Slavic word-stock. (3) Slavic vernaculars use a distinct, etymologically twofold word for 'freedom/liberty'; its word to word translation to English is 'to-pertain-to-oneself' or 'to-be-one's-own-master' or similar.

None of these should of course be normative, but they do represent a common, limited and stable background, upon which particular understandings of what does it mean to be free can meet and discuss their exclusive positions.

(&#) from Inference

Inference should always be drawn upon facts. In the process, no observed and relevant facts should be ignored. There may be some complex issues arising about what is relevant, but we can cut these short by claiming that they become relevant as soon as they can enter the proposed structure of the argument in one or many of its points.

[5] Wikipedia, *Conscience*, IX/2014.

(#) from Practice

In order to be treated as facts of science, observations from practice should be properly obtained and organized. Only as such, they could serve us as the basis for inference, helping one to cope with the arising neuro-ethical challenges.

(#§) Brain-wise

The principle object of contemporary neuro-technologies is certainly the brains. That "Brains cause Minds", as once put by prof. J.R. Searle, is usually taken for granted.

Among the famous, Hume was the first to point out that what we call cause and what effect reflects only our habits. In the eyes of pure reason, immaterialist metaphysics turns out equally sustainable as the materialist one. At the same time, disguised as action and reaction, the pair constitutes one of the basic laws of physics that we know.

Although it is now known that the structure of the brains can change upon their usage, the other way around still seems to be somehow more convenient for many.

(#&) Behaviorist

"Every cognitive enhancement that would enable one to behave better should be allowed and encouraged."

'Behave better' should be replaced by e.g. 'to be more productive at work, more loving at home, more lovable in the society', and similar. The danger of such an attitude is striking. 'The Turing Case' comes to mind. However, as far as the contemporary science of mind is concerned, having in mind the underlying dogmatism of the 'hard' sciences, the behaviorist approach may be the most scientific after all.

(##) the Unexplained

There are always some observations, that do not fit within the corresponding scientific theories. The 'too bad for the observations' stance is often taken by the established scientific community. But when circumstances ripen, a 'new religion', or a paradigmatic shift in science may occur.

C. CONCLUSION (Learning Machines)

Technology should certainly help us to deal with our problems, but can we somehow *learn* what is actually what we really want? In order to conform with the standard four-page layout for this conference paper, we can only conclude as we began. Paraphrasing Turing:

We can only see a short distance ahead, but we can see plenty there that needs to be understood.

References

[1] Farah, M.J., *Cognitive Enhancement*. Online lecture. http://neuroethics.upenn.edu/portfolio-items/cognitive-enhancement-martha-farah-phd/

[2] Turing, A.M., "Computing Machinery and Intelligence", *Mind, A Quarterly Review of Psychology and Philosophy*, Vol. LIX. No. 236. Oxford, 1950.

DOES CONSCIOUSNESS CAUSE BEHAVIOR? IMPLICATIONS FOR MORAL RESPONSIBILITY

Toma Strle
University of Ljubljana
Faculty of Education
Kardeljeva ploščad 16, 1000 Ljubljana, Slovenija
Tel: +386 1 5892 327
e-mail: toma.strle@pef.uni-lj.si

ABSTRACT

Various researchers have tried to show that conscious thoughts (or more generally, conscious states and processes) have no causal influence on our behavior ("no-conscious-influence" thesis), threatening our conception of ourselves as free willed, morally responsible beings. In this paper I will argue such claims are unwarranted. I will claim that understanding the human mind in a purely mechanistic and reductionist manner is impossible — conscious introspection (and first person knowledge) are necessary to grasp fully the meaning of data gained solely by third-person methods. If understanding human mind is impossible without conscious introspection and first person knowledge and if this understanding has causal influence on behavior, we have found an indirect influence of conscious states and processes on our behavior, falsifying the "no-conscious-influence" thesis.

1 The reign of the unconscious

The question of whether we, as conscious beings, have any conscious influence on our decisions, actions and behavior in general is indeed an intricate one and as yet unanswered. Intuitively (one could say experientially) it seems that we are in control of our decisions and actions and thus *a priori* responsible for our endeavors. But in the last two decades or so, a part of mainstream cognitive science (from social and cognitive psychology, to its "neuro" counterparts) has tried to show that the solution to the "riddle of consciousness" — and the answer to the question of what role does consciousness play in our lives — is actually pretty obvious. According to these views conscious states and processes — conscious thoughts, intentions, etc. — play a very minor (and mostly negligible) role at best or none at all. Conscious states and processes have been deemed an epiphenomenon with no causal influence on our decisions and behavior. In their paper *Do Conscious Thoughts Cause Behavior?* Baumeister et al. (2011) nicely illustrate such claims of various researchers from the area of psychology: "Dijksterhuis et al. (2007) asserted that the question of "what behavior requires a conscious decision and what behavior does not" has been resoundingly answered: "Behavior does not originate with a conscious decision" (p. 52). In their model of behavior, they assign "no role for consciousness" (p. 52). A similarly negative assessment led Bargh (1997a) to speculate, "there ultimately is no future for conscious processing in accounts of the mind, in the sense of free will and choice" (p. 52). Wilson (2002) summarized a widespread view by saying, "The causal role of conscious thought has been vastly overstated" (p. 107), and although he stopped short of saying it is zero, he clearly thought it was slight. As to how slight, only Bargh (1997b) has been bold enough to furnish a precise estimate: "Our psychological reactions from moment to moment. . . are 99.44% automatic" (p. 243)." (Baumeister et al., 2011, 332) Some authors even claim that "strictly speaking, conscious thought does not exist" (Dijksterhuis, et al. 2005, 81; quoted in Baumeister et al., 2011, 332). The riddle of consciousness — or so it seems — has been resolved, consciousness "explained away" and the reign passed on to unconscious (brain) mechanisms. The only thing we need to do to be able to put together last pieces of the "explanatory puzzle" of mind is studying unconscious mechanisms in enough detail; mechanisms which according to Wegner (2002) produce both conscious thoughts and behavior, rendering consciousness causally inefficacious[1].

2 The "no-conscious-influence" thesis and neuroethics

If this position turned out to be correct — and we in fact had no (or negligible) conscious influence on our decisions and actions (the "no-conscious-influence" (NCI) thesis) — our view of ourselves as free willed, morally responsible beings would be threatened. It is possible to argue that even if we

[1] Libet (1985) for example similarly claims that our decisions are not initiated by conscious intentions, but originate in unconscious brain mechanisms. Some other examples of such claims can be found in e.g. Soon et al. (2007), Haynes (2011), Wegner (2002), Evans (2010), etc. Of course this "list" is by no means exhaustive — more examples and rigorous critique of such claims are nicely exposed by for example Mele (2009).

lacked any conscious influence on our decisions and behavior (and as a consequence lacked free will) we could still be held morally accountable (and responsible) for our decisions and actions. Even though this is an important position to consider, I will here presuppose that free will is a necessary condition for moral responsibility. I understand free will in the sense that our conscious thoughts, intentions, self-reflections, conscious knowledge of our own minds, etc. are at least sometimes, at least partially, directly or indirectly, causally necessary (but not sufficient) for our decisions, actions and behavior in general[2]. But if our conscious states and processes have no causal influence on our decisions and behavior, we cannot be said to be free willed, morally responsible creatures — at least not in the context of todays democratic societies in which basic social structures (such as constitutions and legal systems) are at least to a certain degree based upon our belief in conscious states and processes (such as intentions) causally influencing sdecisions and behavior.

In the context of neuroethics, questions and implications of the NCI position fall on the intersection of both subfields of neuroethics as divided by Roskies (2002): on the intersection of "ethics of neuroscience" and "neuroscience of ethics". Firstly, in the context of "ethical implications of neuroscience"[3] we are concerned with the question of what consequences "results of those [neuroscientific] studies might have, or ought to have, on existing social, ethical, and legal structures." (Roskies, 2002, 21) and with "implications of our mechanistic understanding of brain function" (Roskies, 2002, 21). Secondly, the question of conscious causality forms an important part of "neuroscience of ethics" where the main concern is what neuroscience (and more broadly cognitive science) can actually tell us about ethical issues and with it traditionally connected concepts such as free will, selfhood and self-control. Can neuroscience and cognitive science really drastically change how we view ourselves, possibly explain all there is to explain about the mind in a mechanistic manner, undermining our strong intuitive belief in ourselves as free willed, morally responsible beings that exercise at least a limited amount of self-control and are able to change themselves? As Roskies (2002) eloquently puts it: "Traditional ethical theory has centered on philosophical notions such as free-will, self-control, personal identity, and intention. These notions can be investigated from the perspective of brain function. … Advances in neuroscientific research in relevant areas may change the very fabric of our philosophical outlook on life. As our predictive grasp of complex behavior improves, how will the bolstered sense of the brain as a deterministic machine affect or undermine our notions of free will or of moral responsibility? Is self-determination, a driving concept in today's bioethics, merely an unscientific fiction?" (Roskies, 2002, 22). On one hand, the answer to the question of what ethical implications neuroscientific studies might have crucially depends on how we answer the question of what neuroscience (and cognitive science) can actually tell us about concepts important for ethical theory (such as free will, conscious volition, self-control, etc.). But the answer to the question of what neuroscientific studies actually tell us about such concepts crucially depends on our position and intuitions regarding the causality of our conscious states and processes.

In order to be sure we draw correct "implications", we firstly need to critically evaluate the NCI thesis — since accepting the thesis without firstly reflecting on our presuppositions and conceptual apparatus we use in interpreting scientific studies[4] could have dire consequences both on how we view ourselves as persons and how we form and develop our society and its structures. I believe that if it in fact turned out we had no conscious influence on our decisions and behavior[5] the concepts of legal (and personal) responsibility would become "obsolete" (at least in the form we know it): we could not treat individuals with brain disorders or mental disabilities (such as delusional disorder or brain tumors) any less morally responsible than healthy individuals, psychological treatments crucially dependent on reporting about one's own mental states and conscious effort should be replaced by pharmacological treatments as a means to self-change, brain/mind enhancement should replace any techniques based on self-effort (such as various meditation techniques), social structures (such as constitutions) presupposing free willed individuals would have to be modified in a way that would not entail free choice for example, to name just a few.

[2] There are of course many different definitions of free will and various positions on what are necessary and sufficient conditions for free will (see for example Kane (2005), Baumeister et al. (2010))

[3] Second subdivision of "ethics of neuroscience" (Roskies, 2002)

[4] I'm intentionally not speaking about scientific findings, since a finding in science already presupposes a certain degree of interpretation of data gathered; but interpretations already carry with them intuitions and theoretical presuppositions about the phenomenon we observed. I'm not claiming this is a problem in itself — since we cannot really get rid of that in any "discourse" we develop from our observations — but that we have to be aware of our intuitions and theoretical presuppositions we bring into our explanations of phenomena we are trying to explain (and understand).

[5] Claiming that conscious thoughts have causal influence on other conscious thoughts, intentions, etc. would not resolve the matter since one could still claim that these other conscious thoughts have no casual influence on behavior and so *ad infinitum*, rendering consciousness once again causally inefficacious on behavior.

Here I will not focus on various consequences the NCI thesis might have for ethical theory but will try to show that such above mentioned "worries" are unwarranted, since the NCI thesis is based on some false assumptions. Following Baumeister et al.'s (2011) critique of the NCI position I will argue that researchers advocating the NCI thesis should make sure there are no such cases where conscious states and processes are causally necessary (even if only partly and indirectly) for our behavior. Only if such cases cannot be found we could rightfully claim that conscious states and processes are merely epiphenomena. Furthermore, I will claim that the NCI thesis comes about partly because mentioned researchers mainly study direct (but not indirect) influence of conscious thoughts on behavior (Baumeister et al. 2011). I will than try to show that today's mechanistic and neuroreductivistic part of cognitive science has neglected the *necessity of conscious introspection and first person knowledge in explaining and understanding human mind.* But understanding human mind — for which conscious introspection is a necessary condition — represents just such an example of indirect causal influence of conscious processes and knowledge on our behavior (I will also have to defend the view that understanding human mind has causal influence on our behavior).

3 Fallacious arguments for the NCI thesis and indirect causation of conscious processes

In the past the influence of consciousness on our decisions, actions and behavior has been overstated; our conscious thoughts do not exercises perfect control over our behavior and they are not sole causes of it. But this does not by any means imply that they play no or a negligible role in the intricate web of causality — rather, they represent an essential part of it. Baumeister et al. (2011) nicely point to two "mistakes" when making conclusions about the influence of conscious thoughts on behavior[6]. They argue: "any evidence that conscious thoughts are themselves the results of other causes (presumably including unconscious processes and brain events) is irrelevant. We are skeptical of uncaused causes. Hence arguments of the sort exemplified by the above quotation from Roediger et al. (2008)—that if a brain event precedes the conscious thought, then the conscious thought is not a cause of the subsequent behavior—are fallacious. The question is whether the conscious thought is a vital link in the causal chain as opposed to being merely a signal or side effect of the true causes. It is quite plausible, for example, that impulses to act generally originate in the unconscious, but the behavioral outcome depends crucially on what happens when they are contemplated consciously. … the steam whistle hypothesis[7] [footnote added by author] is the true null hypothesis in the present review because it treats conscious thoughts as wholly effects and not causes." (Baumeister et al., 2011, 334) The question thus is whether there exist cases of behavior for which conscious thought is causally necessary. Furthermore, they argue that: "More broadly, the argument that "if unconscious thoughts cause X, then conscious thoughts do not" is fallacious. The proper question is whether the conscious processes can play any causal role. A related point concerns indirect causation (control) of behavior. Many criticisms have focused on whether conscious thoughts, choices, and intentions directly cause behavior." (Baumeister et al. 2011, 333)

I believe that the issue of indirect causal influence of conscious states and processes (such as thoughts and intentions) on behavior is an essential point for our discussion about free will and hence moral responsibility, since looking only at direct influences leaves out a great deal of complex interactions between unconscious and conscious processes, behavior and environment. In the context of decision making for example, a large part of studies (from heuristics and biases program (e.g. Kahneman, 2003) to decision satisfaction studies (e.g. Dijksterhuis et al. 2006) have mostly focused on one-shot, simple decisions[8], which led researchers to believe that conscious thoughts have no (or very little) influence on our behavior — but the notion of indirect conscious influence on our decisions has been left out of the picture. I completely agree with Baumeister et al.'s claim that: "conscious causation is often indirect and delayed, and it depends on interplay with unconscious processes. Consciousness seems especially useful for enabling behavior to be shaped by nonpresent factors and by social and cultural information, as well as for dealing with multiple competing options or impulses. It is plausible that almost every human behavior comes from a mixture of conscious and unconscious processing." (2011, 331) Understanding human mind — and legal and societal structures which we implement on the basis of such knowledge — is just such a "nonpresent factor" (and social and cultural information) which causally influences our behavior.

In their review article Baumeister et al. (2011) cite many experimental studies that seems to show that conscious thoughts are a necessary condition for behavior (directly or indirectly influencing it): from mental simulation and practice, anticipating and planning, replaying, interpreting and reflecting on past events, logical reasoning in decision

[6] By behavior they mean for example muscle movements, speech acts, choices, etc.

[7] The "steam whistle hypothesis", put forward firstly by Huxley (1874, from William 2012) states that conscious states and processes are mere epiphenomena, "It says conscious thought resembles the steam whistle on a train locomotive: It derives from and reveals something about activity inside the engine, but it has no causal impact on moving the train." (Baumeister et al. 2011, 332)

[8] And mostly existentially inconsequential decisions, one might add.

making, to communicating one's own thoughts to others (for which a form of conscious, explicit metacognition is needed (Shea et al., 2014)). Here I will not focus on these otherwise important and interesting cases but rather present another such example (understanding mind) where the influence od conscious processes seems even more indirect.

To be able to show that I will firstly have to show that conscious, introspective first-person knowledge of our own mind is a necessary condition for explaining and understanding human mind.

4 The impossibility of explaining and understanding mind without conscious, introspective first-person knowledge.

In this subchapter I will defend the thesis of explanatory irreducibility[9] of conscious mind to unconscious processes. In the next, I will argue that understanding human mind has at least indirect causal influence on our behavior by means of changing environment (e.g. social structures) we live in, which in turn influences how we decide, act and behave. Let me firstly briefly explain the notion of epistemic reduction of which explanatory reduction is a subtype (Brigand & Love, 2012). In the context of researching the experiential part of the mind epistemic reduction thesis would state that we can reduce knowledge about experience gained in the domain of phenomenology (or any other science researching first-person aspect of the mind) to knowledge gained at some lower level, for example to knowledge of the domain of neuroscience, neurobiology, etc. The problem with such a reduction is that even if we had all the knowledge about the mind neuroscience can provide us with, our explanation of the experiential part of the mind would still be missing — our explanations would be devoid of first-person experiential descriptions and explanations, which form an essential part of what we call mind. "An especially tenacious problem here is the question of explanatory reduction (a sub-class of epistemic reduction). The thesis of explanatory reduction states that properties of some higher level can be explained by properties of some lower level. Even though we claimed we had explained all properties of the experiential by properties of the brain, our explanation would still not include the first-person perspective. Leaving out the experiential, first-person perspective would render our explanation of experience incomplete, since an explanation makes sense only if it entails understanding of the phenomenon to be explained. Leaving out the first-person perspective, at least a part of the phenomenon (i.e. experience) would remain unexplained and the reduction would fail. Lets imagine we were able to give a mathematical explanation of experience and that we understood (also on the experiential level?) such an explanation, at least after we got used to the language of mathematics for describing experience. But such an explanation would always, at least implicitly, refer to our own first-person experience which is already knowledge and understanding at a "higher" level." (Strle, 2013, 380) But one might, in the context of understanding causality of conscious processes and states on our behavior, argue that understanding experience gives us nothing over and above understanding unconscious brain mechanisms since consciousness is causally inefficacious — we would be back at the beginning, quarreling about our intuitive presupposition. But we are still faced with the question of whether we can really explain and understand unconscious brain mechanisms without invoking conscious introspective observations and knowledge. Neurophysiological explanations of mental phenomena (and concepts) such as feelings, conscious deliberation, understanding, morality, value etc., "necessarily include (even though many times implicitly, intuitively) our folk psychological knowledge (and understanding) of the experiential, which does not only come from studying neurophysiological substrates of the mind, but also from our own [conscious] introspections." (Strle, 2013, 380) We could not interpret, understand and thus explain data gained solely by third-person techniques — be it brain scans or behavioral measures — if in our interpretations and explanations we did not include our own conscious introspective observations. Concepts such as fear, anger, happiness, mood, depression, value, reward, etc. which neuroscience is eagerly studying, become meaningless concepts if completely devoid of experiential, conscious introspective content — without it we simply could not make sense of them. A paper in the current issue (at the time of writing this paper) of the journal *Nature Neuroscience* titled *Anterior cingulate engagement in a foraging context reflects choice difficulty, not foraging value* (Shenhav et al., 2014) is a good representation of terms that at least to some degree include introspective, first-person, conscious content. What do terms "choice", "difficulty" and "value" found in the title actually mean and refer to if we strip them of our conscious (explicit or implicit) experiential knowledge? Researchers trying to reduce (not only study that aspect) the human mind to its "neuro" (or some other) substrate fall short of the very thing they set themselves to achieve — namely, explain (and understand) the human mind.

5 Indirect influence of understanding mind on our behavior

If conscious introspection is indeed necessary for understanding not only the experiential part of the mind but also for understanding unconscious brain mechanisms, and if (as I will briefly sketch in this chapter) understanding the mind has at least indirect causal influence on our own behavior by means of changing environment[10] (e.g. social

[9] See also Varela, Thompson & Rosch (1991) for an interesting discussion on the topic.

[10] It would be interesting to see what consequences the thesis of extended cognition would have for issues regarding causation of conscious processes in this context.

structures), we have found an indirect influence of our consciousness on our behavior and thus falsifying the null "steam whistle" hypothesis.

Legal structures (and other belief systems in general) are a good example where knowledge of the human mind (e.g. its proneness to cheating and more serious crimes) leads us to implement certain legal structures that "shield" us and others from doing harm, prevent many people from evading paying taxes, etc. Furthermore, knowledge about the human mind and brain leads us for example to treat persons with certain mental disabilities and brain lesions compared to "healthy" individuals differently in the court of law, enables us to suggest various forms of help (be it psychotherapeutical or pharmacological) to persons with mental problems, etc. Moreover, our knowledge about our sometimes "irrational" choices and actions enables us to implement harmless decision aids[11] (or nudges, e.g. Thaler & Sunstein, 2008) which help us with our decisions: obligatory minimum pension taxes, cars reminding us to fasten our sit belts, obligatory car seats for infants and babies, default pro options about donating organs, etc. I believe that understanding human mind in general also helps us with understanding our own minds better. Understanding how and in which situations human beings make "mistakes of reason" (e.g. Piatelli-Palmerini, 1994), for example, helps us at least to a certain degree avoid our own mistakes of reason (e.g. teaching doctors in the context of diagnosing diseases about biases we fall prey to when judging probabilities, knowing when not to judge or decide "too" intuitively or deliberately). Moreover, understanding individual differences of minds of different persons can help us appreciate interpersonal relationships in a new light. These are just some examples I believe show how understanding human mind indirectly causally influences our behavior.

6 In conclusion

Understanding human mind — be it through rigorous scientific investigation or simple introspection and sharing of ideas — causally influences our personal and moral behavior. The "conscious part" of our minds which partly codetermines our personal and moral behavior forms the basis of what we call being human. It is crucial for understanding our own minds and minds of others and thus forms an essential part of moral responsibility; moral responsibility based upon notions of free will, (partial) self-determination, our ability of self-reflection and self-change scaffolded by social structures we build on the basis of our knowledge of human mind(s).

[11] It is of course a matter of debate whether we agree or disagree with such liberal paternalism mentioned here. But I believe that if not violating basic human rights and if freedom to choose not to follow such aids is preserved at least to a certain degree, I see no reason why not to implement some in some form.

References

1. Baumeister, R.F., Mele, A.R., & Vohs, K.D, eds. (2010). *Free Will and Consciousness: How Might They Work?* Oxford, Oxford university press.
2. Baumeister, R. F., Masicampo, E. J., & Vohs, K. D. (2011). Do conscious thoughts cause behavior? *Annual Review of Psychology, 62*(1), 331-361.
3. Brigandt, I., & Love, A. (2012). Reductionism in biology. In Zalta, E. N. (ur.), *The Stanford Encyclopedia of Philosophy* (Summer 2012 Edition). http://plato.stanford.edu/archives/sum2012/entries/reduction-biology/.
4. Dijksterhuis, A., Bos, M. W., Nordgren, L. F. & van Baaren, R. B. (2006). On making the right choice: the deliberation-without-attention effect. *Science, 311*(5763), 1005-1007.
5. Evans, J. (2010). *Thinking Twice, Two minds in one brain.* Oxford, Oxford University Press.
6. Haynes, J.D. (2011). Decoding and Predicting Intentions. *Annals of the New York Academy of Sciences, 1224*, 9-21
7. Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist 58*(9), 697-720.
8. Kane, R. (2005). *A contemporary introduction to Free will*. Oxford, Oxford university press.
9. Libet, B. (1985). Unconscious cerebral initiative and the role of conscious will in voluntary action. *The Behaviour and Brain Sciences 8*, 529-566.
10. Mele, A.R. (2009). *Effective Intentions The Power of Conscious Will*. Oxford, Oxfor University Press.
11. Piatelli-Palmerini, M. (1994). *Inevitable illusions: How mistakes of reason rule our minds*. John Wiley & Sons, Inc., New York.
12. Roskies, A. (2002). Neuroethics for the New Millenia. *Neuron, 35*, 21-23.
13. Shea, N., Boldt, A., Bang, D., Yeung, N., Heyes, C., & Frith, C. D. (2014). Supra-personal cognitive control and metacognition. *Trends in Cognitive Sciences*, *18*(4), 186-193.
14. Soon, C.S., Brass, M. Heinze, H.-J., & Haynes, J.-D. (2008). Unconscious determinants of free decisions in the human brain. *Nature Neuroscience, 11*(5), 543-545.
15. Strle, T. (2013). Why should we study experience more systematically: neurophenomenology and modern cognitive science. *Interdisciplinary Description of Complex Systems, 12*(4), 376-390.
16. Thaler, R.H., & Sunstein, C.R. (2008). *Nudge: Improving Decisions about Health, Wealth, and Happiness*. Yale University Press.
17. Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. Cambridge, MA: MIT Press.
18. Wegner, D.M. (2002). *The Illusion of Conscious Will*. London, Massachusetts, MIT Press (Bradford Books).

19. William, R. (2012). Epiphenomenalism. In Zalta, E. N. (ur.), *The Stanford Encyclopedia of Philosophy* (Summer 2012 Edition). http://plato.stanford.edu/archives/sum2012/entries/epiphenomenalism/.
20. Shenhav, A., Straccia, M.A., Cohen, J.D. & Botvinick, M.M. (2014). Anterior cingulate engagement in a foraging context reflects choice difficulty, not foraging value. *Nature Neuroscience 17*(9): 1249-1254.

ISKANJE DEFINICIJE KAJ JE MEDITACIJA IN PROBLEMI PRI OPAZOVANJU NJENIH UČINKOV

Barbara Škarja
Zavod CDK – Zavod za izobraževanje, vzgojo, razvoj in kulturo
Ruska 13, 1000 Ljubljana, Slovenija
Tel: +386 41 746938
e-mail: Barbara.skarja@cdk.si

POVZETEK

Prispevek v uvodu delno povzema ugotovitve meta študije z naslovom Meditativne prakse za zdravje: stanje raziskav, ki jo je opravila kanadska Univerza v Alberti. Čeprav je bil temeljni namen študije ugotoviti učinkovitost posameznih meditativnih praks za reševanje zdravstvenih in psiholoških težav, tukaj izpostavljam predvsem temeljne probleme s katerim so se soočili pripravljavci študije: (1) opredelitev skupnih elementov različnih meditativnih praks, (2) kako teoretično in operativno definirati pojem meditacije in (3) slaba metodološka kvaliteta dosedanjih raziskav. Rešitev teh problemov bi v prihodnosti omogočala bolj učinkovit pristop k raziskavam o vplivu meditacije na neželena bolezenska in psihološka stanja ter njenih potencialih za človekov psihološki, kognitivni in etični razvoj. Te raziskave so trenutno osredotočene na področje nevrologije in opazovanje sprememb v možganih. Prispevek postavlja tezo, da je v ozadju učinkov, ki jih imajo različne meditativne prakse na različnih ravneh človekovega bivanja, pravzaprav zavest, ki jo s pomočjo pozornosti usmerjamo na različne objekte oz. elemente meditacije.

1 UVOD

Meditacija kot duhovna in zdravilna praksa je v nekaterih delih sveta prisotna že več kot 5.000 let. Zadnja desetletja postaja vse bolj popularna tudi na Zahodu predvsem kot dopolnilna terapevtska metoda za številne zdravstvene probleme [1], pa tudi kot metoda za razvoj človekovih potencialov in duhovno rast.

Na Univerzi v Alberti so naredili obsežno študijo z naslovom Meditativne prakse za zdravje: stanje raziskav. Pregledali in sintetizirali so vso literaturo o vplivu meditativnih praks na fizično in psihološko stanje človeka, ki je bila na razpolago v 17 bazah podatkov o medicinski in psihološki literaturi do leta 2005.

Za potrebe študije so najrazličnejše meditativne prakse s pomočjo Delphi metode razvrstili v pet širokih kategorij; (1) meditacije z mantro (vključujejo Transcedentalno meditacijo – TM® , Sprostitveni odziv – RR in Standardizirano klinično meditacijo - CSM), (2) meditacije zavedanja (vključuje Vipasano, Zenbudistično meditacijo, na zavedanju utemeljeno zmanjšanje stresa – MBSR, na zavedanju utemeljeno kognitivno terapijo – MBCT), (3) Jogo, (4)Tai-či in (5) Či-gong.

Za vsako kategorijo so bili opredeljeni naslednji elementi: položaj telesa, dihanje, usmerjanje pozornosti, duhovnost ali vera, pogostost in trajanje izvajanja meditativne prakse. Prisotnost posameznih elementov in poudarki posameznih praks so razvidni iz Tabele 1: *Značilnosti meditativnih praks.*

2. UGOTOVITVE ŠTUDIJE "MEDITATIVNE PRAKSE ZA ZDRAVJE: STANJE RAZISKAV"

V raziskavo o terapevtskih učinkih meditativnih praks je bilo vključeni 813 študij, njeni rezultati pa ne morejo potrditi njihove terapevtske učinkovitosti. Študija priporoča, naj bodo nadaljnje raziskave usmerjene k iskanju teoretične in praktične definicije meditacije, ki bi omogočala primerjanje učinkov različnih meditativnih praks. Ugotovitve, ki izhajajo iz analize posameznih elementov meditacije so naslednje.

2.1 Telesni položaj

Nekatere prakse predpisujejo točno določen položaj telesa, medtem ko pri drugih to ni bistveno. Nekatere meditacije vključujejo gibanje, druge so striktno sedeče. Iz tega lahko sklepamo, da položaj telesa ni tisti, ki bi opredeljeval meditacijo.

2.2 Dihanje

Uporaba diha je prisotna v vseh praksah, razlikuje pa se pomembnost in pozornost, ki jo praksa namenja dihanju. Dihanje je lahko aktivno (obstaja na stotine tehnik, glede na cilj, ki ga želimo doseči) ali pasivno, naravno. Čeprav so elementi dihanja v praksah univerzalni, je to bolj izraz vseprisotnosti dihanja kot pa univerzalna lastnost meditacije same.

2.3 Usmerjena pozornost

Pozornost in njen objekt sta ključna elementa v vseh meditativnih praksah. Objekti se razlikujejo; mantra, svečka, dihanje, podoba, nič. Mantra se lahko ponavlja tiho, glasno ali v mislih. Izbira mantre je raznolika; narava izbrane mantre naj bi vplivala z asociacijami, ki jih povzroči beseda ali pa z vibracijami, ki jih povzroča izgovarjanje mantre. Nekatere mantre za tiste, ki ne poznajo Sansksrta, nimajo pomena, druge ga imajo. Čeprav je pozornost domnevno

Tabela 1: Značilnosti meditativnih praks

meditat. praksa	glavni elementi	dihanje	pozornost	izvajanje
meditacije z mantro				
TM®	sedeči položaj, zaprte oči osebna mantra v sanskrtu	pasivno ni povezano z mantro	p. usmerjena na mantro, mantra se ponavlja tiho	dvakrat dnevno, 15 do 20 min. na izvedbo, poučujejo certificirani TM® učitelji
Sprostitveni odziv (RR)	udoben položaj, sede, kleče, čepe, oči odprte ali za prte, lahko vključuje pregled telesa	nosno pasivno, mantra povezana z izdihom,	p. usmerjena na dihanje, mantra se ponavlja tiho, misli se ignorirajo	dvakrat dnevno, 15 do 20 minut na izvedbo, vsaj dve uri po jedi
Klinično standardizirana meditacija (CSM)	udoben sedeč položaj, mantra v sanskrtu ali individualno izbrana m. oči zaprte (pogled na prijeten objekt), potem zaprte za ponavljanje mantre	pasivno, ni povezano s ponavljanjem mantre	p. usmerjena na mantro, ki se najprej izgovarja na glas, nato tiše in končno v tišini, misli so prepoznane s se nanje ne osredotoča	dvakrat dnevno, 20 minut na izvedbo
meditacije zavedanja				
Vipasana	sedeč položaj, kultivacija zavestne prisotnosti	pasivno, nosno	p. usmerjena na dihanje, najprej vdih in izdih, na nosnice ali na telesne občutke	na začetku 20 minut, dokler je udobno sedimo
Zen	sedeč položaj, lotos, pollotos, položaj ust, jezika, rok, oči pol zaprte, pogled uprt v tla	aktivno, vdih skozi nos, izdih skozi usta in nosno, več vzorcev	p. usmerjena na štetje dihov, koan ali sedenje, ne na posamezne ideje ali izkušnje	nekaj minut do nekaj ur
na zavedanju utemeljen sprostitveni odziv (MBSR)	kultivacija zavestne prisotnosti; sedeče meditacije, pregled telesa, položaji hatha joge	aktivno (z diafragmo) in pasivno	p. usmerjena na dihanje v nosnicah ali abdomnu, p. usmerjena na občutke v telesu, p. usmerjena na dihanje in občutke, ki se pojavijo v različnih položajih	45 minut na dan, skupinsko uvajanje z izkušenim praktikom MBSR
na zavedanju utemeljena kognitivna terapija (MBCT)	temelji na MBSR programu, kultivacija širokega zavestnega zrenja; sedeča meditacija, pregled telesa	pasivno	p. je usmerjena na dihanje v nosnicah ali na dviganje in spuščanje abdomna, p. je usmerjena na telesne občutke v delu telesa, ki ga pregledujemo	skupinsko uvajanje z izkušenim praktikom meditacije zavedanja
Joga				
Kundalini joga, Sahaja joga, Hatha joga (različice)	spoštovanje etike, telesni položaji, dihalne tehnike, koncentracija in meditacija z zavedanjem	aktivno in pasivno, tehnike so različne	p. je pri vseh tehnikah usmerjena na dih, pri nekaterih tehnikah pa tudi na položaj telesa	vsak dan, od 15 minut do več ur, poučujejo izkušeni jogiji ali guruji
Tai-či				
Yang, Chen, Sun, Wu (Yian Qian in He Qin)	počasni, zavestni gibi (položaji se razlikujejo med šolami), telo sproščeno, zgornji del vzravnan, usta zaprta, zobje niso stisnjeni	aktivno, nosno	p. je usmerjena na gibanje in notranjo energijo (či)	vsak dan, 20 do 25 minut, prej 20 minut ogrevanja, potem 10 minut ohlajanja
Či-gong				
različne tehnike	meditacija, predpisan položaj za sedečo meditacijo, gibanje v sproščenem stoječem položaju, dihalne vaje	aktivno, tehnike se spreminjajo	p. je usmerjena na "vitalno polje" ter na vdih in izdih zraka	dvakrat dnevno, 20 do 30 minut, posamično izvajanje ne presega 3 ure

univerzalna, obstajata najmanj dva vidika pozornosti, ki jih lahko uporabimo in široka paleta tehnik za njeno ohranjanje, od katerih pa nobena ni univerzalna.

2.4 Duhovnost in religioznost

Nobena od meditativnih praks ne zahteva, da bi sprejeli poseben sistem prepričanj ali religiozni okvir. Edino Či-gong predpostavlja, da sprejmemo taoistične metafizične predpostavke, da lahko pravilno razumemo, vizualiziramo in vodimo tok čija. Za uspešno izvajanje meditacije do določene stopnje ne potrebujemo posebnega sistema prepričanj.

2.5 Pogostost in dolžina izvajanja meditacije

Velike razlike v pogostosti in trajanju meditacije otežujejo posploševanje tega elementa.

Raznolikost kombinacij elementov in različni poudarki, ki jih posamezne prakse dajejo tem elementom, onemogočajo, da bi lahko definirali, kaj so univerzalni elementi meditacije in kaj so dopolnilni elementi posamezne prakse.

3. ŠTUDIJA O VPLIVU MEDITACIJE NA MOŽGANE

Razvoj tehnologije, ki s pomočjo magnetne resonance (MR) omogoča opazovanje dogajanja v možganih, je raziskave o učinkih meditacije prenesel na raven nevrologije. Raziskave, ki jih je s svojo skupino raziskovalcev opravila Sara W. Lazar [2], so pokazale, da imajo ljudje, ki dalj časa meditirajo, večjo gostoto možganske skorje kot tisti, ki ne meditirajo. Spremembe so opazne predvsem v predelu hipokampusa, ki je odgovoren za učenje in spomin in v strukturah, ki so povezane s samozavedanjem, sočutjem in introspekcijo. Manjša gostota sive snovi pa je prisotna v amigdali, ki igra pomembno vlogo pri strahu in stresu.

V študijo je bilo vključenih 16 udeležencev 8 tedenskega tečaja na zavedanju utemeljene sprostitve stresa (MBSR). Meditacijo zavedanja so izvajali povprečno 27 minut na dan, njihova pozornost je pri tem brez sodbe spremljala občutke, čustva in mentalna stanja. Pri kontrolni skupini se v istem časovnem intervalu niso pojavile nobene

spremembe. Ta študija odpira vrata novim raziskavam, ki bodo skušale osvetliti, kaj je v ozadju teh sprememb.
Iz obeh študij lahko povzamemo naslednje; iz prve, da je usmerjanje pozornosti skupni element vseh meditativni praks in da bi morda ob bolje izpeljanih študijah morda lahko dokazali terapevtski učinek njihovega izvajanja; in iz druge, da meditacija zavedanja spreminja naše možgane. Ker so možgani nadzorni center telesa, lahko sklepamo, da posledično potencialno vpliva tudi na naše fiziološko stanje, čustvene odzive, kognitivne funkcije in osebnostne značilnosti.

4. MEDITACIJA JE VEČ KOT POZORNOST IN ZAVEDANJE – KAJ JO DEFINIRA?

Najbolj univerzalni element meditacije je usmerjanje pozornosti. Pozornost, kot jo definira SSKJ je "zavestna miselna zbranost, povečano zanimanje, zavzetost za kaj". Pozornost je v meditaciji usmerjena na zavedanje. Zavedati se po SSKJ pomeni "biti v duševnem stanju, v katerem se neposredno ve za svoje obstajanje in svoja duševna stanja. Vendar meditacija ni samo pozornost in ni samo zavedanje. Odgovor na to, kar loči meditacijo od običajne pozornost in zavedanja, lahko najdemo v Patanjdžalijevih Joga Sutrah , kjer je opredeljenih osem korakov tako imenovane "radža joge" ali joge razuma [3]. Meditacijo v najožjem pomenu besede opiše kot podaljšano zbranost, ki pripelje um v stanje mirovanja "joga čittavrti nirodha" ("joga je ukinitev modifikacij uma"). Meditacija torej ni samo osredotočenost, ampak je pomembno tudi njeno trajanje. Glede na to bi meditacijo lahko definirali kot dejanje volje, s katerim zavestno usmerimo pozornost na določen objekt, proces ali subjekt, in vztrajamo pri njegovem zavedanju, dokler se um ne umiri v stanju čistega zavedanja. Meditacija je neke vrste zavedanje zavedanja, dokler zavedajoči se ne postane čista zavest, v kateri se zrcali zunanja in notranja resničnost, taka kot je. V običajnem zavedanju je opazovalec zlit z opazovanim. To, kar čutim in mislim, sem jaz. V procesu meditacije se najprej vzpostavi dvojnost med opazovalcem in opazovanim, pride do razistovetenja [4]. Razistovetenje je postopno, najprej se zavedamo sebe in čutnih zaznav, nato sebe in občutkov, sebe in misli, misli in odziva na svoje misli, praznega prostora med mislimi, idej, ki še niso misli in tako dalje. Z nadaljevanjem odmikanja od vsebin zavedanja pride sčasoma do stanja čistega zavedanja – zavedanja brez vsebine oz. stanja čistega bivanja, ko individualna zavest ponikne sama vase in se zlije z univerzalnim poljem zavesti. In ko zavest znova vznikne iz univerzalnega polja čiste zavesti, postane individualna in določena z vsebinami uma, telesa in psihe.

5. DVOSMERNI UČINKI ZAVEDANJA

Empirično dejstvo je, da se človek zaveda tistega, na kar je pozoren. Tisto, na kar smo pozorni, vstopa v našo zavest. Pozornost je torej tista, ki določa, kaj vstopa v našo zavest. Pozornost je lahko osredotočena, izostrena, ali pa periferna, razširjena. Pozornost pa ne definira samo polja našega zavedanja, ampak tudi vpliva na tisto, česar se zavedamo.
Zavedanje ni samo receptivno, ampak tudi aktivno. Naše zavedanje vpliva na objekt ali subjekt naše pozornosti. Ko nekoga opazujemo in se ga zavedamo, se ga naša zavest na nek način dotika, vpliva nanj. Pozornost torej določa, kaj je tisto, kar vstopa v zavest, hkrati pa zavest na nek način učinkuje na tisto, na kar smo pozorni.

6. IZKUŠNJE O UČINKIH PODALJŠANE POZORNOSTI

Izkušnje kažejo, da dalj časa trajajoča pozornost vpliva na tisto, na kar smo pozorni. Podajam nekaj empiričnih opažanja iz literature in lastne prakse.

6.1 Ozaveščenost

Lahko se zavedamo, da je kajenje škodljivo za naše zdravje, vendar dokler o tem nismo dovolj ozaveščeni, ne bomo zmanjšali števila pokajenih cigaret. Ozaveščenost, ki jo lahko definiramo kot poglobljeno zavedanje, prinese spremembo ravnanja.

6.2 Pozornost spodbuja rast in razvoj

Iz literature je znan poskus, ki ga je izvedel Roberto Assagioli z rastlinami. Dvema skupinama ljudi je dal enake sadike rastlin in jih prosil, da jih na določen način zalivajo. Eni skupini je naročil, naj se ob zalivanju rastlinam še posebej posvetijo, se z njimi pogovarjajo, jim predavajajo glasbo ipd., drugim pa nič. Izkazalo se je, da so rastline, ki so poleg vode dobile tudi nekaj pozornosti, bolje uspevale in bolj bogato cvetele kot tiste, ki so bile samo zalivane.
Tudi otroci za zdrav razvoj potrebujejo določeno mero pozornosti. Zato na otroških igriščih pogosto slišimo: "Poglej, kako visoko bom skočil." In če nismo dovolj pozorni sledi: "Poglej še enkrat!"

6.3 Pozornost spreminja vzdušje

Kako pozornost v trenutku spremeni posameznika ali skupino ljudi, je opazil tudi Piero Ferrucci, ko je opazoval, kako prijatelj, psiholog, vodi meditacijo v hoji. Udeleženci so morali počasi hoditi sem in tja, pozorni na vsak korak. V petih minutah se je ozračje spremenilo. Prej je bilo zmedeno in razpršeno, nato se je očistilo in odprlo. [5].

6.4 Učinki pozornosti na telo, dihanje, mišljenje pri izvajanju Globinske sprostitve in Meditacije Duhovne univerze

Globinska sprostitev je meditativna praksa namenjena aktivnemu in preventivnemu zmanjševanju stresa in je hkrati uvod v Meditacijo Duhovne univerze, ki je namenjena osebni integraciji in duhovni rasti.
Obe praksi sta zasnovani na usmerjanju pozornosti in zavedanju, pri čemer upoštevata njegovo dvosmernost. Meditant najprej usmeri pozornost na določen element meditacije (del telesa, dihanje, mantro) in se zave odziva v tem delu telesa; opazuje dogajanje in spremembe, ki se dogajajo, ne da bi jih zavestno usmerjal, presojal ali jih pričakoval. Edini zavestni napor, ki ga vlaga, je usmerjanje pozornosti in njeno ohranjanje. Aktivni dejavnik procesa je navidez nedejavno zavedanje.

Kot posledica zavedanja telesa se pojavljajo občutki mravljinčenja, toplote, hladu, občutek sproščenosti, napetosti v telesu popuščajo. Ko se meditanti zavedajo dihanja, opažajo, da se počasi umirja, občasno je lahko poglobljeno, dihanje postaja vse bolj enakomerno, umirjeno, skoraj neopazno. Obenem popuščajo tudi čustvene napetosti in nemir, misli se prav tako umirijo. Pojavijo se trenutki brez misli, trenutki čiste prisotnosti, ko je človek samo opazovalec dogajanja.
Po nekaj mesecih rednega izvajanja meditanti opažajo, da so bolj zadovoljni s seboj in s svojim življenjem, bolj optimistični, samozavestni, lažje rešujejo vsakdanje probleme, so bolj zbrani pri delu, čustveno se manj vznemirjajo, bolj so sproščeni ter bolj strpni in razumevajoči do drugih, bolje spijo, se bolj zdravo prehranjujejo in so na splošno bolj odporni. Zmanjšala se je tudi odvisnost od kave, alkohola, cigaret in pomirjeval [6].

6.5 Učinki pozornosti na psihološke vsebine pri izvajanju imaginativnih vaj iz psihosinteze

Pri psihosintezi gre za poseben način dela s psihološkimi vsebinami, ki so na meji zavednega in nezavednega. Z receptivno usmerjeno pozornostjo na problem ali čustvo, pustimo, da se v zavesti pojavi vizualna podoba tega čustva ali problema, nato pa s podaljšano zbranostjo to podobo opazujemo nevtralno brez sodb in dovolimo, da se spreminja. Po nekajkratnih ponovitvah postopka postajajo podobe vse bolj razvidne, urejene, harmonične in navdihujoče. Kot bi se pred našimi očmi samodejno dogajala pozitivna preobrazba in razvoj.

Slika 1: Primer postopne preobrazbe psihološkega stanja jeze v ustvarjalnost s pomočjo zavedanja

7. ZAKLJUČEK

Iz zgoraj navedenih opažanj lahko povzamemo, da podaljšano in poglobljeno zavedanje ni nevtralno, ampak ima določene učinke na zavedajočega se in na objekt zavedanja. Ti učinki gredo v smeri zaželenega, uravnoteženega, harmoničnega, zdravega in celostnega stanja telesa, uma in duha. Na osnovi teh opažanj lahko postavimo tezo, da je ključni element meditacije zavest, ki jo s pozornostjo usmerjamo na različne elemente meditacije glede na učinke, ki jih želimo doseči.
O sami naravi zavesti danes z znanstvenega zornega kota ne vemo veliko, izkustveno pa lahko rečemo, da deluje v smeri vzpostavljanja reda, ravnovesja, harmonije in celostnosti. Z meditacijo lahko po eni stani spoznavamo naravo zavesti same, po drugi strani pa opazujemo njene učinke. Z ustrezno zasnovanimi študijami bi njene učinke lahko potrdili in praktično uporabili za dvig kvalitete individualnega in skupnega življenja.

Reference

[1] Ospina MB, Bond TK, Karkhaneh M, Tjosvold L, Vandermeer B, Liang Y, Bialy L, Hooton N, Buscemi N, Dryden DM, Klassen TP. *Meditation Practices for Health: State of the Research.* Evidence Report/Technology Assessment No. 155. (Prepared by the University of Alberta Evidence-based Practice Center under Contract No. 290-02-0023.) AHRQ Publication No. 07-E010. Rockville, MD: Agency for Healthcare Research and Quality. June 2007.

[2] Britta K. Hölzel, James Carmody, Mark Vangel, Christina Congleton, Sita M. Yerramsetti, Tim Gard, Sara W. Lazar. Mindfulness practice leads to increases in regional brain gray matter density**.** *Psychiatry Research: Neuroimaging*, 2011.

[3] Primož Škoberne s sodelavci, *Luč prastare modrosti*, Učbenik za slušatelje prvega letnika Duhovne univerze, Ljubljana, 1991, str. 134

[4] Roberto Assagioli, *Psychosynthesis,* A Manual of Principles and Techniques, HarperCollins Publishers, 1965, str. 116

[5] Piero Ferruci, Moč prijaznosti, Zavod CDK, Ljubljana, 2007, str. 75

[6] Branko Krapež, *Vpliv Globinske meditacije na kvaliteto življenja*, diplomska naloga, Univerza v Ljubljani, Visoka šola za socialno delo, Ljubljana, 1988, str. 37-44.

KVANTNO-INFORMACIJSKI NIVO KOT PODLAGA KOMPLEKSNIH KOGNITIVNIH PROCESOV

Metod Škarja
samostojni raziskovalec,
Adria Mobil d.o.o.
metod.skarja@guest.arnes.si

Povzetek

Kvantni nivo realnosti omogoča mnogo širši in bolj celosten nabor informacij, ki pridejo do čutil in naprej do možganov, kot klasično zaznavanje. Sama struktura in principi delovanja tega nivoja načeloma omogočajo mnogo bolj temeljito "informiranost" tako glede prostorskih informacij (nelokalnost) ko tudi vpogleda v vse možne razvoje sistemov in snjihove okolice v prihodnosti. Informacije na tem nivoju so neposredno dostopne le kvantnemu nivoju naših možganov, kjer pa lahko posredno vplivajo tudi na kognitivne procese na klasični ravni .

Uvod

Klasično dobivamo informacije iz okolja preko čutil. Pri tem se čutila ločijo, iz kakšne daljave in s kakšno hitrostjo dobivajo informacije, od vida na eni strani do čistih kontaktnih čutil kot sta okus in otip.

Informacije, dobljene preko čutil, obdelujemo v možganih. Temu se pridružijo še bolj grobe ali do različne stopnje obdelane informacije, ki jih dobimo od drugih ljudi (informacije, mnenja, komentarji, razna znanja) ter informacije in vsebine, ki so plod našega lastnega procesiranja v možganih, bodisi trenutnega ali v preteklosti. To v grobem zaokroža informacijski okvir, znotraj katerega klasično gledano delujejo naši možgani.

Z razvojem ved, ki se ukvarjajo z organizacijo žive in nežive materije na bolj fundamentalni in holistični ravni (npr. bioelektromagnetika) ter z aplikacijo teh spoznanj in principov na delovanje možganov ter splošno na kognitivne procese in možen pojav zavesti, se kaže, da zaradi svoje strukture in značilnosti kvantnega nivoja pojavnega sveta morda ključno vlogo igra prav kvantna teorija.

Kvantna teorija in znotraj nje še posebej kvantna teorija polja omogoča nov, bolj fundamentalen pogled na organizacijo žive snovi in s tem tudi možganov. Za razliko od generiranja prostorskega in časovnega reda preko statističnih mehanizmov, je red, ki izhaja iz kvantne teorije polja, emergenten red dinamične narave na osnovi kvantnih interakcij. Zanj so značilni kolektivni nihajni načini s pripadajočimi kvanti (Itzykson, Zuber, 1980, Anderson, 1984). Princip, ki velja za neživo materijo, velja splošno tudi za živo materijo in možgane, le da so procesi v slednjih dveh primerih veliko bolj kompleksni (Fröhlich, 1968, 1975, 1988, Del Giudice et al, 1985, 1986, 1988, 1998). Razlika med neživo, ostalo živo materijo in možgani je v naraščajoči stopnji odzivnosti na vse stimuluse, tako glede razločljivosti kot senzitivnosti (Škarja, 2006).

Podobno kot na splošno za živo materijo so bili na analognem principu razviti tudi modeli za delovanje možganov (Ricciardi, Umezawa, 1967, Stuart et al, 1978, 1979, Umezawa et al, 1982, Vitiello 1995, 2001, Jibu, Yasue, 1992). Eden od predlaganih načinov, kako lahko možgani učinkovito uporabljajo svoj kvantni nivo za procesiranje velikega števila informacij, je podan v (Hameroff, 1987), za zgoščen pregled in nadaljnje implikacije glej (Škarja, 2006).

Namen tega prispevka je pokazati, na kakšne načine lahko kvantni nivo realnosti s svojimi principi in značilnostmi obogati informacijsko podstat procesov, ki potekajo v možganih. Iz samih osnov kvantne teorije pokaže, od kje izhajajo možne informacijske povezave med posameznimi sistemi in znotraj samih sistemov, kakšen je možen doseg, jakost in razločljivost takih povezav, tako v prostorskem kot časovnem smislu.

Struktura kvantne teorijev

Na splošno v kvantni teoriji določen sistem opišemo z valovno funkcijo ψ, ki zadošča Schrödingerjevi enačbi, ki pa jo tu zaradi nazornosti v nadaljevanju zapišemo tudi v integralni obliki,

$$\psi(\vec{r}_2\ ,t_2) = \iint G(\vec{r}_1,\vec{r}_2,t_1,t_2)\psi(\vec{r}_1\ ,t_1)\ d\vec{r}_1\ ,dt_1$$

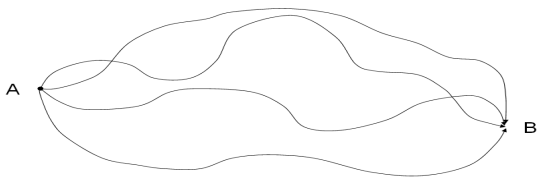
kjer Greenova funkcija oz. propagator sistema G opiše, kako sistem samega sebe preslika iz enega v drugo stanje (Peruš, 1995, p. 132). Integral poteka po celotnem prostoru in celotnem časovnem intervalu od t_1 do t_2. To načeloma pomeni, da vse točke sistema preko medsebojnih interakcij vplivajo na vsako od njih (oz. točneje rečeno, upoštevan je eventualen prispevek vseh točk v celotnem časovnem intervalu). Kakšen in kolikšen pa je konkreten doprinos oz. vpliv posameznih točk na določeno točko, pa pove Greenova funkcija.

Podobne integralne enačbe lahko zapišemo tudi za klasične sisteme, tu npr. pri opisu nihanja strune kljub integraciji po celotni struni in navideznemu

prispevku celotne strune k gibanju posamezne točke, na gibanje te točke dejansko neposredno vplivata le sosednji točki na struni (druge pa le posredno preko sosednjih točk).
Glavna značilnost kvantne teorije proti klasični so vplivi tudi nelokalni vplivi okolice na sistem in obratno tako v prostorskem kot tudi časovnem smislu. Prostorsko to pomeni, da na del sistema lahko vplivajo tudi tisti deli sistema oz. okolice, kjer sicer ni nobene klasične interakcije (niti stične niti preko polja). V časovnem smislu to pomeni, da na razvoj sistema vpliva tako njegova preteklost kot tudi vsi možni razvoji sistema v prihodnosti.
Kolikšen je ta "nelokalni" vpliv" sicer pokaže Greenova funkcija. Za sisteme, ki so po lastnostih blizu klasičnim oz. so klasični, se izkaže, da so nezanemarljivi kvantni vplivi le tam, kjer imamo prisotne klasične vplive (stične interakcije, interakcije preko (EM) polj).

Pristop "integralov po poti" (Path integral approach)

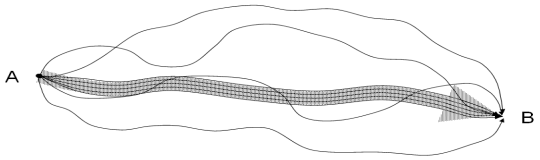
Formulacije kvantne mehanike v obliki "integralov po poti" (*path integral approach*, Path integral formulation, 2014) lepo pokaže, da kvantni sistem pri svojem razvoju "otipa" celotno svojo okolico in da le-ta tudi dejansko vpliva na njegov razvoj. Ta formulacija je matematično ekvivalentna opisu s Schrödingerjevo enačbo, nazorno pa pokaže strukturo razvoja sistema. Na verjetnost, da se sistem razvije iz stanja A v stanje B, vplivajo vse možne poti, po katerih lahko ta razvoj poteka. Če opazujemo razvoj sistema, to pomeni, da moramo pri tem razvoju med dvema stanjema A in B upoštevati vse možne vmesne poti razvoja skozi vsa možna vmesna stanja sistema, tudi klasično povsem nemogoče.



Slika 1: Prikaz nekaj možnih poti sistema od stanja A do stanja B.

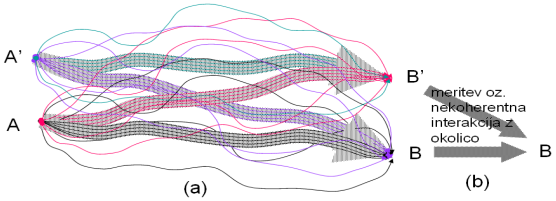
Za celotno amplitudo verjetnosti za prehod iz stanja A v stanje B je potrebno sešteti oz. integrirati po vseh t.i. fazah različnih poti, zaradi česar pride do interferenčnih efektov različnih poti.. Večina poti navadno med seboj destruktivno interferira in tako malo ali nič ne prispeva h končni verjetnosti. Če je sistem klasičen ali blizu klasičnemu, potem od vseh poti ostane le pot (oz. natančneje "ozek" snop poti), ki bi jo sistem ubral tudi v klasičnem primeru. Več ima sistem "kvantnega značaja", širši je lahko ta snop poti, ki največ prispevajo k prehodu iz A v B.

Spodnja slika prikazuje tak razvoj sistema od stanja A do stanje B, kjer je z osenčenim področjem prikazan največji prispevek k temu prehodu.



Slika 2: Prikaz snopa poti (osenčeno območje), ki največ prispevajo k prehodu od stanja A v stanje B, ter nekaj preostalih možnih poti, katerih prispevek je majhen oz. zanemarljiv.

Za kvantne sisteme je značilno, da se lahko obstajajo oz. se paralelno razvijajo skozi večje število stanj (t.i. kvantna superpozicija). Za vsak tak razvoj od začetnega proti enemu od končnih stanj velja, kar smo zapisali zgoraj. Tudi začetno stanje je lahko superpozicija več stanj, tako da se kvantni sistem dejansko lahko razvija skozi zelo kompleksno mrežo številnih začetnih, vmesnih in končnih stanj. Tak bolj kompleksen primer razvoja iz superpozicije dveh začetnih stanj A in A' proti končnima stanjema B in B' je prikazan na levem delu spodnje slike (3a).

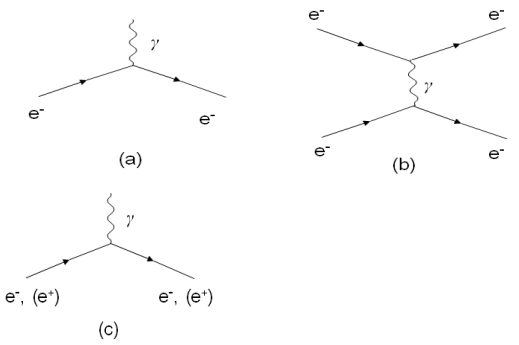


Slika 3: (a) Razvoj bolj kompleksnega kvantnega sistema v superpoziciji dveh stanj. (b) Prikaz meritve oz. nekoherentne interakcije sistema z okolico.

Omenimo, da se prehod v točno določeno končno stanje zgodi ob merjenju na sistemu (t.i. redukcija valovne funkcije) oz. bolj splošno ob t.i. nekoherentni interakciji sistema z okolico z verjetnostjo, ki jo določa verjetnostna amplituda za vsako možnost. Ta proces meritve oz. "dekoherence" sistema je simbolično prikazan v desnem delu zgornje slike (3b). Z verjetnostjo, določeno po principih, opisanih zgoraj, preide sistem v eno od stanj B oz. B' (superpozicija se poruši). Omenimo še to, da pri meritvah to stanje poznamo in z njim računamo oz. delamo naprej, pri splošni nekoherentni interakciji z okolico pa v splošnem ne, tako da moramo od tu dalje tak sistem obravnavati tudi statistično.

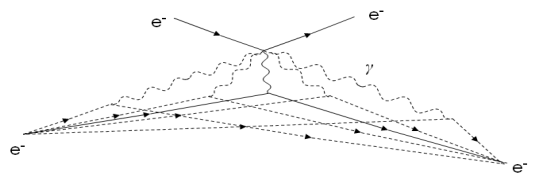
Feynmanovi diagrami in interakcija sistema s samim seboj ter okolico

Pri razvoju sistema od začetnega (začetnih v primeru superpozicije) proti končnemu (končnim) stanju sistem, le-ta interagira z okolico in v splošnem tudi znotraj sebe, še posebej če gre za sestavljen oz. kompleksen sistem.
Za interakcijo sistema z okolico in s seboj so vizualno zelo primerni Feynmanovi diagrami (Feynman diagram, 2014). Ti lahko na nazoren način prikažejo vse možne interakcije, ki se sistemu lahko zgodijo in jih moramo upoštevati pri "integralih po poti". Velika večina interakcij, ki so jim sistemi, ki nas pretežno zanimajo, podvrženi, so elektromagnetne narave. Večina teh interakcij poteka preko interakcij med elektroni atomov ali molekul in fotoni realnih ali virtualnih EM polj. Pri zunanjih EM poljih nastopajo realni, , pri interakcijah dveh teles pa se le-ta prenaša večinoma preko t.i. virtualnih fotonov. Na spodnji sliki je prikazano nekaj takih interakcij. Formalno lahko razumemo gibanje elektrona e^- v času naprej tudi kot gibanje pozitrona e^+ v času nazaj.



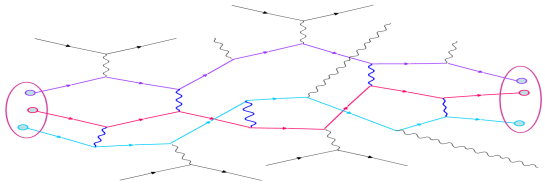
Slika 4: (a) Interakcija elektrona e- z zunanjim EM poljem oz. fotonom γ, (b) interakcija dveh elektronov preko virtualnega fotona γ, (c) elektron, ki se giblje v času naprej, lahko formalno interpretiramo tudi kot gibanje pozitrona e+ v času nazaj.

Pri tem je pomembno poudariti, da se interakcija ne zgodi v določeni točki, ampak se dogaja ves čas. Vpliv vsake take interakcije na razvoj sistema je potrebno integrirati od začetka do konca poti, čeprav je njen največji prispevek (pogosto tudi edini nezanemarljiv) v področju, kjer sta si npr. elektrona tudi dejansko fizično blizu oz. kjer je npr. zunanje EM polje tudi dejansko prisotno.



Slika 5: Simboličen prikaz, kako je treba interakcijo dveh elektronov (oz. če posplošimo dveh sistemov) upoštevati po celotni poti (prikazane so le različne možne točke interakcije za spodnji sistem, podobno je tudi pri zgornjem sistemu.

Iz te "raztegnjene" interakcije po celotni poti razberemo, da informacija o okolici (in tudi o samem sistemu) prihaja do sistema preko (virtualnih) fotonov ves čas. Tako je sistem "informiran" o vsej svoji okolici, še preden dejansko pride v klasično nezanemarljiv stik z njo oz. tudi še po takem stiku.
Sestavljen sistem interagira tako z okolico kot sam s seboj na lahko zelo kompleksen način. Primer trodelčnega sistema je prikazan spodaj. Prikazane so interakcije z zunanjimi polji in telesi ter interakcije sistema s samim seboj.

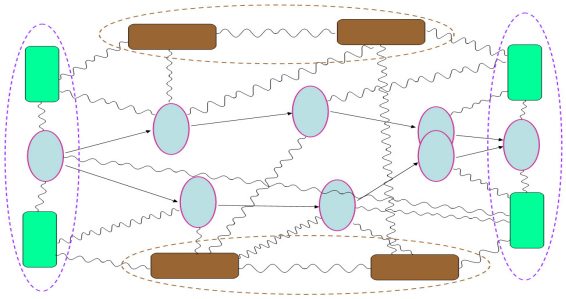


Slika 6: Primer trodelčnega sistema v interakciji z okolico in samim seboj.

Število in vrstni red interakcij z okolico ter sistema s samim seboj se spreminja in upoštevati moramo vse možne variante. Tako od ene možne "konfiguracije interakcij" s slike 6 pridemo do množico različnih poti med dvema stanjema, kot je prikazano na slikah 1 in 2.

Kvantni nivo kot (popoln) informacijski medij

Kot izhaja iz same strukture kvantne teorije, kvantni nivo v vsaki točki "zagotavlja" sistemu informacijo tako o vsej okolici (formalno brez omejitve) kot tudi o vseh možnih prihodnjih razvojih sistema vključno z možnimi razvoji okolice. Informacija do sistema pride preko virtualnih fotonov. Po formalno pravilni interpretaciji, da gibanje elektrona v času naprej ustreza gibanju pozitrona v času nazaj, tudi po "elektronskih" vejah prihaja informacija iz prihodnosti o nadaljnjem razvoju sistema. Shematično to prikazuje spodnja slika.



Slika 7: Shematičen prikaz vpliva začetne, vmesne in končne okolice na sistem. Prikazani sta dve možni poti razvoja sistema. Virtualni fotoni v vsakem trenutku dovajajo vpliv celotne okolice kot tudi sistema samega nase.

Dejanski vpliv teh interakcij na sistem je znaten le tam, kjer se posamezni vplivi koherentno seštejejo. Pri običajnih sistemih je to navadno v področjih in časih, ko je tudi klasična interakcija nezanemarljiva. Bolj ko je sistem oz. okolica (kvantno) koherentna, večje je lahko to področje vpliva na sistem, tako v prostorskem kot tudi časovnem smislu. V tej smeri so potrebne še številne teoretične in praktične raziskave, zlasti za določitev pogojev, pod katerimi se to področje lahko razteza znatno preko področja klasično nezanemarljivih interakcij. Podobno, kot se lahko s tega mesta teoretično uglasimo s katerokoli radijsko postajo na zemlji, praktično pa je to odvisno od kvalitete sprejemnika, je tudi sprejem kvantnih informacij iz bolj oddaljene okolice verjetno ključno odvisen od stopnje kvantne koherentnosti in kompleksnosti sistema.
Iz lastnosti samih Feynmanovih diagramov se da pokazati, da vmesna nekoherentna interakcija sistema z okolico močno zmanjša oz. praktično v celoti izniči vpliv, ki ga ima razvoj sistema po tej interakciji na razvoj sistema pred to interakcijo. Informacija sicer še vedno prehaja tudi preko takega dogodka, a je bistveno bolj "zašumljena" (v analogiji z radijskimi valovi bi lahko rekli, da ima močno zmanjšano amplitudo z več šuma).

Implikacije za kognitivne proces

V literaturi se pojavljajo številne indikacije, da fizični možgani kot taki kljub svoji kompleksnosti ne zadoščajo za celovito procesiranje vseh informacij in vsebin. Vključiti je potrebno tudi njihov kvantni nivo (glej npr. Hameroff, 1987). Tako naj bi fizični del možganov prejemal impulze iz okolja, nato pa se ti impulzi preko vzpostavitve kvantne koherence prevedejo na kvantno raven možganov, kjer poteka dejansko procesiranje informacij. V naslednjem koraku se rezultati tega procesiranja preko kvantne dekoherence prevedejo nazaj na fizični nivo možganov, kjer rezultirajo tako v fizičnem zavedanju posameznih vsebin kot tudi v razpošiljanju ustreznih signalov po živcih od možganov v telo. Ti koraki naj bi se dogajali v ritmu znanih možganskih EEG valovanj. Pristop, ki bolj temelji na kvantni teoriji polja, je podan v (Freeman, Vitiello, 2006) in literaturi tam.
To bi pomenilo, da večja kvantna koherenca kot je vzpostavljena v možganih, več kvalitetne informacije tudi na kvantni ravni lahko možgani prejmejo iz okolice. Večja kvantna koherenca tukaj pomeni tako prostorsko večja področja kot časovno daljše intervale (verjetno ni naključje, da globlja stanja zavesti z globljim uvidom vključujejo počasnejše EEG ritme). Na kvaliteto te informacije pa ne vpliva le stanje možganov, ampak celotnega sistema, ki to informacijo do možganov prevaja. Pojavi se tudi vprašanje, koliko lahko možgani zaradi svoje bolj koherentne narave sprejmejo informacijo neposredno s kvantnega nivoja. Sami principi obnašanja kvantnih sistemov to načeloma omogočajo.

Diskusija in zaključek

V prispevku je prikazano, da vsaj formalno kvantni sitem dobiva informacijo o vsej svoji okolici kot tudi o možnih prihodnjih in preteklih razvojih. Ta informacija do sistema prihaja predvsem preko virtualnih fotonov vseh možnih interakcij sistema z okolico in samega s seboj in vpliva na njegov razvoj. Zaradi konstruktivne in destruktivne interference teh vplivov je ta vpliv navadno znaten le tam, kjer je tudi dejansko taka interakcija nezanemarljiva. Za bolj kvantno koherentne sisteme kot tudi za bolj kvantno koherentno okolico pa so ti vplivi lahko nezanemarljivi tudi v področjih in na časovnih intervalih, ko sama interakcija ni več bistvena.
V literaturi je pokazano (Hameroff, 1987, Freeman, 2006), da po vsej verjetnostni lahko možgani vsebujejo oz. generirajo največje kvantno-koherenčne domene v živih organizmih. To jim omogoča, da lahko v največji meri koristijo in razbirajo informacije, ki so neposredno na voljo na kvantni ravni. Te informacije lahko pridejo do njih tako preko kvantnega nivoja čutil oz. živčnega sistema kot po vsej verjetnosti tudi neposredno (mind-mind interaction).
V prispevku so navedene tudi omejitve glede takega prenosa informacij (vpliv koherence, dekoherence). Koliko in v kakšni meri lahko informacije pridejo do možganov neposredno po kvantnem nivoju, bo potrebno še nadalje raziskovati oz. ali to zadostuje, ali pa so za to potrebni še kaki drugi še neznani mehanizmi.

Literatura

[1] Anderson, P.W. (1984): Basic notions of condensed matter physics. Menlo Park: Benjamin

[2] Bohm D., Hiley, B.J. (1993) The undivided universe: An ontological interpretation of quantum field theory, Routledge, London

[3] Del Giudice E, Doglia S, Milani M, Vitiello G (1985): A quantum field theoretical aproach to the collective behaviour of biological systems, Nuclear Physics, B251(FS13), 375-400

[4] Del Giudice, E., Doglia, S., Milani, M., Vitiello, G. (1986): Electromagnetic field and spontaneous symmetry breakdown in biological matter. Nucl. Phys., 1986a, B275 (FS 17), 185-199.

[5] Del Giudice, E., Doglia, S. et al. (1988): Structures, Correlations and Electromagnetic Interactions in Living Matter: Theory And Applications, In Fröhlich, H., eds. Biological Coherence and Response to External Stimuli, Berlin, H. Springer Verlag, pp.49-84.

[6] Del Giudice, E., Preparata, G. (1998): A New QED Picture of water: Understanding a Few Fascinating Phenomenon, In Sassaroli, E., Srivastava, Y., et al., eds, Macroscopic Quantum Coherence, Singapore, London, New York, World Scientific, 1998, pp. 108-129

[7] Feynman diagram (2014): dostopno na http://en.wikipedia.org/wiki/Feynman_diagram

[8] Freeman, W.J., Vitiello, G. (2006): Nonlinear brain dynamics as macroscopic manifestation of underlaying many.body field dynamics. Phys. Life Rev. 3, 93-118

[9] Fröhlich, H. (1968): Long-range Coherence and Energy Storage in Biological Systems, Int. J. Quantum. Chem., 2(5), 641-649

[10] Fröhlich, H. (1975): Evidence for Bose Condensation-like Excitation of Coherent Modes in Biological Systems, Phys. Lett., 51A(1), 21-22

[11] Fröhlich H: Theoretical Physics and Biology (1988): In: Fröhlich H (ed.), Biological Coherence and Response to External Stimuli, Springer Verlag, Berlin, Heidelberg, New York, London, Paris, Tokyo

[12] Hameroff, S.R. (1987): Ultimate Computing:Biomolecular consciousness and nanotechnology. Amsterdam: Elsevier North Holland

[13] Itzykson, C., Zuber (1980): Quantum Field Theory, New York: McGraw-Hill

[14] Jibu, M., Yasue, K. (1992): A physical picture of Umezawa's quantum brain dynamics. In R. Trappl ed., Cybernetics and System Research, Singapore, World Scientific, p.797-804.

[15] Path integral formulation (2014): dostopno na http://en.wikipedia.org/wiki/Path_integral_formulation

[16] Peruš, M. (1995), "Vse v enem, eno v vsem. Možgani in duševnost v analizi in sintezi". Ljubljana: DZS

[17] Principle of least action (2014): dostopno na http://en.wikipedia.org/wiki/Principle_of_least_action

[18] Ricciardi, L. M., Umezawa, H. (1967): Brain and physics of many-body problems, Kybernetik, 1967, 4, 44-48. Reprint in Globus, G. G., Pribram, K. H., Vitiello, G. eds (2005): Brain and Being, Amsterdam, John Benjamins, pp. 255-266.

[19] Stuart, C.I.J., Y. Takahashi in H. Umezawa (1978): On the stability and non-local properties of memory, J. Theor. Biol., 71, 605-618.

[20] Stuart, C.I.J., Y. Takahashi in H. Umezawa (1979): Mixed system brain dynamics: neural memory as a macroscopic ordered state, Found. Phys., 9, 301-327.

[21] Škarja M. (2006), Kvantna teorija polja, možgani in zavest, Zbornik mednarodne konference *Kognitivna znanost: 9. mednarodna multikonferenca Informacijska družba IS 2006*, Ljubljana, Slovenija

[22] Umezawa, H., Matsumoto H. in Tachiki M. (1982): Thermo Field Dynamics and Condensed States. Amsterdam: North-Holland

[23] Vitiello, G. (1995): Dissipation and memory capacity in the quantum brain model, Int. J. Mod. Phys., B9, 973-989.

[24] Vitiello, G. (2001): My Double Unveiled. Amsterdam, John Benjamins.

MULTIDISCIPLINARY AND TRANSDISCIPLINARY APPROACH BASED ON BODY SCHEMA – CASE STUDY OF A 5-YEAR OLD GIRL WITH MILD DEVELOPMENTAL DELAY

Lovro Tacol[1], Tina Bregant[2]

1) Middle European interdisciplinary master programme in Cognitive Science (MEi:CogSci), University of Ljubljana, Slovenia

2) Ambulatory unit for preschool children, Health Centre Medvode, Slovenia

e-mail: lovro.tacol@gmail.com

ABSTRACT

In this paper we present a 5-year old girl E. T. with a mild developmental delay, primarily due to sensory and motor problems. We introduce the case through different perspectives, which mainly derive from different fields of practice of specialists who examined her. As girl's problems are complex and not easy to tackle, we turn from multidisciplinary to transdisciplinary approach through the perspective of body schema. Finally, we hypothesize that sensory integration therapy improves girl's body schema and thus facilitates her development the most.

1. INTRODUCTION

Observation of young children is a trained skill which helps a professional to know a child better. While observing how a child interacts with their peers, adults, and how they behave in different settings, one is getting to know the child without speaking to her. However, observation that isn't adequately skilled or repeated in different settings may mislead professionals into being judgmental. Teamwork of different specialists – i.e. the multidisciplinary approach to a problem – helps to take different perspectives at the child development. Review of documentation, interviews with parents, child, and professionals, interaction, and observation of a child point to several problem areas, which can be tackled only when the data obtained about the child are summed up. However, multidisciplinary approach sometimes looses the focus on the patient as every specialist is trained in their own way. Hence another, preferentially transdisciplinary approach should be used, so that the patient stays in focus and benefits the most.

Body schema is a postural model that keeps track of limb position and plays an important role in control of action. It involves aspects of both central (brain processes) and peripheral (sensory, proprioceptive) systems. It can be considered as the collection of processes that registers the posture of one's body parts in space [1]. It is important to make a clear distinction between body schema and body *image*. The former works on a subconscious level, unlike the latter which is thought to be a conscious knowledge of the body [2] or a set of beliefs, attitudes and perceptions about one's body [3]. For instance, when someone is walking down the stairs, his body schema registers the general shape and posture of his body without him actually being aware of it.

Recent brain imaging techniques ensure to have revealed neuronal substrates for human body schema [4]. A dynamic postural model is said to be computed especially in the primary motor cortex; here, proprioceptive signals from muscle spindles are transformed into motor commands, which may underlie the perception of limb movement and facilitate its efficient motor control. Somatic signals from different body parts are integrated in the course of hierarchical somatosensory processing, and activity in higher-order somatosensory parietal cortices is capable of representing a postural model of the entire body. The right fronto-parietal regions connected by the most inferior branch of superior longitudinal fasciculus fibers seem to have the functions of updating the body schema [4].

2. METHODS

In the ambulatory unit for preschool children a few children were observed during regular examination which included Denver testing. A 5-year old girl, E. T., was selected for the case study. Written consent for observing, filming, and documentation browsing was obtained from her parents prior to the study. We searched the child's medical records – exams, diagnostic tests, and different specialists' opinions and performed unstructured interviews with her parents. To understand her functioning better, the girl was filmed during medical examinations, spontaneous activity, and during sensory integration therapy.

3. RESULTS OBTAINED FROM THE MULTIDISCIPLINARY APPROACH

3.1. Medical records analysis

The child seemed to have developed normally in first few months, but around seventh month growth and especially motor development slowed down. She was examined by pediatrician and diagnosed with developmental delay and stunted growth. Year later she was treated by ophthalmologist and diagnosed with divergent strabismus. At four years pediatrician diagnosed her with social functioning disorder. Apart from physical exam some other diagnostic tools were used: MR brain imaging was done at 15 months and showed wider lateral ventricles and unmyelinated frontal and temporal regions in subcortical white matter. Psychologist described E. T. as calm, quiet, and generally unmotivated, especially for moving. Her motor performance at ten months was rated the third percentile (criterion based on WHO). She started to stand independently around the 13th month and started to walk around the 20th month. The girl spoke only few words till she was three years old. She is still very shy and uncomfortable around unknown people. However, she shows interest in communication and can interact appropriately when feeling comfortable with them. E. T. received extensive neuro-physiotherapeutic treatment and occupational therapy for two years and she still receives sensory integration therapy, logopedic treatment and special pedagogic support in kindergarten. Child's mother reported she is herself stiff and ponderous regarding movement and that her first child (E. T.'s older sister) also received neuro-physiotherapeutic treatment for hypertonia.

3.2. Observation, videotaping, and interviews

After careful observation of E. T.'s behaviour, we see her as an otherwise lively and happy child, but with diminished ability to successfully perform motor actions and fine movements, especially novel ones. She seems to have overcome the fear and uneasiness of initiation and carrying out specific movements neither. She just needs more time in order to choose the right movement strategy. While she is choosing it, she has learnt to search for external support in form of instructions and suggestions.

From the short video footages we get much more information than expected – very short, stiff movements, sometimes even in dystonic form become prominent. Interaction with the doctor can be easily observed as well. Footage clearly shows the problems with pointing to certain body parts which leads us to the concept of body schema.

E. T.'s mother points out that the child's father has also had quite poor motor skills as a child. Adding this to what was previously known from the family history and genetic background, we see girl's problems as more understandable.

4. TRANSDISCIPLINARY APPROACH – BODY SCHEMA

Even though different perspectives from different experts give a lot of information about the child's situation, we integrate and reflect them through a more holistic view. We conclude that E. T. doesn't have an adequate body schema. Since she doesn't have a good sense of her body (parts), she isn't as able to successfully perform motor actions as her peers; she also needs more time to choose the right movement strategy. Inadequate body schema could also help to explain why the girl is mainly afraid of her peers but not as much of adults. We presume that 5-year olds – who are typically very lively and playful – disturb E. T.'s peripersonal space, for instance when running and jumping around in the kindergarten during play. Assuming she doesn't balance her body very well (which is evident from watching her perform certain movements that require good balance on the sensory integration therapy) she is more easily "thrown off" the balance when suddenly approached by a fast moving "object", i.e. one of her peers. Following the same train of thought

the adults – typically being slower in movement and especially able to adapt to children – presumably act as a "stable shelter" and thus don't disturb the girl's private space and her body schema. The child's mother also reported she noticed that usually the bigger the person, the safer her daughter feels around that person. We also hypothesize that E. T's body schema could explain her divergent strabismus. We look at it as a result of an adaptive mechanism the girl employed and evolved to help her move through the environment. She may use one eye to "stabilize", to fixate her body in the surroundings – for example she fixated on her supporting mother, on some salient object near her or simply on a horizon – and the other eye to explore, to scan the environment. Throughout a person's life, body schema is thought to develop based on the sensory information used by the moving body and by its interactions with the environment [5].

We conclude that the sensory integration therapy facilitates E. T.'s development the most, because it challenges her to explore her body, the ever-changing environment and the interaction between the two – it therefore gradually improves her body schema. Even though some authors say that the body schema is a subpersonal mechanism that cannot be modified via acts of will [6], we assume that via appropriate sensory stimulation and controlling the balance while performing certain movements, it is possible to modify the musculoskeletal system – and thus the body schema. Child's mother indeed confirmed the biggest improvement in all the areas of development after this therapy.

5. CONCLUSIONS

We have learnt from this specific case that the observation of a child is very important, however, it must be done several times, in different settings, from different perspectives, which include different professionals. Videotaping can be of additional help as it helps us to record very brief movements, facial expressions, and also the course of action: its smoothness, sequential actions, and interaction with the environment.

Interaction with a child and interviews with parents are essential as well in order to understand a child better and offer her a meaningful therapy.

We believe that the girl benefited most from both multidisciplinary as well as transdisciplinary approach. As novel techniques were introduced and trained, and as new professional was involved, her daily routine was changed – but she and her mother accepted it. They were satisfied as daily routine of these children can become boring and the children can become tired of the same therapist and same exercises they are training every day.

The case of this girl showed us that when multidisciplinary approach does not yield success, one should turn to transdiciplinary approach. Shifting from a professional standpoint to a more holistic one can also be helpful.

6. ACKNOWLEDGMENTS

We thank E. T. and her parents, who were willing to participate and helped us learn from them.

References

[1] Holmes, N. and Spence, C. (2004). The body schema and the multisensory representation(s) of peripersonal space. *Cognitive processing*, *5*, 94–105.

[2] Sato, Y., Iizuka, H. and Ikegami, T. (2013). Investigating Extended Embodiment Using a Computational Model and Human Experimentation. *Constructivist Foundations*, *9*(1), 73–84.

[3] Gallagher, S. (2005). *How the body shapes the mind*. New York, NY: Oxford University Press.

[4] Naito, E. (2014). Neural representation of human body schema and corporeal self-consciousness. *Brain and Nerve*, *66*(4), 367–380.

[5] Assaiante, C., Barlaam, F., Cignetti, F. and Vaugoyeau, M. (2014). Body schema building during childhood and adolescence: a neurosensory approach. *Clinical Neurophysiology*, *44*(1), 3–12.

[6] Martinez-Pernia, D. and Ceric, F. (2011). Introduction to a Theoretical Model Based on Embodied Cognition: A Pilot Study of the Diagnosis and Treatment of Hemiphobia. *Top Stroke Rehabilitation*, *18*(6), 798–807.

IN DEFENCE OF PRECISE CREDENCES

Borut Trpin
Department of Philosophy
Faculty of Arts Ljubljana
Aškrčeva cesta 2, 1000 Ljubljana, Slovenia
e-mail: borut.trpin@gmail.com

ABSTRACT

Degrees of belief (credences) are standardly modelled by mathematical single-valued probabilities. There has recently been a lot of interest for imprecise credences which are multi-valued and usually represented as intervals of probabilities. I provide a coherence-based principle and two cases which demonstrate that there is no need for imprecise credences. Even more: they can lead to irrationality.

1 INTRODUCTION

The world we live in is full of uncertainties: we cannot know for certain how much the price of gas will rise or drop in the next days, whether it will rain tomorrow, who will win the election and so on. Proponents of the degree-of-belief interpretation of probability, also known as Bayesians (after their founder Thomas Bayes), made a popular claim that uncertainty requires rational agents to operate with degrees of beliefs (also known as credences) instead of full beliefs.

Credences are usually modelled as mathematical probabilities (from 0 to 1) with different probabilities being equal to different credences (the higher the probability the stronger the credence). This idea is at the core of Bayesianism, which has demonstrated that an agent can only be rational if her credences follow the laws of probability (Kolmogorov's axioms) [7]. While this interpretation has many problems of its own, one specific problem has recently caused a lot of debate amongst the researchers, namely, should the probabilities after which we model credences be precise or imprecise?

The introduction of imprecise probabilities (families of probabilities instead of single probabilities) has divided researchers in two camps: sharpers (proponents of precise credences) and non-sharpers (proponents of the imprecise approach). The main idea of non-sharpers is that precise credences are not strong enough: if an agent is confronted with imprecise (ambiguous, conflicting or scarce) evidence, she ought to adopt imprecise credences (modelled by imprecise probabilities). The sharpers, which I adhere to in this paper, on the contrary do not agree with them.

Imprecise probabilities *prima facie* look very appealing, but, as I will demonstrate, can lead to irrational behaviour. This means that the imprecise (non-sharp) evidence does not require imprecise probabilities (which is what motivates many non-sharpers, e.g. [8], [9], [10], [14]).

Does this mean that I should pretend I'm perfect (as the title question of Julia Staffel's draft [15] asks) and pretend all I ever deal with are risks and not uncertainties (in Knight's sense, [12])? My answer is short: No. (Usual) precise probabilities were introduced as a tool to deal with different credences and while there certainly are special cases, which raise philosophical interest, precise probabilities remain the most forceful way to deal with them. I will argue that the uncertain situations allow multiple possible precise credences, but not all at once (as imprecise credences suggest). I will develop my defence of the precise credences on two special cases, which seem to call for imprecision, and show why and how imprecise approach leads in wrong directions. These two cases are the jellyfish guy case and the Ellsberg paradox.

2 THEORETICAL FRAMEWORK

Let me first introduce a few theoretical considerations on the nature of imprecise probabilities, (im)precise credences and associated theoretical questions.

What exactly are imprecise probabilities in a formal language and how are they related to classical precise probabilities? Imprecise probabilities are a generalisation of precise probabilities. They are most often represented with intervals of probabilities, even though the spread can also be represented as a set of probability functions. It suffices to limit myself to interval-based imprecise probabilities as my defence depends on the fundamental idea that there a single credence cannot have multiple values. My objections can, though, also be applied to other representations of imprecise credences.

The interval-based imprecise credences are represented on an interval of precise probabilities with lower and upper probabilities as its endpoints. The idea to represent probabilities with intervals rather than singular numerical values is relatively old (one of the earlier proponents was the famous economist J. Keynes in 1920's [11]), but only gained wider recognition in the last twenty years or so. Imprecise probabilities were introduced for a variety of reasons, one of them being that sharp probabilities are over-informative. It seems very hard to pinpoint the exact probability of most events, so it is, according to the non-

sharpers, more accurate if an interval-based estimate is given. Pinpointing a precise probability (based on, e.g. maximum entropy principle) could in some situations mean that more information was introduced than evidence allows and this would lead to disastrous consequences (see van Fraassen's cube factory paradox [18]).
Another motivation for imprecise probabilities lies in their apparent similarity to psychological reality. Ascribing precise numerical values to credences strikes us as psychologically unconvincing. What does it mean to have, say, 0,563 credence that it will rain tomorrow? Even more, how could this particular number be more appropriate than 0,564? While historical accounts show that the earlier application of imprecise probabilities went into other directions (the before-mentioned Keynes, for example, used the imprecise approach in his work on logical probabilities), it is exactly this subjective interpretation of probability that gained the strongest momentum when applying imprecise probabilities to imprecise credences.[1]
An important theoretical difference between precise and imprecise credences is their conditionalization, i.e. updating prior credences when confronted with new evidence. Conditionalization is, at least theoretically, quite simple for precise credences. The most basic proceeding is as follows: a rational agent has some prior credence, $P_{prior}(H)$, and some conditional credence, P(H|E). When she learns *E*, her posterior credence changes to $P_{posterior}(H)=P(H|E)$. When confronted with imprecise credences, conditionalization basically works the same, but the whole process requires much more computation as every value in the interval is updated, conditional on the new evidence.

One of the main reasons that a rational agent should still prefer imprecise credences despite their computational complexity is, according to the non-sharpers, that imprecise credences provide higher accuracy. An imprecise credence of [0,3, 0,4] (between 0,3 and 0,4) in some proposition *P* is more accurate than a credence 0,34 in the same proposition given that its objective chance is not 0,34 but rather 0,341. This strikes as unnatural as we are more inclined to accept non-accurate but precise estimates than wider intervals, as Yaniv and Foster [19] have demonstrated in their psychological experiments. The higher accuracy is not hard to understand if the rain example is exaggerated: it is much more likely that the actual objective chance of tomorrow's rain is included in my credence if my credence is [0,1, 0,9] instead of 0,34. But even though this wider interval is more accurate, it is a lot less informative and almost useless. Non-sharpers are not unprepared for such objections and wouldn't agree with such a definition of accuracy. They constrain arbitrary widening (or narrowing) of the intervals with an important rule: lower credence should be exactly as low as the evidence minimally allows, while the upper should be as high as it allows. If a rational agent is faced with completely ambiguous evidence, her credence should thus be [0, 1]. The credence of tomorrow's rain of [0,1, 0,9] would thus be wrong as the evidence does not allow it (given that we do not live in England). This restriction makes imprecise credences much more attractive, but still leaves an important open question: how exactly to determine the correct (and after all precise) lower and upper boundaries? How could the credence of [0,3, 0,4] be acceptable, given some evidence, while [0,29, 0,41] would be wrong? This is a major problem for the standard interval-based credences as the upper and lower boundaries remain sharp (and thus subject to the same criticism as sharp probabilities). It is possible to envision a solution to this problem - boundaries could be non-sharp (a similar idea was suggested in [17]) so that the credence would look somewhat like this: $P(A) = {}_a[^b x, y {}_c]^d$; $0 \leq a \leq b \leq x \leq y \leq c \leq d \leq 1$ with [a,b] and [c,d] being boundaries defined as intervals. But it is obvious that we could repeat this process infinitely as boundaries of any interval are in essence sharp. This essential flaw is not just characteristic of interval-based credences but for all non-sharp probabilities: how to allow some singular credences and exclude some? The non-sharpers essentially remain sharp.
This opens the question of primary theoretical role of (prior) credences. Konek [13], discussing the related problem of the priors, listed a few of the most influential accounts:
1. Informational account: To accurately reflect the informational content of the agent's evidence.
2. Subjectivist account: To accurately represent the agent's opinions about the plausibility of hypotheses (or, more generally, propositions).
3. Practical account: To yield the most sensible decision-making policy under conditions of ignorance.
4. Instrumental account: To put us in a position to secure accurate, minimally luck-dependent posterior credences by updating on new data.

The practical account is problematic as the most sensible decision-making policy "depends on which epistemic perspective you evaluate it from" ([13], p. 9). Most non-sharpers adhere to informational and subjectivist accounts and both accounts depend on accuracy, which is in conflict with precision and informativeness (the less precise credences are the less informative they are). The instrumental account (Konek's position) remains the most promising of those listed. It directly suggests that credences are theoretical constructs and that their role should be defined by their relationship between prior and posterior credences. It remains problematic, though, as it aims at accuracy (alethic correctness), which is a sufficient, but not necessary aim for rational agents. I argue that the necessary principle should rather be coherence.
The problem with accuracy is that many researchers who aimed at it implicitly "derived deductive consistency as a

[1] It should be noted though that imprecise probabilities are successfully used in other scientific fields, like statistics and quantum physics.

coherence norm for full belief" [3]. Coherence, on the other hand, is a weaker principle than consistency. It still requires the credences to respect the laws of probability, but they do not need to be completely deductively consistent.

The preface paradox, a problem related to the difference between consistency and coherence, has recently been raised and it roughly goes as follows:

Imagine that you wrote a book and have reread every sentence many times looking for mistakes. Yet it is highly plausible that there may be some mistakes left, so you write in your preface that you are aware of this and that all mistakes were unintended. The paradox arises because of two inconsistent claims, both supported by your evidence:

1. Your evidence (thorough reading) suggests that every sentence of the book is free of mistakes.
2. Your evidence (past experience) suggest that human mind is prone to error, so there must be at least one mistake in the book.

The paradox arises because of the demand for consistency, which is a classical way to reach accuracy. One suggested solution is to withhold both claims, but as Easwaran and Fitelson [3] have demonstrated this is not the correct solution for rational agents. Rather than withhold both beliefs, one should withhold the demand for complete accuracy or as Fitelson and Easwaran have shown, one should aim for beliefs which avoid accuracy-dominance. It is fully rational to hold both of the claims (1) and (2), even though this might be inaccurate (and inconsistent). This occurs because accuracy is too strong constraining requirement for perfectly rational agents, so one is not only able to, but required to be perfectly rational with weaker constraints. To put it in simpler terms (departing from Easwaran and Fitelson's formally more detailed account, dealing with full beliefs): one should avoid accuracy-dominated credences for weaker, coherent (with regards to evidence) beliefs. This brings us to a coherence principle (CP):

CP: A set of credences is coherent, in the most simplified form, if there are no other sets of credences that are better supported by evidence, regardless of the situation we are in**.**

It is exactly this tension between consistency (accuracy) and coherence (best evidential support), which theoretically furthers the defence of precise credences. CP let's us recognize that the requirements of accuracy, one of the motivations behind imprecise credences, are too strong and that a weaker principle (CP), satisfiable by precise credences, is sufficient for a perfectly rational agent. Imprecise credences are, though, compatible with CP, but unnecessary. What is more: a perfectly rational agent should avoid them as they unjustifiably lower the informative value of her credences.

This leads us to a novel account of the theoretical role of credences, the so-called coherence-based instrumental account (C-B I);

C-B I account: The role of credences is to be defined by their prior-posterior relationship in regards to credence-updating. The role of prior credences is, thus, to put a perfectly rational agent in a position to secure coherent posterior credences that are best supported by evidence by updating on new evidence.

3 THE JELLYFISH GUY CASE

Still, there are some special cases that supposedly justify the use of imprecise credences. I refer to one of the more bizarre mental experiments, pointing in this direction, as the jellyfish guy case. It was introduced by Adam Elga [5] and goes as follows:

"A stranger approaches you on the street and starts pulling out objects from a bag. The first three objects he pulls out are a regular-sized tube of toothpaste, a live jellyfish, and a travel-sized tube of toothpaste. To what degree should you believe that the next object he pulls out will be another tube of toothpaste?"

A natural response is that I cannot have a precise credence. The whole situation is clearly bizarre and very unique. I have no past experience with strangers, who walk around with a jellyfish in their bag, so any precise credence (e.g. 0,2, 0,94, 0,53) could only be arbitrary. The only way out of it would be to apply the maximum entropy principle and say that I should have 0,5 credence that the next object he pulls out will be a tube of toothpaste, but this answer is unacceptable - there are no reasons to justify one (maximum entropy) or another principle. It is not that I do not have enough computational skills to determine the correct credence. The problem is that the evidence on hand does not allow me to determine which principle could be applied in this situation. As Elga [5] pointed out, this case is clearly artificial, but realistic scenarios have also been proposed. E.g. what is your credence that "the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in [40 years]" [5]? Such scenarios seem to call for non-sharp answers: if your evidence is essentially non-sharp, so should be your credences and it seems perfectly rational to do so.

Let me now show, why and where such claims go into the wrong direction. Imagine that my credence about the next item the stranger takes out of his bag is non-sharp, for example [0,3, 0,9]. Such credence is consistent (and hence coherent) with the strange evidence and very wide (non-sharpers claim that in cases of complete ambiguity, the rational credence is spread on the whole interval [0, 1]). The problem with such non-sharp credence is that it doesn't conform to the requirements of the C-B I account as I've listed it. Exactly how could holding such prior credence secure coherent posterior credence, best represented by evidence, if we were to update it? It doesn't. If I were

introduced to some new evidence (it would be on the news that there is a guy who walks around the town with a jellyfish, two tubes of toothpaste and a sock in his bag), my posterior credence would drop to [0, 0,3] (as I can still only be partially sure with such a bizarre guy). But this is not best supported by evidence: there is nothing in the evidence that demands a wide credence after all - it allows multiple (precise) possibilities, but not a single multiple-valued credence. It is only rational to have such multiple-valued credence in some rare cases like in quantum physics scenarios. A perfectly rational epistemological agent, confronted with the jellyfish guy case, should then have multiple possible credences (as the evidence is very vague) with all of them being precise as there are no evidential reasons for the opposite.

4 ELLSBERG PARADOX

The jellyfish guy case is very unrealistic, so we should consider another more famous example that non-sharpers often refer to: the Ellsberg paradox (so named after Daniel Ellsberg, who first introduced it in [6]). The paradox can be simply presented in the following way:

There is a vase about which you are know the following: there are 90 balls of three different colours inside. One third (30) of the balls are black and the other two thirds are either red or yellow.
You are offered two exclusive choices:
1.A: You get 10€ if you draw a black ball, or
1.B: You get 10€ if you draw a red ball.
and another two choices:
2.A: You get 10€ if you draw either black or yellow ball, or
2.B: You get 10€ if you draw either yellow or red ball.

The paradox arises because most people choose answers 1.A and 2.B, which are inconsistent. If you choose answer 1.A, this would mean that you believe there are more black balls than red. This implies that you believe there are less or equal than 30 red balls ($B=30 \geq R$), for example 29. Because you know that there are 60 yellow or red balls, this would also imply that you believe there are at least 30 yellow balls. So if there are 29 red balls, there need to be 31 yellow balls. If you evaluate answers 2.A and 2.B on this basis, you conclude that the option 2.A gives at least 60 balls (61 in my example), and the option 2.B at most 60 (59). If you choose answer 1.A, it would only be rational to choose the answer 2.A. The same holds if you initially choose 1.B (you think there are more than 30 red balls). It would then only be rational to choose 2.B. The paradox arises because, as said, most people choose two incosistent answers 1.A and 2.B.
This is usually explained by ambiguity aversion. Both options 1.A and 2.B are clear; the first gives 30 balls and the other 60 and this supposedly makes them more appealing. But as I am evaluating answers from the epistemological normative point of view in this paper, psychological reasons may be put aside.
Let's see why imprecise credences look appealing from the normative point of view and why they ultimately fail in comparison to precise credences. It is tempting to apply imprecise credences to cases like Ellsberg paradox. A rational credence about option 1.A would thus be 1/3, while it would be [0, 2/3] about 1.B]. 2.A would be [1/3, 1] and 2.B would be 2/3.
While such imprecise credences (1.B and 2.A) seem highly accurate, they do not provide any rational guidance on selection. How may a perfectly rational make the first choice between 1.A and 1.B? She can't, because there is no rational way of comparing which choice is better as one is precise and the other is imprecise. A correct set of choices (1.A, 2.A or 1.B, 2.B) would follow if this first choice was made, but there is no rational ground to make it. Our perfectly rational agent withholds her choice and gives up the possible prize, which is clearly irrational. This demonstrates another possible violation of the C-B I principle. If the main argument against imprecise credences in the jellyfish guy case was based on the nature of evidence, Ellsberg paradox shows they may lead to irrational withholding of choices (and the updating from prior to posterior credences doesn't take place).
This problem perishes if precise credences are used. Let's take a look at one of many evidentially possible sets of precise credences a perfectly rational agent may have:
1.A: 1/3, 1.B: 1/6; 2.A: 5/6, 2.B: 2/3. The rational choice would then directly follow: 1.A and 2.A. A formal proof that precise credences always lead to a set of choices with maximum expected utility could be provided, but is not necessary for our means.

5 CONCLUSION

These two special cases should provide sufficient support for my defence of precise credences against imprecise ones. More cases could be provided to show how imprecise probabilities lead to possibly disastrous consequences.
It would be, though, interesting to test the C-B I principle and the results of precise and imprecise credences in other important cases, which open some of the hot question in the philosophy of probability, like the Sleeping Beauty problem [4]. The problem is important because it tackles the question how to set the (rationally) fair prior credences.
It is by now also clear why imprecise credences are so appealing at the first sight: they look like a good representation of our actual credences - human agents (but also perfectly rational agents, as was shown by the jellyfish guy case) are often dealing with fuzzy evidence and the instinct is that our credences should then also be fuzzy (imprecise). The main problem is in the misunderstanding of the precise credences which allow multiple possibilities, except not all at once.
This arises mainly because the actual theoretical role of credences is not discussed often enough and the

interpretation one uses is often implicit and naive. We must be aware, though, that credences are theoretical constructs and so they should play a role most suitable for our fundamental epistemological principles. It should be noted, though, that there are no real reasons credences couldn't also take part in the empirical reasoning of common people [16].

I only pointed out problems that arise after using imprecise credences if they are confronted with my C-B I principle, but there are more problems for non-sharpers, which I haven't discussed. One of the most frequent attacks says that imprecise credences lead to probabilistic dilations which, roughly speaking, occur when a more precise estimate E changes to a less precise estimate E when new evidence F is learned (for a non-sharper's counterargument, see [1]).

To conclude on a happier note: imprecise probabilities are not defeated by my arguments. There are some great uses for them, for example in quantum physics and statistics. But there is really no place for imprecise probabilities in analyses of credences. So far.

References

[1] Bradley, S. and Steele, K. S. (2013). "Uncertainty, learning, and the "Problem" of dilation". *Erkenntnis.*

[2] Destercke, S. and Dubois, D. (2006). "A unified view of some representations of imprecise probabilities". *Conference paper.* SMPS.

[3] Easwaran, K. and Fitelson, B. "Accuracy, Coherence and Evidence." forthcoming in *Oxford Studies in Epistemology.*

[4] Elga, A. (2000), "Self-locating belief and the Sleeping Beauty problem". Analysis, 60: 143–147.

[5] Elga, A. (2010). "Subjective Probabilities should be Sharp" *Philosophers' Imprint.* 10:5.

[6] Ellsberg, D. (1961). "Risk, Ambiguity, and the Savage Axioms". *Quarterly Journal of Economics* **75** (4): 643–669.

[7] Hartmann, S. and Sprenger, J. (2010). »Bayesian Epistemology« In S. Bernecker and D. Pritchard (ed.), *Routledge Companion to Epistemology*. London: Routledge, 609-620.

[8] Jeffrey, R. (1983). Bayesianism with a human face. In John Earman (ed.), *Testing scientific theories*, p. 133–156. Minneapolis: University of Minnesota Press.

[9] Joyce, J. M. (2005). "How probabilities reflect evidence". *Philosophical Perspectives*, 19:153–178.

[10] Kaplan, M. (1996). *Decision Theory as Philosophy*. Cambridge: Cambridge University Press.

[11] Keynes, J. M. (1921). *A Treatise on Probability*. London: Macmillan And Co.

[12] Knight, F. H. (1921) Risk, Uncertainty, and Profit. Boston, MA: Hart, Schaffner & Marx.

[13] Konek, J. P. (2013). *New Foundations for Imprecise Bayesianism.* PhD thesis. University of Michigan.

[14] Levi, I. (1980). *The enterprise of knowledge*. Cambridge: MIT Press.

[15] Staffel, J. (2012) "Should I pretend I'm perfect?" *Draft.* University of Southern California.

[16] Staffel, J. (2013) "Can there be reasoning with degrees of belief?" *Synthese*, 190:16, p. 3535-3551.

[17] Sturgeon, S. (2008). "Reason and the grain of belief". *Noûs*, 42:139–165.

[18] van Fraassen, B. (1989). *Laws and Symmetry*, Oxford: Clarendon Press.

[19] Yaniv, I. and Foster, D. P. (1997). "Precision and accuracy of judgmental estimation". Journal of Behavioral Decision Making, 10: 21–32.

MOŽNOSTI NATURALISTIČNEGA POJMOVANJA DUHA

Andrej Ule, Odd. za filozofijo
Filozofska fakulteta, UL
Aškerčeva 2, 1000 Ljubljana
Tel. +386 1 241 1102; Fax: +386 1 4259 337
e-mail: andrej.ule@guest.arnes.si

Povzetek

Razpravljam o možnosti naturalistične razlage vznika duha, tj. duhovnih zmožnosti pri živih bitjih. Analiziram Batesonovo informacijsko-sistemsko teorijo duha, Peircejevo teorijo semioze in nekatere koncepte biosemiotike. Vsem tem pojmovanjem manjka teoretska razlaga vznika duha, predvsem (i) vznik interpretantov znakov in (ii) doživljajske perspektive iz nežive narave. Predlagam hipotezo o posebni trans-objektivni dimenziji perspektivičnosti, tj. realna možnost pridobivanja bolj ali manj izrazite doživljajske perspektive v obliki »biti X« za vse dovolj razvite naravne bitnosti. Zavzemanje doživljajske perspektive vključuje večjo občutljivost tudi za potencialne, ne zgolj aktualne dogodke, npr. povečano občutljivost za vse, kar je lahko v »korist« ali »škodo« nekega sistema.

Ključne besede: duh, informacijski sistem, semioza, biosemiotika, doživljajska perspektiva

Abstract: Possibilities of a naturalistic comprehension of the mind.

The article examines whether it is possible to provide a coherent naturalist explanation of the emergence of the mind (spirit), i.e. mental abilities of living beings. I analyze Bateson's informational-systemic theory of mind, Peirce's theory of semiotics, and some biosemiotic proposals. All of these concepts fail to provide a plausible theoretical explanation of the emergence of mind, particularly (i) the emergence of the interpreters of signs and (ii) the emergence of the experiential perspective out of the non-living nature. I propose a hypothesis of the trans-objective perspectivity dimension, i.e. the real possibility of acquiring a more or less distinctive experiential perspective in the form of like-to-be-X for all sufficiently developed natural entities. Taking on an experiential perspective also contains a greater sensitivity for not only actual, but also potential events, e. g. a greater sensitivity for everything that can be "useful" or "harmful" to the system in question..

Key words: mind (spirit), information system, semiozis, biosemantics, experiential perspective

Vsak povedni stavek, vsaka misel propozicionalne vrste z vsebino *p*, je logično ekvivalenten stavku, misli *p in* (*q ali non-q*), prav tako tudi stavku, misli *p ali* (*q in non-q*), ker je še razmeroma evidentno, a je logično ekvivalenten tudi stavku, misli *če* (*če q, potem q*), *potem p* in še nekaterim tovrstnim stavčnologičnim kompozicijam. Na prvi pogled se to zdi izumetničeno »logificiranje«, čeprav je logično gledano povsem korektno. Zdi se, kot da vsak stavek implicitno predpostavlja vse druge stavke, saj namesto *q* lahko postavimo katerikoli drug stavek. Podobno je ugotavljal sicer že Wittgenstein, ko je v *Traktatu* zapisal: »Če so dani elementarni stavki, so nam dani že *vsi* elementarni stavki« (5.524). Drugače rečeno, z vsakim stavkom mora biti dana *možnost kateregakoli drugega stavka*, podobno mora z vsako propozicionalno mislijo biti dana *možnost katerekoli druge propozicionalne* misli.

Vsak smiselni stavek (misel) tako »implicira« ves *logični prostor* jezika ali mišljenja, tj. vse možne logične operacije z njim in drugimi možnimi stavki (mislimi). Teh stavkov je seveda neskončno mnogo, ta neskončnost ni nikoli aktualna, le potencialna. Bistveno je, da je ta potencialnost dana skupaj z vsakim uporabljenim stavkom ali dejansko propozicionalno mislijo, ne pa morda posebej dodana ali »vprogramirana« v možganih. Omenjena implikacija seveda ni stavčnologična implikacija »če – potem«, temveč neka zveza med dejanskim in možnim, ki se (prosto po Wittgensteinu) zgolj kaže na stavku (misli), če ga dejansko uporabimo (mislimo).

To se mi zdi presega zmožnosti vseh sodobnih računalnikov in v tem smislu lahko trdim, da noben od njih (še) *ne govori* in *ne misli*. Ljudje zgolj *interpretiramo* »vedenje« sedanjih računalnikov kot govor ali mišljenje. Govorim tudi o *duhovni zmožnosti* ljudi, kajti omenjena zveza dejanskosti in potencialnosti je značilna za vse duhovne zmožnosti in edino za duhovne zmožnosti. Te zmožnosti so same po sebi enotnost dejanskih mentalnih pojavov določene vrste (npr. misli, stavkov, predstav, metafor, namer, stremljenj) in neskončnih možnosti povezovanja in navezovanja pojavov z drugimi pojavi sorodne vrste. Takšne zmožnosti terjajo posebno obliko občutljivosti živega bitja za potencialne, ne le dejanske, aktualne razmere, v katerih se nahaja in sposobnost mentalnega nanašanja na možne, ne le dejanske procese, zlasti za dejanska in možna lastna dejanja in dejanja drugih živih bitij, s katerimi je dano živo bitje v stiku. To terja dokaj kompleksne oblike kognitivnih modelov situacij, »teorij uma« in dojemanja aktualnosti in potencialnosti samega sebe skozi te modele. Praviloma pripisujemo duhovne zmožnosti le ljudem, vendar nekatere raziskave kažejo, da so določeni zametki duhovnih zmožnosti prisotni tudi pri višje razvitih živalih (primatih, delfinih in kitih, nekaterih ptičih) (Boesch, 2007, McGrew, 2011).

S tem ne izključujem možnosti, da lahko tudi računalniki in podobna informacijska orodja lahko kdaj izkažejo duhovne zmožnosti, vendar morajo pred tem postati informacije, ki jih prejemajo in obdelujejo, *relevantne za njih same* in ne zgolj za nas, ki uporabljamo njihove »usluge«. To pa pomeni, da morajo pridobiti določeno vrsto *doživljajske perspektive*, tj. dojemanja (zaznavanja in ocenjevanja) situacij, ki so zanje relevantne s stališča danega infomacijskega sistema kot celote. Kolikor mi je znano, pa smo ob vsem neznanskem razvoju računalništva in umetne inteligence danes še daleč od tega. O tem sem več pisal v svojem poglavju v knjigi »*Mind in Nature*« (Ule, 2012).

Če želimo »naturalistično« pojasniti razvoj duhovnih zmožnosti pri ljudeh in na sploh pri živih bitjih, moramo torej nekako »naturalizirati duha«. To pa je seveda laže reči kot storiti. Do sedaj je bilo le malo resnih poskusov neredukcionistične naturalizacije duha, tj. razlage brez končne eliminacije duha kot zgolj antropomorfnega gledanja na pojave, ki se je razvilo tekom naravne in kulturne evolucije.

Eden resnejših poskusov neredukcionistične in vendar naturalistične razlage razvoja in pojava duha predstavlja sicer že nekoliko »postarana«, a po mojem mnenju še vedno zanimiva in pomembna sistemska teorija duha, kot jo je razvijal ameriški biolog, antropolog in terapevt Georg Bateson. Najbolj koncizno je o tem govoril v svoji zadnji knjigi »Duh v naravi« (*Mind in Nature*, 1992), kjer je postavil deset meril za to, da nekemu bitju, procesu ali sistemu pripišemo značaj duha. Bateson navaja naslednje značilnosti oz. »kriterijev« duha oz. sistemov, ki jih lahko imamo za duhovne ali »mentalne« v širšem smislu:

1. Duh je sestav delov ali komponent, ki interagirajo med seboj.
2. To interakcijo poganjajo razlikovanja. Razlika je nesubstancialna, ne obstaja v prostoru in času, temveč je v bolj odnosu z informacijo (kot negaentropijo) in entropijo kot energijo.
3. Mentalni (duhovni) proces zahteva dodatno energijo.
4. Mentalni proces terja krožne (ali še kompleksnejše) verige določil.
5. V mentalnem procesu se učinki razlik štejejo kot transformacije (tj. kodirane vrednosti predhodnih dogodkov). Pravila takšnih transformacij morajo biti razmeroma stabilna (tj. bolj stabilna kot vsebina), čeprav so tudi sama podvržena transformacijam.
6. Opis in klasifikacija teh transformacijskih procesov vsebuje hierarhijo logičnih tipov, ki so imanentni obravnavanim pojavom (Bateson, 1992: 92).

Sistem, ki ima *vse* te značilnosti, je po Batesonu duhovni sistem, oz. *sistem duha* in poseduje *mentalnost v širšem smislu*. Po Batesonovem mnenju tem »merilom« duha ustrezajo npr. mišljenje, evolucija življenja, ekologija, življenje, učenje ipd. To je seveda zelo širok in za marsikoga verjetno neobičajen nabor duhovnih oz. mentalnih procesov. Zanimivo, da med njimi npr. ni doživljajske zavesti, ta je za Batesona le nek epifenomen globlje in nezavedne mentalne dejavnosti. Duh je za Batesona očitno imenenten naravnim procesom in sistemom določene vrste, nikakor ni naravi transcendenten. Za Batesona je za duha odločilen peti kriterij, ki ga Bateson včasih na kratko povzame tudi v svoji znani opredelitvi informacije: *informacija je razlika, ki proizvede razliko*. Pri tem je prevzel osnovno zamisel klasične Shannonovske opredelitve minimalne informacije kot minimalno razliko, ki jo lahko prepozna nek informacijski sistem, vendar jo je nadgradil z idejo, da mora informacija proizvesti neko drugo, novo razliko. Kje jo proizvede? V sistemu ali procesu, ki je »občutljiv« za razlike določene vrste in »ustrezno«, tj. po določenih pravilih reagira tako, da se v njem sproži nova razlika. Ta razlika lahko dalje proizvaja še celo verigo novih in novih razlik v sistemu (npr. nek vidni signal, ki deluje na percepcijski organ, deluje nanj le tedaj, če predstavlja kako prostorsko ali časovno razliko glede na dotedanje stanje organa, ta razlika se nato lahko pretvori v ustrezno razliko živčnih impulzov, ki potuje po živčnem sistemu in se dalje pretvarja, morda proizvede celo kak enostavni zavestni vtis, ki je prav tako enostavna razlika med zaznamki).

Bateson dalje terja od mentalnih procesov, da transformacije razlik potekajo kot kodiranje in dekodiranje predhodnih vrednosti po določenih pravilih, ki ustrezajo določenim logičnim zahtevam, npr. zahtevi, da vsako kodiranje ali dekodiranje poteka v določenem »kontekstu razumevanja« informacije, pri čemer določila konteksta ne morejo biti ali postati kaka vrednost ali informacija znotraj tega konteksta samega. To zahtevo je Bateson izpeljal iz Russellove teorije logičnih tipov, po kateri noben razred (množica, kontekst) ne more biti član samega sebe, ker sicer sledijo razni logični oz. splošneje, komunikacijski paradoksi. Od tod izhaja Batesonov šesti kriterij za obstoj duha, namreč obstoj določene hierarhije logičnih tipov kodirnih oz. transformacijskih kontekstov, ki jih Bateson včasih opiše kot hierarhijo sporočil, metasporočil, meta-metasporočil itd., ki pa je imanentna informacijskim sistemom samim, ne pa npr. zgolj značilnosti njihovih opisov v naših, človeških teorijah o njih.

Sistem z duhovnimi značilnostmi ima po Batesonu sposobnost avtonomnega uravnavanja svojega vedenja v okolju, dalje tak sistem je sposoben umiranja, tj. prekinitve informacijskih krogotokov in s tem konec svoje avtonomije, sistem je sposoben spominjanja, učenja in učenja učenja in končno, sistem je sposoben povezovanja z drugimi sorodnimi sistemi v obsežnejše celote, ki v nekaterih primerih lahko postanejo novi, obsežnejši sistemi z duhom (prav tam: 127).

Bateson se sprašuje tudi, ali so sistemi z duhom nujno zavestni. To ni nujno, ker je zavest epifenomen zelo visoko elaborirane oblike duha. Res pa je vsak tak duhovni sistem sposoben nečesa manj kompleksnega, namreč lahko prepozna podobnost in razlike med značilnostmi drugih sistemov in lastnimi značilnostmi. V eni svojih prejšnjih knjig, zbirki člankov »Koraki k ekologiji duha« (*Steps to*

an Ecology of Mind) je Bateson navedel še nekaj pomembnih značilnosti ali znakov sistemov z duhovnimi značilnostmi, npr. to, da so to značilnosti teh sistemov kot celot, ne pa njihovih delov (Bateson, 1992: 322). To pomeni, da ni smiselno spraševanje, »Ali lahko računalnik misli« ali »Ali je duh v možganih?«, kajti računalnik je zgolj en lok obsežnejšega krogotoka, ki vključuje med drugim tudi ljudi, ki delajo z računalnikom in mu posredujejo informacije ali uporabljajo informacije, ki jih posreduje računalnik. Le o tem obsežnejšem sistemu se po Batesonu lahko smiselno vprašamo, »ali misli« in odgovor na to vprašanje je po Batesonu nedvomno, »da«. Kar pa ne pomeni npr., da ima ta sistem tudi zavest, saj zavest ni nujna za duha in mišljenje. Podobno tudi ne moremo smiselno govoriti o duhu v možganih, kajti možgani so le en od podsistemov človeka, pa tudi posamezni človek je le sestavni del obsežnejšega življenjskega sistema, v katerem lahko preživi (prav tam: 323).

Po Batesonu »človeški duh« biva le v tem obsežnejšem sistemu, torej ni niti v možganih niti le v posamezniku, kar pa zopet ne pomeni, da je tak sistem tudi zavesten. Bateson je s tem svojim pojmovanjem postal eden začetnikov teorije o *eksternalizaciji duha*, tj. teorije o duhu, ki ni zamejen le z mejami možganov, pa tudi ne z mejami posameznega mislečega organizma. S tem je skušal Bateson preseči po njegovem mnenju nesmiselne dualizme, kot je npr. med duhom in snovjo ali med notranjim in zunanjim. Batesonova teorija je izjemno zanimiva in pomembna, vendar očitno pomanjkljiva, kajti manjka ji nemara odločilni člen ali vidik duhovnosti, namreč *razumevanje* sporočil, informacij, znakov. To pa zato, ker razumevanje nujno vključuje doživljanje in smiselno dojemanje informacij, ki jih kak duhovni sistem prejema ali sporoča drugim duhovnim sistemom. To pomanjkljivost lahko odpravimo ali vsaj omilimo z upoštevanjem Peircejeve semiotike.

Charles Sander Peirce je namreč postavil izjemno pomembno hipotezo o naravi, delovanju in logičnih lastnostih znakov. Peirce razume znak kot pomenljivo bitnost, ki ima svoj pomen le v okviru trojiške relacije med *fizično ali duševno prezenco znaka* (t.i. prvost), *označenim predmetom* (t.i. drugost) in *interpretantom, ki razume znak* kot pomenljiv in v odnosu do označenega predmeta (t. i. tretjost) (Peirce, 1985). Znakovna relacija je torej v osnovi naslednja: Interpretant tolmači A (razume) znak B kot predstavnika (reprezentanta) predmeta C.

Po Peirceju je znakovna trojiška relacija celota, ki se je ne da sestaviti iz posameznih členov, vzetih za sebe ali iz treh podrejenih dvojiških relacij: prezenca znaka – označeni predmet, interpretant – označeni predmet in interpretrant – prezenca znaka. Interpretant je za Peirceja predstavlja duhovno komponento znakovnega odnosa, ki se pri ljudeh uteleša v človeški zmožnosti razumevanja jezikovnih in nejezikovnih znakov in mišljenja. Peircejeva teza o nujni triadični semiotski relaciji seveda nasprotuje sicer precej uveljavljeni De Saussirjevi in nato strukturalnistični tezi o bistveno diadični naravi semioze, namreč kot odnosa med označevalcem in označencem, a v razpravo o tem, kdo ima tu (bolj) prav se na tem mestu ne bom spuščal. Sam seveda podpiram Peircejevo tezo.

Peirce je uvedel danes zelo uveljavljeno razliko med vrstami znakov: ikonami, indeksi in simboli. *Ikone* se nanašajo na predmet zaradi ali ob pomoči podobnosti med znakom in predmetom, interpretant mora le prepoznati to podobnost, *indeksi* se nanašajo na predmet ob pomoči vzročno-posledične povezave, oni so neposredne posledice pojavljanja predmetov v določeni situaciji, interpretant mora le zaznati to povezavo in na njeni osnovi »sklepati« na pojav označenega predmeta. *Simboli* pa se nanašajo na označeni predmet na podlagi kakega posebnih pravil ali konvencij, ki so sprejete v skupnosti tistih, ki uporabljajo dani znak. Interpretant mora tu poznati dana pravila ali konvencije, šele potem lahko razume simbol. Jezikovni znaki so npr. tipični primeri simbolov. Peirce je priznaval sposobnost za semiozo tudi nekaterim razvitejšim živim bitjem, ne le ljudem.

Ker po Peirceju vse vzročno-posledično delovanje poteka po sekvencah dvojiških relacij med vzroki in učinki, semiotska relacija presega sleherno vrsto vzročnosti in s tem presega domeno fizične realnosti. Za Peirceja je prav obstoj fizično nezvodljive trojiške relacije, ki jo predpostavlja sleherna smiselna raba znakov, eden od dokazov za nefizičnost duha in obenem za njegov obstoj v naravi. Vendar tako kot Bateson tudi Peirce od tod ni sklepal na transcendentnost duha glede na naravo, pač pa je spekuliral o spontani emergenci sposobnosti za oblikovanje semiotskih odnosov v poteku biološke in nato kulturne evolucije živih bitij. Žal te svoje domneve Peirce ni natančneje formuliral. Peirce je ob koncu življenja razvil neke vrste panteizem ali bolje, panpsihizem, po katerem je vsa narava, tako neživa kot živa na nek način vsaj potencialno oduhovljena, vendar je duh v naravi prisoten latentno in se v toku evolucije postopoma skristalizira oz. realizira v pojavu živih bitij, ki so sposobni za semiozo, tj. smiselno kreacijo in uporabo znakov. To seveda spominja na Batesonovo domnevo o evoluciji sistemov duha (t.i. kreature) iz fizične narave (t.i. plerome), pa tudi na Whiteheadovo procesno metafiziko (Whitehead, 1978).

Bateson v svojih delih vsaj izrecno ne predpostavlja triadične semiotske relacije, zdi se, da mu povsem zadoščajo procesi kodiranja in dekodiranja sporočil (informacij), ki so lahko bolj avtomatski (kot je npr. pri manj razvitih živih bitjih) ali bolj zavestni oz. namenski (pri ljudeh in bolj razvitih živih bitjih). Vendar, kot smo videli, Bateson meni, da gre v obeh primerih lahko za procese z duhom, če le nastanejo v sistemih, ki ustrezajo Batesonovim merilom za nastanek in obstoj duha. Vendar natančnejši pregled Batesonove teorije pokaže, da tudi on pozna razne vrste semiotskih trojnosti, le da jih ni nikjer ekspliciral. Bateson npr. govori o medsebojni povezanosti pojavov hipne afekcije (danes bi morda dejali trenutnega »zaznavanja kvalij«), enostavne zaznave in enostavnim učenjem (tvorjenjem elementarnih navad), kar je biološki

proces na povsem elementarni ravni pri vseh živih bitjih, sposobnih čutne zaznave svoje okolice. To je podobno Peircejevi trojici med prvostjo, drugostjo in tretjostjo na primeru elementarnega »oblikovanja navad«.

Na nekoliko višji ravni je pri Batesonu podobna trojica: pripravljenost za sprejemanje struktur/oblik - preprosto zavedanje struktur/form – oblikovanje obsežnejših »vzorcev, ki povezujejo« enostavne zaznave v kompleksne zaznavne vtise, še višje pa trojica: občutljivost za estetske značilnosti zaznanega predmeta – sprejemanje informacij – oblikovanje »zavesti o svetosti« narave (Eicher-Catt, 2008). Tudi te trojice so podobno nerazdvojljive kot Peircejeva semioza. Zato se zdi povsem smotrno, dopolniti Batesonova merila za duha še z dodatno zahtevo, namreč da mora »duhovni sistem« omogočati razvoj nerazdvojljive triadične semiotske relacije: znak-objekt-interpretant.

Sodobnejšo verzijo teorije o porajanju duha v živi naravi najdemo v t.i. biosemiotiki, danes že precej razviti vedi o porajanju in obstoju semiotskih odnosov v živi naravi. Osnovna teza biosemiotike je, da vse življenje (ne le pri živalih, temveč tudi pri rastlinah, bakterijah in virusih) sloni na semiozi, tj. na znakih, informaciji in kodih (Sebeock, 1985, 2010; Barbieri, 2010; Hoffmeyer, 2010). Vendar je vprašanje, ali v vseh območjih življenja res lahko govorimo o Peircejevskem tipu semioze, ki povsod predpostavlja interpretante znakov, saj se zdi, da npr. vsaj genetsko kodiranje in dekodiranje v DNA in RNA ne potrebuje nobenega interpretanta, ker potekajo ti procesi povsem avtomatsko, seveda nezavedno in povsem vzročno-posledično. Pravzaprav le morda ljudje tem procesom pripisujemo peircejevsko-semiotski značaj, tj. mi postajamo dodatni interpretanti dogajanja. Vendar obstajajo tudi drugačna tolmačenja tega procesa, npr. da celični sistem, ki proizvaja proteine na podlagi zakodiranih sporočil, podanih v genski strukturi DNA, predstavlja elementarno obliko znakovnih interpretantov, torej gre tudi tu morda za zelo preprosto obliko peircejevske semioze (Barbieri, 2010). V tem smislu lahko sprejmemo misel Thomasa Sebeoka, da ni absolutne meje, kjer bi semiotika živih sistemov (zoosemiotika) naenkrat prešla v antropo-semiotiko. Sebeok se ob tem sklicuje tudi na ugotovitev francoskega biologa in filozofa Francoisa Jacoba, ki je pri vseh sesalcih ugotavljal sposobnost delovanja glede na določene predmete tudi brez njihove zaznave. To je sposobnost za simboliziranje in predstavlja neke vrste filter med organizmom in njegovim okoljem (Sebeok, 1985: 302)..

Lahko torej sprejmemo osnovno zamisel naturalizacije duha, kot se nam ponuja skozi misel Peirceja, Batesona in nekaterih avtorjev biosemiotike, namreč da obstaja neka evolucijska kontinuiteta v razvoju semioze od prvih živih bitij do človeka in v tem smislu lahko govorimo o »duhu v naravi«. Vendar ostaja odprtih nekaj težavnih vprašanj. Če drži Peircejeva ugotovitev o nujni triadičnosti vsake semiotske relacije in o njeni neizpeljivosti iz zgolj diadičnih vzročno-posledičnih povezav med dogodki, potem ne vemo, kako lahko naturalistično razložimo vznik semioze iz nežive narave, ki naj bi bila podvržena zgolj vzročno-posledičnim povezavam. Podobno vprašanje se zastavlja Batesonu, namreč kako lahko v naravi iz območja fizikalno-kemijskih procesov vzniknejo informacijski sistemi, ki smiselno »mapirajo« značilnosti okoliških teritorijev. Peirce je vprašanje o vzniku semioze »rešil« le spekulativno s svojo pan-spiritualno hipotezo, po kateri je semioza potencialno prisotna v vsej naravi, torej tudi v ti. neživi snovi, npr. v atomih. Bateson ni šel tako daleč v razširjanju duha na vso naravo, ker ni sprejemal ideje, da imajo temeljni gradniki snovi, tj. atomi ali atomski delci kakega duha, ker pač niso informacijski sistemi. Zato na podlagi svojih teoretskih opredelitev ni mogel pojasniti vznik informacijskih sistemov iz neinformacijskih sistemov. Nekateri zagovorniki Batesonovih osnovnih idej ponujajo različne dopolnitve Batesonove teorije, ki naj zapolni ta manko. Tyrone Cashman je npr. predlagal, da je podlaga mapiranju sposobnost organizmov, da se dejavno odzovejo na predmet svoje zaznave in zaznajo tudi učinke svojega delovanja. Tako se vzpostavi enostavni povratni krog med vedno posredno zaznavo okolja in neposrednim delovanjem nanj, kar je nato podlaga semioz in intencionalnosti doživljanja (Cashman, 2008). Terrence Deakon in Jeremy Sherman pa sta predlagala, da so manjkajoči evolucijski člen, ki je posredoval med neživim in živim svetom t. i. avto-celice, ki naj bi obstajale iz recipročnih povezav med avtokatalitičnimi krogotoki in procesi spontanega zapiranja avto-celice pred rušilnimi vplivi iz okolja. Molekularne sestavine za tovrstno zapiranje so bili tudi rezultati avtokataliz. Podobne sisteme še danes najdemo pri preprostih virusih in včasih ne potrebujejo niti molekul DNA in RNA. Po Deakonu in Shermanu so avto-celice predstavljale preproste zasnove individualnosti, usmerjenosti k ciljem, zaznavanja in ocenjevanja dogajanja okrog njih (Deakon, Sherman, 2008). Obe navedeni domnevi sta zanimivi in verjetno nujna naravna pogoja za razvoj preprostih primerov semioze pri živih organizmih, vendar manjka še veliko, preden bomo lahko pojasnili nastanek prvih pravih naravnih kodirnih procesov in sistemov, kot jih poznamo npr. pri molekulah RNA in DNA.

Biosemiotiki se na splošno izogibljejo vprašanju, kako semioza vznikne iz nesemiotske fizično-kemijske stvarnosti, kar seveda vprašanja ne reši, temveč ga le odlaga dokler se ne ponudi kakšna sprejemljiva naturalistična razlaga. Seveda obstaja še možnost kake transcendentalne, s pomočjo kake izven- ali nad-naravne hipoteze, npr. s kreacionizmom, vendar zagovorniki naturalizacije duha te razlage seveda ne sprejemajo. Sam pa zastavljam še en, po moje težji problem, ki sem ga na kratko omenil že prej, namreč kako naturalistično razložiti vznik organizmov z lastno (notranjo) doživljajsko perspektivo. Posedovanje lastne doživljajske perspektive je po mojem mnenju nujni pogoj za vznik višjih oblik semioze, npr. tistih, ki vključujejo kompleksno zaznavanje raznih življenjskih situacij in anticipiranje možnih

prihodnjih dogajanj, npr. možnih odzivov drugih organizmov na lastno vedenje v dani situaciji. Seveda je posedovanje lastne doživljajske perspektive nujno tudi za vznik mišljenja in jezika. Moram poudariti, da lastna doživljajska perspektiva ne pomeni nujno posedovanja zavesti o samem sebi, predstavo o jazu ipd. To so primeri visoko razvite doživljajske perspektive, ki jih po sedanjih podatkih ne smemo raztegniti čez mejo človeškega sveta. Vendar lastna doživljajska perspektiva lahko vsebuje tudi precej bolj elementarne oblike. Grobo rečeno, je dovolj že sposobnost organizma za urejanje čutnih vtisov v skladu s svojo reprezentacijo samega sebe, tj. oblikovanje nekakšnega središča svojih čutnih vtisov, ki potem predstavlja izhodišče ali centralno referenčno točko pri ocenjevanju možnih, ne zgolj dejanskih potekov dogodkov v življenjsko pomembni okolici organizma (Ule, 2012: 176-7).

Lahko domnevamo, da imajo vsi organizmi, ki imajo možgane (tj. vsaj od vretenčarjev dalje) sposobnost notranjega mapiranja okolja zunaj sebe v neki notranji reprezentaciji, vsaj bolj razviti vretenčarji pa imajo verjetno tudi sposobnost mapiranja samega sebe v okviru reprezentacije okolja. Od tu je le korak do vznika lastne doživljajske perspektive. Dejansko lahko vsaj pri sesalcih predpostavljamo, da poznajo lastne doživljajske perspektive. Vendar nastopi tu vprašanje, »od kje se vzame« kaka doživljajska perspektiva, kajti logična analiza možnih opisov teh perspektiv pokaže, da teh opisov ne moremo v celoti prevesti ali reducirati na opise s stališča tretje osebe. O tem lepo govori znameniti Nagelov spis »Kako je biti netopir?« (Nagel, 1979) Poleg tega doživljajska perspektiva terja obstoj ti. »notranjih« kvalij, tj. dalje nezvodljivih kvalitet tistih občutkov, ki se glede na reprezentacijsko shemo organizma locirajo v »notranjosti« organizma (ali na njegovi telesni površini). Tudi teh občutkov ne moremo v celoti zvesti na reprezentacije objektivnih stanj stvari brez doživljajske perspektive. Zato sem že v nekaj svojih spisih predlagal domnevo, da ima sama materialna stvarnost (tj. materialni kozmos) poleg prostorsko-časovnih dimenzij tudi *dimenzijo perspektivičnosti*, tj. realna možnost pridobivanja bolj ali manj izrazite doživljajske perspektive v obliki »biti X« za vse dovolj razvite naravne bitnosti (Ule, 2001: 315-321; 2008: 167- 175; 2012: 183-188).

Za sedaj razumem svoj govor o »dimenziji perspektivičnosti« bolj kot koristno metaforo trans-objektivne možnosti zavzemanja doživljajske perspektive za vse dovolj kompleksne naravne bitnosti kot za izdelan teoretski koncept. Vendar tudi ta metafora po mojem mnenju ponuja možnost nadaljnje izdelave ustreznega znanstvenega koncepta *potenciala perspektivičnosti*. Ne predpostavljam nobenih merljivih določil tega pozicioniranja bitnosti glede na to dimenzijo, čeprav lahko vsaj v orisih razlikujem različne stopnje ali intenzivnosti pozicioniranja. Predpostavljam tudi možnost pomikanja po »osi« perspektivičnega pozicioniranja od najbolj preprostih oblik pozicioniranja brez kognitivne zavesti, čustvenega pozicioniranja do miselne zavesti o lastnem jazu, kot jo pozna človek, morda so možne še višje oblike.

V načelu moramo priznati možnost zavzemanja doživljajske perspektive vsem bitnostim, ki so razvile občutljivost za to, kako poteka njihovo življenje v odnosu do drugih živih bitij, s katerimi prihajajo v stik. Če sprejmemo trans-objektivno *možnost zavzemanja lastne doživljajske perspektive*, ki je lastna naravi in se lahko aktualizira v določenih okoliščinah, potem lahko vsaj v načelu razumemo transformacijo od stanja domnevno popolne odsotnosti kakršne doživljajske perspektive (stanje opisljivo le s stavki v tretji osebi) v stanje, ko neka bitnost pridobi generično in individualno doživljajsko perspektivo (jezikovno to opišemo s pomočjo stavkov v prvi osebi). Od tega ne izključujem tudi neživih bitnosti, npr. kaki sistemi umetne inteligence ali roboti. Svoje domneve ne razširjam v kak panpsihičen sistem (kot sta storila npr. Peirce in Whitehead, pa tudi Nagel), torej ne predpostavljam nobene kozmične ali transkozmične zavesti, kozmičnega ali transkozmičnega duha ipd. Res pa je, da moja hipoteza takšne zavesti ali duha ne izključuje. Dopuščam pa, da v pri mnogih naravnih bitnostih obstaja neke vrste predzavestna občutljivost za realni potencial, ki ga vsem naravnim bitnostim ponuja dimenzija perspektivičnosti. Kako daleč »nazaj« v živo in morda neživo snov sega ta občutljivost, ne morem utemeljeno soditi.

Zavzemanje doživljajske perspektive vključuje večjo občutljivost za potencialne, ne zgolj aktualne dogodke, npr. povečano občutljivost za vse, kar lahko »koristi« ali »ogroža« obstoj nekega sistema, ki pozna kako obliko semioze (ali »duha« po Batesonu). S tem se poveča tudi njegova zmožnost preživetja v nepredvidenih, težavnih okoliščinah. Domnevam, da poznamo ljudje neko generično dano (tj. evolucijsko nastalo) in dalje socio-kulturno obliko lastne doživljajske perspektive, ki ima različne oblike in stopnje, npr. miselno in ne zgolj čustveno ali občutenjsko samozavedanje (zavest o lastnem jazu).

Sedaj se lahko vrnem k začetku svojega teksta, namreč k vprašanju, kako je možno dojemanje stavkov ali misli v prostoru možnih logičnih operacij z njimi. Ugotavljali smo, da se vsak uporabljeni povedni stavek, vsak dejanska misel implicitno nanaša na v načelu neskončno množico drugih stavkov ali misli, s katerimi se lahko povezuje v nove stavke ali misli. Ugotavljali smo, da to nanašanje ne moremo razumeti po vzorcih fizične vzročnosti. Tu gre za poseben primer interpretacije znakov, tokrat jezikovnih ali miselnih znakov stanj stvari, ki jih opisuje dani stavek oz. misel. Gre za poseben, zelo izrazit primer nemožnosti redukcije triadične sheme semioze na konjunkcijo diadičnih odnosov. Vendar po moji hipotezi lahko tudi vznik zmožnosti mišljenja in govora v evoluciji lahko vsaj v načelu razložimo kot posebno, evolucijsko in nato socio-kulturno podprto obliko semioz, ki vsebuje podobno visoko razvito obliko doživljajskega pozicioniranja govorno-miselnih akterjev. Vsaj meni se zdi samoumevna

ugotovitev, da miselno in jezikovno artikulirana doživljajska perspektiva (med drugim) vsebuje tudi implicitno uporabo neskončnega potenciala za logične operacije s stavki (mislimi), čeprav ta uporaba pri vseh ljudeh ni razvita v enaki meri. Seveda s tem še daleč nisem razložil pojava in razvoja družbenih in kulturnih oblik duha, tega, kar prosto po Heglu poimenujem »objektivni duh«, npr. razlago razvoja jezika, vendar sem podal vsaj podlago za takšno, še vedno naturalistično razlago.

Literatura:

Barbieri, M. (2010): Biosemiotics: A new understanding of life. V: D. Faverau (izd.), *Essential Readings in Biosemiotics.* Springer, Dordrecht:751- 796.

Bateson, G. (1978): *Steps to an Ecology of Mind*. Jason Aronson, Northvale.

Bateson, G. (1992): *Mind and Nature*. *A necessary Unit*. Dutton, New York.

Boesch, C. (2007): What makes us human (Homo Sapiens)? The challenge of cognitive cross-species comparison. *Journal of Comparative Psychology*, 121, 3: 227 – 240.

Cashman, T. (2008): What connects the map to the teritory? V: J. Hoffmeyer (izd.), *A Legacy for Living Systems. Gregory Bateson as Precursor of Biosemiotics.* Springer, Dordrecht: 45 – 58.

Deacon, T., Sherman, J. (2008): The pattern which connects Pleroma to Creatura: The autocell bridge from physics to life. V: J. Hoffmeyer (izd.), *A Legacy for Living Systems. Gregory Bateson as Precursor of Biosemiotics.* Springer, Dordrecht: 59 - 76.

Eicher-Catt, D. (2008): Bateson, Peirce and the sign of sacred. V: J. Hoffmeyer (izd.), *A Legacy for Living Systems. Gregory Bateson as Precursor of Biosemiotics.* Springer, Dordrecht: 257- 276.

Faverau, D. (2010): Introduction: An evolutionary history of biosemiotic. V D. Favereau (izd.), *Essential Readings in Biosemiotics.* Springer, Dordrecht: 1 – 80.

Hoffmeyer, J. (2010): The semiotic of nature: Code-duality. V: V D. Favereau (izd.), *Essential Readings in Biosemiotics.* Springer, Dordrecht: 583- 628.

McGrew, W. C. (2001): *Kulturni šimpanz. Razmišljanja o kulturni primatologiji*. Studia Humanitatis, Ljubljana.

Peirce, C. S. (1985): Logic as semiotic: The theory of sign. V: T: Sebeock (1985): 4-23.

Sebeok, T. A. (1985): Zoosemiotic components of human communication. V: T. A. Sebeock, *Semiotics. An Introductory Antology*. Indiana University Press, Bloomington: 292- 325.

Sebeok, T. A. (2010): Biosemiotics: Its roots, proliferation and prospect. V: D. Faverau (izd.), *Essential Readings in Biosemiotics.* Springer, Dordrecht: 217-236.

Ule, A. (2001): *Logos spoznanja*. ZPS, Ljubljana.

Ule, A. (2008): Consciousness as process and experiential dimension. V: A. Ule: *Circles of Analysis. Essays on Logic, Mind and Knowledge*. LIT, Wien, Berlin.

Ule, A. (2012): Mind in physical reality, its potentiality and actuality. V: M. Uršič, O. Markič, A. Ule, *Mind in Nature. From Science to Philosophy*. Nova, New York.

Wittgenstein, L. (1976): *Logično filozofski traktat.* MK, Ljubljana.

Whitehead, A. N. (1978): *Process and Reality: An Essay in Cosmology*. The Free Press, New York.

AUTOPHAGY IN NEURODEGENERATIVE AND NEUROPSYCHIATRIC DISEASES

Mira Polajnar, Eva Žerovnik
Department of Biochemistry and Molecular and Structural Biology
Jožef Stefan Institute
Jamova cesta 39, 1000 Ljubljana, Slovenia
Tel: +386 1 477 3753; fax: +386 1 477 3984
e-mails: m.polajnar@dkfz-heidelberg.de and eva.zerovnik@ijs.si

ABSTRACT

Protein misfolding, subsequent aggregation and toxicity of the aggregates are the leading causes of most known dementias. Many of these, in addition to neurodegeneration, present themselves with comorbidities such as cognitive impairment and different mental disturbances. We previously proposed autophagy as a possible common impairment between progressive myoclonic epilepsies (PMEs) and neurodegenerative diseases[1]. We now argue along similar lines for some neuropsychiatric diseases, such as depression and schizophrenia[2] and show that existing and new therapies for these seemingly different diseases could be augmented with drugs targeting autophagy.

1. POSSIBLE ENTRY POINTS AND DRUGS TARGETING AUTOPHAGY[1]

Macroautophagy (also referred only as autophagy) is a lysosomal degradation pathway that leads to engulfment and digestion of portions of cell's cytoplasm in a regulated manner. In this was quality and quantity control of the cell is maintained. Autophagy starts with the formation of the isolation membrane or a phagophore, extends to the autophagosome, which encapsulates and seals its cargo (i.e. proteins, aggregates, organelles) before delivering it to the lysosome. Upon fusion with the lysosome (into an autophagolysosome), the cargo is broken down into its constituent components and recycled to fuel the energy demands of the cell and sustain homeostasis. Autophagy is regulated by intracellular and extracellular signals mediated by at least two complexes: (i) Atg1/unc-51-like kinase (ULK) complex that acts downstream of the mammalian target of rapamycin (mTOR) complex 1 (mTORC1) and (ii) Beclin 1/class III phosphatidylinositol 3-kinase (PI3K) complex.

Because the signalling pathways of autophagy are very complex and still not fully understood, there are many potential entry points where the pathways could be modulated. **Rapamycin**, one of the best known inducers of autophagy through mTOR inhibition, has shown promise in a fruit fly model of Huntington's disease (HD)[3] and other proteinopathies like Parkinson's (PD)[4], Alzheimer's disease (AD)[5] and prion[6] mouse models, respectively.

Furthermore, caloric restriction and resveratrol both promote Sirtuin1 (SIRT1)-dependent autophagy which was shown to be neuroprotective in models of AD and amyotrophic lateral sclerosis (ALS)[7]. **Resveratrol** was additionally shown to reduce oxidative stress and neuronal cell death[8] and protect from amyloid beta (Aβ) neurotoxicity in a rat model[9]. Acetylase inhibitor **spermidine** stimulated autophagy independent of SIRT1. In spite of the difference in the primary targets of resveratrol and spermidine, both compounds activate convergent pathways and elicit similar changes in the (de)acetylation pattern of proteins[10]. Spermidine was found to reduce neuron loss in ALS mouse model[11] and improve memory in a HD rodent model[12].

Trehalose is another autophagy inducing component acting independently of the mTOR-pathway. It has shown promise in models of HD[13], ALS[14], tauopathies[15-16] and prion disease[17].

Moreover, it was recently reported that **astemizole**, a drug already approved for human use, inhibited pathological prion protein (PrPSc) replication and induced autophagy through an unknown mechanism[18].

[1] Contents are shortened from the paper: 2. Polajnar, M. & Zerovnik, E. Impaired autophagy: a link between neurodegenerative and neuropsychiatric diseases. *J Cell Mol Med* (2014).

2. INDUCING AUTOPHAGY MAY BE COUNTERPRODUCTIVE

One should be aware of counterproductive effects of autophagy boosting in specific neurodegenerative conditions. In certain cases, boosting autophagic activation may lead to an increased accumulation of non-degradable autophagosomes and even to contribute to the pathology. For example, it was reported that a mouse ALS model presented exacerbated apoptosis of neuronal cells and disease progression after treatment with rapamycin[19]. Specific pathogenesis of the disease and the fact that rapamycin is primarily used as an immunosuppressant may underlie the devastating effects on neurons, whereas other autophagy inducers improved cell survival in ALS models.

3. COMMON LINKS BETWEEN NEUROPSYCHIATRIC DISEASE AND NEURODEGENERATION

Several neuropsychiatric comorbidities like depression and apathy have been observed in patients with neurodegenerative diseases[20]. Abnormalities in social behaviour have been observed also in mouse models of PD[21], AD[22], and HD[23]. Diseases like schizophrenia and bipolar disorder are on the other hand considered to origin during neurodevelopment, however, a neurodegenerative hypothesis is on the rise but still controversial[24-25]. In its support, schizophrenic mouse models and severe patient cases are known to exhibit thinning of the cerebral cortex[26].

Interestingly, a reduction in mRNA levels of Beclin1, one of the key proteins in autophagy, was recently reported in the hippocampus of schizophrenia patients[27]. In addition, several mood stabilizing drug have been shown to induce autophagy. For example, **lithium**, a classic mood stabilizer, was proposed for treatment of HD[28], ALS[29], and was shown to reduce PrPSc (a scrapie form of the PrP prion) through the induction of autophagy[30]. Together with two other mood stabilizing and anticonvulsant drugs, **valproic acid (VPA) and carbamazepam (CBZ),** lithium is hypothesized to indirectly induce autophagy through inhibiting inositol monophosphatase (IMPA1) and other enzymes in the phosphatidylinositol pathway[31-32]. It was shown that lithium and valproate have a synergistic neuroprotective effect in an ALS mouse model[33]. However, several follow-up studies on mice and patients found no significant effect of lithium on the ALS disease pathology (reviewed in[34]). On the other hand, other studies show effects of lithium and CBZ in mouse models of tauopathy[35] and AD[36].

Lastly, a known inducer of autophagy, **trehalose**, showed an anti-depressant effect in in a mouse model with manic-like behaviours[37].

4 CONCLUSIONS:

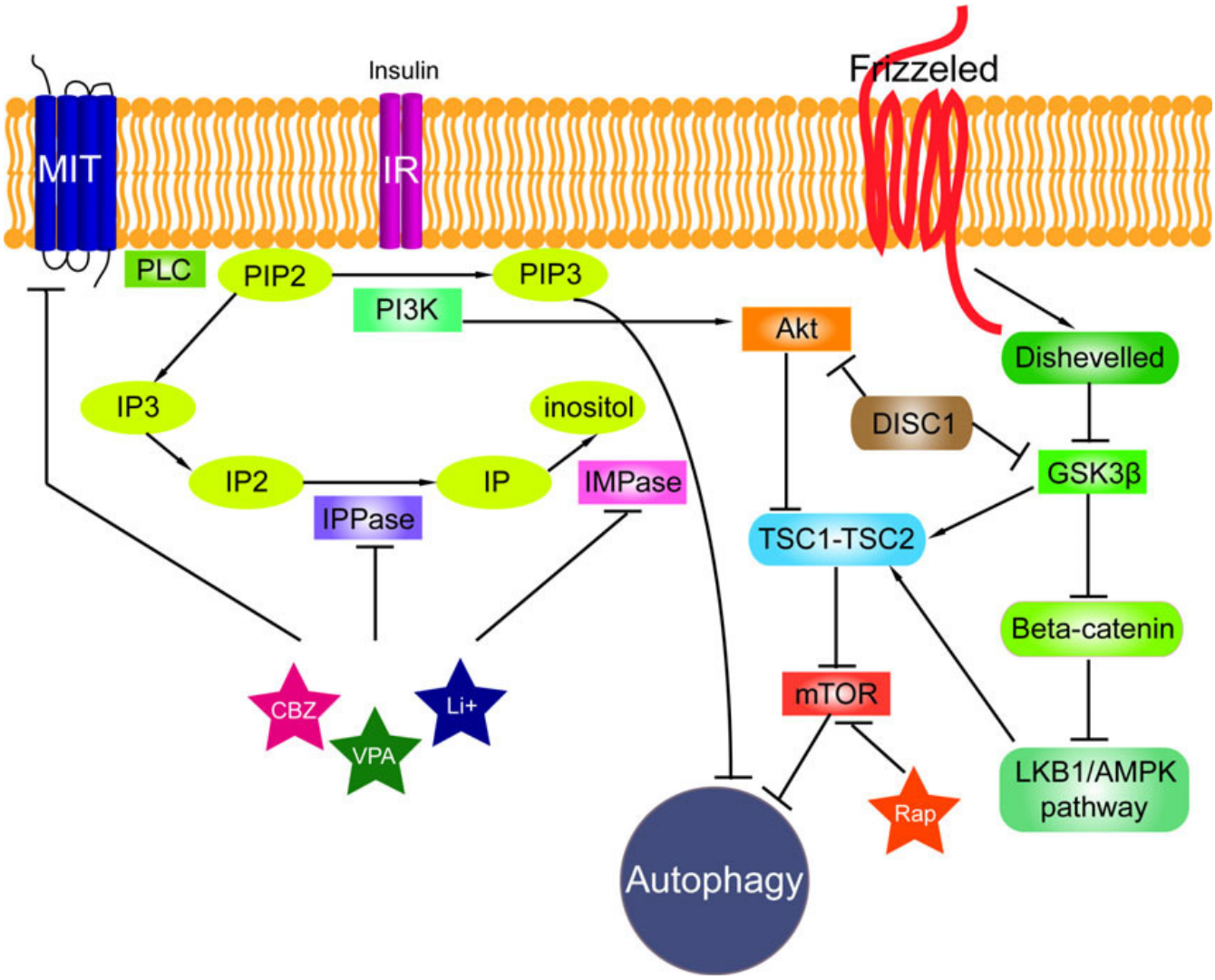
1. Augmenting autophagy could be beneficial for several proteinopathies and certain neuropsychiatric disorders. Indirect evidence suggests that in addition to lithium, anticonvulsant drugs and mood stabilizers such as CBZ and VPA both positively influence mood and at the same time stimulate autophagy.

2. In the light of recent findings that DISC1, a protein implicated in schizophrenia[38], bipolar disorder and depression, forms aggregates in cells[39] these drugs and other such agents (many of them from natural sources) could help by inducing aggregate clearance by autophagy in patients with these disorders. Bearing this in mind, these disease could be regarded as a type of proteinopathy[40].

References

1. Polajnar, M. & Zerovnik, E. Impaired autophagy: a link between neurodegenerative diseases and progressive myoclonus epilepsies. *Trends Mol Med* **17**, 293-300 (2011).
2. Polajnar, M. & Zerovnik, E. Impaired autophagy: a link between neurodegenerative and neuropsychiatric diseases. *J Cell Mol Med* (2014).
3. Ravikumar, B.*, et al.* Inhibition of mTOR induces autophagy and reduces toxicity of polyglutamine expansions in fly and mouse models of Huntington disease. *Nat Genet* **36**, 585-595 (2004).
4. Xiong, N.*, et al.* Potential autophagy enhancers attenuate rotenone-induced toxicity in SH-SY5Y. *Neuroscience* **199**, 292-302 (2011).
5. Majumder, S., Richardson, A., Strong, R. & Oddo, S. Inducing autophagy by rapamycin before, but not after, the formation of plaques and tangles ameliorates cognitive deficits. *PloS one* **6**, e25416 (2011).
6. Cortes, C.J., Qin, K., Cook, J., Solanki, A. & Mastrianni, J.A. Rapamycin delays disease onset and prevents PrP plaque deposition in a mouse model of Gerstmann-Straussler-Scheinker disease. *The Journal of neuroscience : the official journal of the Society for Neuroscience* **32**, 12396-12405 (2012).
7. Kim, D.*, et al.* SIRT1 deacetylase protects against neurodegeneration in models for Alzheimer's disease and amyotrophic lateral sclerosis. *The EMBO journal* **26**, 3169-3179 (2007).
8. Khan, R.S.*, et al.* SIRT1 activating compounds reduce oxidative stress and prevent cell death in neuronal cells. *Frontiers in cellular neuroscience* **6**, 63 (2012).
9. Frozza, R.L.*, et al.* Neuroprotective Effects of Resveratrol Against Abeta Administration in Rats are Improved by Lipid-Core Nanocapsules. *Molecular neurobiology* **47**, 1066-1080 (2013).
10. Morselli, E.*, et al.* Caloric restriction and resveratrol promote longevity through the Sirtuin-1-dependent induction of autophagy. *Cell death & disease* **1**, e10 (2010).
11. Wang, I.F.*, et al.* Autophagy activators rescue and alleviate pathogenesis of a mouse model with

proteinopathies of the TAR DNA-binding protein 43. *Proceedings of the National Academy of Sciences of the United States of America* **109**, 15024-15029 (2012).
12. Velloso, N.A.*, et al.* Spermine improves recognition memory deficit in a rodent model of Huntington's disease. *Neurobiology of learning and memory* **92**, 574-580 (2009).
13. Fernandez-Estevez, M.A.*, et al.* Trehalose reverses cell malfunction in fibroblasts from normal and Huntington's disease patients caused by proteosome inhibition. *PloS one* **9**, e90202 (2014).
14. Zhang, X.*, et al.* MTOR-independent, autophagic enhancer trehalose prolongs motor neuron survival and ameliorates the autophagic flux defect in a mouse model of amyotrophic lateral sclerosis. *Autophagy* **10**(2014).
15. Rodriguez-Navarro, J.A.*, et al.* Trehalose ameliorates dopaminergic and tau pathology in parkin deleted/tau overexpressing mice through autophagy activation. *Neurobiology of disease* **39**, 423-438 (2010).
16. Schaeffer, V.*, et al.* Stimulation of autophagy reduces neurodegeneration in a mouse model of human tauopathy. *Brain* **135**, 2169-2177 (2012).
17. Aguib, Y.*, et al.* Autophagy induction by trehalose counteracts cellular prion infection. *Autophagy* **5**, 361-369 (2009).
18. Karapetyan, Y.E.*, et al.* Unique drug screening approach for prion diseases identifies tacrolimus and astemizole as antiprion agents. *Proceedings of the National Academy of Sciences of the United States of America* **110**, 7044-7049 (2013).
19. Zhang, X.*, et al.* Rapamycin treatment augments motor neuron degeneration in SOD1(G93A) mouse model of amyotrophic lateral sclerosis. *Autophagy* **7**, 412-425 (2011).
20. Polajnar, M. & Zerovnik, E. Impaired autophagy: a link between neurodegenerative diseases and progressive myoclonus epilepsies. *Trends in molecular medicine* **17**, 293-300 (2011).
21. Taylor, T.N., Greene, J.G. & Miller, G.W. Behavioral phenotyping of mouse models of Parkinson's disease. *Behavioural brain research* **211**, 1-10 (2010).
22. Filali, M., Lalonde, R. & Rivest, S. Anomalies in social behaviors and exploratory activities in an APPswe/PS1 mouse model of Alzheimer's disease. *Physiology & behavior* **104**, 880-885 (2011).
23. Menalled, L.*, et al.* Systematic behavioral evaluation of Huntington's disease transgenic and knock-in mouse models. *Neurobiology of disease* **35**, 319-336 (2009).
24. Gupta, S. & Kulhara, P. What is schizophrenia: A neurodevelopmental or neurodegenerative disorder or a combination of both? A critical analysis. *Indian journal of psychiatry* **52**, 21-27 (2010).
25. Goodwin, G.M., Martinez-Aran, A., Glahn, D.C. & Vieta, E. Cognitive impairment in bipolar disorder: neurodevelopment or neurodegeneration? An ECNP expert meeting report. *Eur Neuropsychopharmacol* **18**, 787-793 (2008).
26. Cannon, T.D.*, et al.* Cortex mapping reveals regionally specific patterns of genetic and disease-specific gray-matter deficits in twins discordant for schizophrenia. *Proceedings of the National Academy of Sciences of the United States of America* **99**, 3228-3233 (2002).
27. Merenlender-Wagner, A.*, et al.* Autophagy has a key role in the pathophysiology of schizophrenia. *Molecular psychiatry* (2013).
28. Sarkar, S.*, et al.* A rational mechanism for combination treatment of Huntington's disease using lithium and rapamycin. *Human molecular genetics* **17**, 170-178 (2008).
29. Fornai, F.*, et al.* Lithium delays progression of amyotrophic lateral sclerosis. *Proceedings of the National Academy of Sciences of the United States of America* **105**, 2052-2057 (2008).
30. Heiseke, A., Aguib, Y., Riemer, C., Baier, M. & Schatzl, H.M. Lithium induces clearance of protease resistant prion protein in prion-infected cells by induction of autophagy. *Journal of neurochemistry* **109**, 25-34 (2009).
31. Sarkar, S.*, et al.* Lithium induces autophagy by inhibiting inositol monophosphatase. *The Journal of cell biology* **170**, 1101-1111 (2005).
32. Williams, R.S., Cheng, L., Mudge, A.W. & Harwood, A.J. A common mechanism of action for three mood-stabilizing drugs. *Nature* **417**, 292-295 (2002).
33. Leng, Y.*, et al.* Synergistic neuroprotective effects of lithium and valproic acid or other histone deacetylase inhibitors in neurons: roles of glycogen synthase kinase-3 inhibition. *J Neurosci* **28**, 2576-2588 (2008).
34. Gamez, J., Salvado, M., Martinez de la Ossa, A. & Badia, M. Lithium for treatment of amyotrophic lateral sclerosis: much ado about nothing. *Neurologia (Barcelona, Spain)* (2013).
35. Shimada, K.*, et al.* Long-term oral lithium treatment attenuates motor disturbance in tauopathy model mice: implications of autophagy promotion. *Neurobiology of disease* **46**, 101-108 (2012).
36. Li, L.*, et al.* Autophagy enhancer carbamazepine alleviates memory deficits and cerebral amyloid-beta pathology in a mouse model of Alzheimer's disease. *Current Alzheimer research* **10**, 433-441 (2013).
37. Kara, N.Z.*, et al.* Trehalose induced antidepressant-like effects and autophagy enhancement in mice. *Psychopharmacology (Berl)* **229**, 367-375 (2013).
38. Mao, Y.*, et al.* Disrupted in schizophrenia 1 regulates neuronal progenitor proliferation via modulation of GSK3beta/beta-catenin signaling. *Cell* **136**, 1017-1031 (2009).
39. Leliveld, S.R.*, et al.* Insolubility of disrupted-in-schizophrenia 1 disrupts oligomer-dependent interactions with nuclear distribution element 1 and is associated with sporadic mental disease. *J Neurosci* **28**, 3839-3845 (2008).
40. Nucifora, L.G.*, et al.* NPAS3 and Implications for Protein Aggregation in Schizophrenia. *Biol Psychiat* **75**, 317s-317s (2014).



Taken from 2. Polajnar, M. & Zerovnik, E. Impaired autophagy: a link between neurodegenerative and neuropsychiatric diseases. *J Cell Mol Med* (2014). Open access. Copy right to John Wiley & Sons

ETHICAL IMPLICATIONS OF MECHANISTIC APPROACH

Olga Markič
Filozofska fakulteta, Univerza v Ljubljani
Aškerčeva 2, 1000 Ljubljana, Slovenija
e-mail: olga.markic@guest.arnes.si

ABSTRACT

The author discusses ethical implications of the nowadays prevailing viewpoint in cognitive science, i.e. mechanistic approach. She stresses the importance of mutidirectional communication between scientists and humanists that may overcome too reductionistic understanding of the neuroscientific research.

1 INTRODUCTION

"Scientific Revolution" in the seventeenth century introduced new methods in studying nature: observation, experiment and the precise measurement of quantities. At the same time, the Aristotelian method of explanation in terms of final ends was replaced by a mechanical or mechanistic method of explanation in terms of the regular, deterministic behavior of matter and motion. As Tim Crane put it, "we can say that, according to the mechanical world picture, things do what they do not because they are trying to reach their natural place or final end, or because they are obeying the will of God, but, rather, because they are caused to move in certain ways in accordance with the laws of nature."(Crane, 1995: 3)
Such an approach seems suitable for inorganic nature, but how to explain two great mysteries, the nature of life and mind? The discovery of the structure of DNA by Watson and Crick and further research in genetics suggests an answer to the first one and there are many who think that the explanation of the mind will also come soon. The mechanistic approach of neuroscience and cognitive science gives us fascinating results but also starts to question some basic assumptions about ourselves and our place in nature. In this paper I will sketch some ethical considerations and implications that come from such an approach.

2 MECHANISTIC APPROACH AND MODULAR HYPOTHESIS

Although almost everybody would agree that the brain gives rise to perception, cognition, emotion, volition and other mental states, there remains a challenge to precisely determine how mental phenomena rise from the brain. There are different frameworks for understanding the mind (see Markič, 2012, 2013a, 2013b) which can be associated with different standpoints concerning mind-body problem. In this paper I will concentrate on reductionistic mechanistic picture which is sometimes wrongly seen as "the" scientific picture, but is more accurately described as scientistic[1].
The scientistic attitude is the attitude of many scientists who think that consciousness, cognition, and volition – the last surviving mysteries (cf. Dennett, 1991) – can be fully explicated and accounted for in neurobiological terms. The more radical among them are convinced that the concepts employed in the humanistic worldview (beliefs, emotions, free will) are mere illusions and have no reference in the (physical) world (e.g. Churchland, 1988; Wegner, 2002). This radical attitude finds a very vivid expression in Crick's words:

["T]he study of consciousness is a scientific problem. (...) There is no justification for the view that only philosophers can deal with it. Philosophers have had such a poor record over the last two thousand years that they would do better to show a certain modesty rather than the lofty superiority that they usually display. (...) I hope that more philosophers will learn enough about the brain to suggest ideas about how it works, but they also learn how to abandon their pet theories when the scientific evidence goes against them or they will only expose themselves to ridicule." (Crick, 1994: 257–258)

Mechanistic approach finds its way in the *modular hypothesis* which is implicitly or explicitly present in much of recent research. It consist of the idea that the mind consists of a plethora of different cognitive functions (modules) and that these are somehow instantiated or realized in discrete brain regions. If we assume that specific brain regions are specialized for specific mental functions, then it seems that mental properties of a certain experience could be analytically explained (away?) by the (say, causal) properties of specific brain regions. If, for instance, it turns out that, as suggested by Zeki (Kawabata and Zeki, 2004; Zeki and Romaya, 2008), the orbito-frontal cortex is involved in the processing of beautiful pictures, then it would seem plausible that the experience of beauty that is commonly assumed to be the basic of aesthetics might be accounted for in terms of the activation of this particular

1 This section draws partly on material from (Vörös and Markič, 2014).

region. In other words, the modular conception of the brain rests on the idea that properties of a given mental phenomenon are nothing but the sum total of properties of brain regions that have been shown to accompany this experience.

Neuroimaging research (fMRI, PET, EEG) offers to the public relatively simple visual images that can mask the complexity of the underlying processes that result in the images. This leads to the unbalanced enthusiasm for the neurotechnology and to ethical implications discussed in the next section.

Racine identifies three concepts that can help us identify emerging interpretations of neuroscience: neuroessentialism, neurorealsim and neuropolicy (Racine, 2010: 101-107).

The concept of neuroessentialsim "identifies interpretations proposing that the brain is the self-defining essence of a person, a secular equivalent to the soul. The brain becomes shorthand for concepts (e.g. the person, the self) that may express other features of the individual not ordinarily found in the concept of the brain." (101).

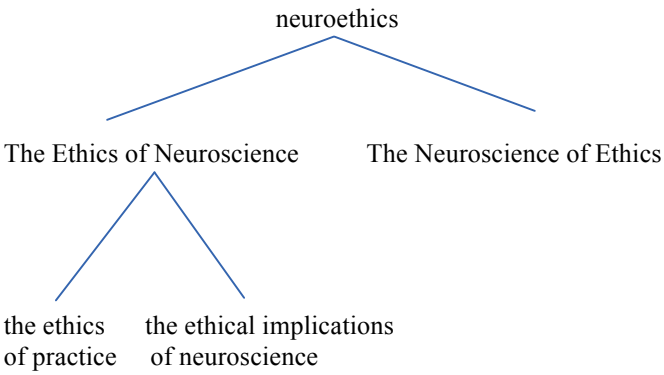
The concept of neurorealism "suggests that neuroimaging research yields direct data on brain function" (106). One such popular view is that neuroimaging is "mind reading".

The third concept, neuropolicy, "describes attempts to use fMRI results for promoting political and personal agendas" (107). The result of application of these three concepts is the generally optimistic interpretation of the use of neurotechnologies seeing the potential benefits for diagnostic procedures and treatments.

But, as I would like to stress in the next section, such understanding opens a plethora of ethical implications and must lead to philosophical, ethical and social debates on neuroscience.

3 ETHICAL IMPLICATIONS

Research in cognitive science, particularly neuroscience, has lead to the new field of neuroethics. As Adina Roskies observes: "The intimate connection between our brains and our behaviors, as well as the peculiar relationship between our brains and our selves, generate distinctive questions that beg for the interplay between ethical and neuroscientific thinking." (Roskies, 2002:21). She has proposed a devision that has become widely used by the neuroeticists and is schematically presented as follows (Roskies, 2002:21 - 23).



According to Roskies, the ethics of practice is concerned with the ethical issues and considerations that should be raised in the course of designing and executing neuroscientific studies, while the ethical implications of neuroscience explore the evaluation of the ethical and social impact that the results of those studies might have, or ought to have, on existing social, ethical, and legal structures. The neuroscience of ethics deals with the scientific approach to the understanding of ethical behavior.

I see this division as a good analytic tool that is analogous to the division in the field of philosophy and neuroscience where we talk about philosophy of neuroscience and neurophilosophy (see Markič, 2011). The first deals with the meta level and provides philosophical reflections on neuroscience and the second is concerned with the traditional philosophical problems in philosophy of mind (e.g. the mind-body problem, the free will problem, the problem of other minds) and the impact of neuroscientific research on proposed solutions. We have to be aware that in spite of differences in posed questions both approaches are closely connected and complement one another. The same is true also for both branches of neuroethics, particularly connected are the ethical implications of neuroscience and the neuroscience of ethics. I will outline ones that are based on the mechanistic understanding.

It is without doubt that the advances in neuroscience are/will be able to bring better medical treatments and diagnostic procedures to the patients. But, and this is our concern, they will also open questions, particularly if the stress will be limited only to the mechanistic aspects.

Martha Farah has pointed out that "some neuroethical issues arise specifically because the brain is the organ of the mind" (Farah, 2010: 7). She mentioned a set of issues emerging from developed technologies for monitoring (various brain imaging methods) and manipulating the brain (e.g. psychopharmacology and TMS). The main concern is that the use of them will compromise our humanistic image. Flanagan (2002) describes the humanistic image as a set of beliefs about ourselves based on the assumption that we are spiritual beings with free will and consequently able to lead a moral and meaningful life. It has its roots in religion and in perennial philosophy (i.e. Plato, Aristotle, Augustine, Aquinas, Descartes, Hume, Kant).

The mechanistic approach threatens to compromise our strongly held beliefs about our values like freedom, privacy, fairness and responsibility. If someone has the tools to enhance cognitive abilities, change the moods and manipulate with the memories, this power has to be used very cautiously. Racine (2010) in his book *Pragmatic neuroethics* suggests that we have to take into account two complementary concepts of morality - moral acceptability and moral praiseworthiness. He models his pragmatic neuroethics approach on the debates on deliberative democracy and discourse ethics on pragmatic thinking of philosopher Jürgen Habermas. Following him Racine suggests that "the validity of norms, especially those that strive to reach moral excellence and moral praiseworthiness, must be tested in actual open and democratic discourse.

Moral praiseworthiness and the search for a common good and other moral ideals must be enacted in ways that are consistent with a commitment to both individual autonomy and public autonomy." (Racine, 2010: 134).

4 CONCLUDING REMARKS

The worry many humanists express is that the interpretation of some cognitive neuroscientists who think that decisions, choices and actions are merely the result of neural mechanisms and could not be seen as free anymore and would not support moral responsibility. Free will would be best seen as just an illusion (e.g. Libet, 1999; Wegner, 2002, 2008; Wegner and Wheatley, 1999). This is often seen as "the" interpretation of the neuroscientific investigations, but as I have argued (Markič, 2009, 2011) it is just one of the possible interpretations. Nevertheless taking it as "the" interpretation it may have a force to change the beliefs and values and radically change our humanistic image.

Ethical considerations are closely tied to the broader understanding and interpretation of the results of the scientific research and embedded in different cultural environments. I think that media covering research in neuroscience, but often also neuroscientists themselves are not careful enough in acknowledging this. Science is seen as a discourse of experts, driven by objective knowledge and free of value. But, particularly in the cognitive science, it is impossible to eliminate philosophical and cultural background. Science thus brings also reactions based on personal belief and culture and includes applications and values sustaining them. It is therefore very important that communication is not just unidirectional. Because of the complexity and various sources of ethical concerns, the communication has to be multidirectional and it is a task of humanists, particularly philosophers in philosophy of mind and ethics, to explicate the assumptions on which the research and interpretations are based. As Eric Racine has suggested, they have to "unveil different forms of reductionism and bring awareness to the inherent complexity of research and patient care" (Racine, 2010: 118). Ethical, legal and social considerations of neuroscientific research are closely intertwined with the epistemological issues – what neuroscientific data mean.

REFERENCES

Crane, T. (1995). *The mechanical Mind.* Penguin Books.

Churchland, P.M. (1988). *Matter and Consciouness.* Cambridge/MA, London: MIT Press.

Crick, F. (1994): The Astonishing Hypothesis: The Scientific Search for the Soul. New York: Scribner.

Dennett, D.C. (1991). *Consciousness Explained.* Boston: Little, Brown and Company.

Farah, M. (2010). *Neuroethics: An Introductions with Readings.* The MIT Press, Cambridge, Ma and London.

Flanagan, O. (2002). *The Problem of the Soul: Two Visions of the Mind and How to Reconcile Them*. Basic Books, New York.

Kawabata, H. and Zeki, S. (2004): Neural Correlates of Beauty. *Journal of Neurophysiology* 91 (4), 1699–705.

Libet, B. (1999). "Do We Have Free Will"*, Journal of Consciousness Studies*, VI (8–9), 47–57.

Markič, O. (2009): Neuroscience and the Image of the Mind. In Eva Žerovnik, Olga Markič and Andrej Ule (eds.), *Philosophical Insights About Modern Science,*135-144. New York: Nova Science Publishers, Inc.

Markič, O. (2011). *Kognitivna znanost: filozofska vprašanja.* Aristej, Maribor.

Markič, O. (2012). "Mind in cognitive science: from computational models to the embodied situated cognition". In Uršič, M., Markič, O., Ule, A. (eds.) *Mind In Nature: From Science To Philosophy,* 79-127. New York: NovaScience Publishers, Inc.

Markič. O. (2013a). "Critical reflections about neuroscience and its application". In Gams, M. et al. *Proceedings of the 16th International Multiconference Information Society - IS 2013, October 7th-11th, 2013, Ljubljana, Slovenia : volume A*. Ljubljana: Institut Jožef Stefan, 325-327.

Markič. O. (2013b). "The philosophical framework for understanding neuroscientific research". *INDECS,* 11/4, 351-362

Racine, E. (2010). *Pragmatic Neuroethics*. Cambridge/MA, London: MIT Press.

Roskies, A. (2002). »Neuroethics for the New Millenium«, *Neuron*, Vol. 35, July 3, 2002, 21–23.

Roskies, A. (2006). "Neuroscientific challenges to free will and responsibility". *Trends in Cognitive Sciences* Vol.10 No. 9, 419-423.

Vörös, S. and Markič, O. (2014). "Photograph of the Soul: Towards a Critical Neuroscience". Teorija in praksa (in press).

Wegner, D. (2002). *The Illusion of Conscious Will*. Cambridge, Ma., London: MIT Press.

Wegner, D. (2008). “Self Is Magic” in J. Bear, J. Kaufman and R. Baumeister (eds.). *Are we Free?: Psychology and Free Will*. Oxford, New York: Oxford University Press.

Wegner, D., Wheatley, T. (1999). “Apparent Mental Causation”. *American Psychologist*, Vol. 54, 480- 491.

Zeki S. and Romaya J. P. (2008): Neural Correlates of Hate. *PLoS One* 3 (10), 35–56.

Indeks avtorjev / Author index

Konferenca / Conference
Uredili / Edited by

Kognitivna znanost /
Cognitive Sciences
Olga Markič, Toma Strle, Urban Kordeš, Matjaž Gams