Zbornik 20. mednarodne multikonference

INFORMACIJSKA DRUŽBA - IS 2017

Zvezek B

Proceedings of the 20th International Multiconference

INFORMATION SOCIETY - IS 2017

Volume B

Kognitivna znanost
Cognitive Science

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

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9.–13. oktober 2017 / 9–13 October 2017
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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2017

Multikonferenca Informacijska družba (http://is.ijs.si) je z **dvajseto** zaporedno prireditvijo osrednji srednjeevropski dogodek na področju informacijske družbe, računalništva in informatike. Letošnja prireditev je ponovno na več lokacijah, osrednji dogodki pa so na Institutu »Jožef Stefan«.

Informacijska družba, znanje in umetna inteligenca so spet na razpotju tako same zase kot glede vpliva na človeški razvoj. Se bo eksponentna rast elektronike po Moorovem zakonu nadaljevala ali stagnirala? Bo umetna inteligenca nadaljevala svoj neverjetni razvoj in premagovala ljudi na čedalje več področjih in s tem omogočila razcvet civilizacije, ali pa bo eksponentna rast prebivalstva zlasti v Afriki povzročila zadušitev rasti? Čedalje več pokazateljev kaže v oba ekstrema – da prehajamo v naslednje civilizacijsko obdobje, hkrati pa so planetarni konflikti sodobne družbe čedalje težje obvladljivi.

Letos smo v multikonferenco povezali dvanajst odličnih neodvisnih konferenc. Predstavljenih bo okoli 200 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic. Prireditev bodo spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica, ki se ponaša s **40-letno** tradicijo odlične znanstvene revije. Odlične obletnice!

Multikonferenco Informacijska družba 2017 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Soočanje z demografskimi izzivi
- Kognitivna znanost
- Sodelovanje, programska oprema in storitve v informacijski družbi
- Izkopavanje znanja in podatkovna skladišča
- Vzgoja in izobraževanje v informacijski družbi
- Četrta študentska računalniška konferenca
- Delavnica »EM-zdravje«
- Peta mednarodna konferenca kognitonike
- Mednarodna konferenca za prenos tehnologij - ITTC
- Delavnica »AS-IT-IC«
- Robotika

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in inštitucijam, še posebej pa 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 2017 bomo petič 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 bo prejel prof. dr. Marjan Krisper. Priznanje za dosežek leta bo pripadlo prof. dr. Andreju Brodniku. Že šestič podeljujemo nagradi »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobilo padanje slovenskih sredstev za akademsko znanost, tako da smo sedaj tretji najslabši po tem kriteriju v Evropi, jagodo pa »e-recept«. Čestitke nagrajencem!

Bojan Orel, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2017

In its **20th year**, the Information Society Multiconference (http://is.ijs.si) remains one of the leading conferences in Central Europe devoted to information society, computer science and informatics. In 2017 it is organized at various locations, with the main events at the Jožef Stefan Institute.

The pace of progress of information society, knowledge and artificial intelligence is speeding up, and it seems we are again at a turning point. Will the progress of electronics continue according to the Moore's law or will it start stagnating? Will AI continue to outperform humans at more and more activities and in this way enable the predicted unseen human progress, or will the growth of human population in particular in Africa cause global decline? Both extremes seem more and more likely – fantastic human progress and planetary decline caused by humans destroying our environment and each other.

The Multiconference is running in parallel sessions with 200 presentations of scientific papers at twelve conferences, round tables, workshops and award ceremonies. Selected papers will be published in the Informatica journal, which has **40 years** of tradition of excellent research publication. These are remarkable achievements.

The Information Society 2017 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Facing Demographic Challenges
- Cognitive Science
- Collaboration, Software and Services in Information Society
- Data Mining and Data Warehouses
- Education in Information Society
- 4th Student Computer Science Research Conference
- Workshop Electronic and Mobile Health
- 5th International Conference on Cognitonics
- International Conference of Transfer of Technologies - ITTC
- Workshop »AC-IT-IC«
- Robotics

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national engineering academy, the Slovenian Engineering Academy. In the name of the conference organizers we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

For the fifth year, the award for life-long outstanding contributions will be delivered in memory of Donald Michie and Alan Turing. The Michie-Turing award will be given to Prof. Marjan Krisper for his life-long outstanding contribution to the development and promotion of information society in our country. In addition, an award for current achievements will be given to Prof. Andrej Brodnik. The information lemon goes to national funding of the academic science, which degrades Slovenia to the third worst position in Europe. The information strawberry is awarded for the medical e-recipe project. Congratulations!

Bojan Orel, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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Blaž Zupan
Boris Žemva
Leon Žlajpah

Invited lecture

AN UPDATE FROM THE AI & MUSIC FRONT

Gerhard Widmer
Institute for Computational Perception
Johannes Kepler University Linz (JKU), and
Austrian Research Institute for Artificial Intelligence (OFAI), Vienna

Abstract
Much of current research in Artificial Intelligence and Music, and particularly in the field of Music Information Retrieval (MIR), focuses on algorithms that interpret musical signals and recognize musically relevant objects and patterns at various levels -- from notes to beats and rhythm, to melodic and harmonic patterns and higher-level segment structure --, with the goal of supporting novel applications in the digital music world. This presentation will give the audience a glimpse of what musically "intelligent" systems can currently do with music, and what this is good for. However, we will also find that while some of these capabilities are quite impressive, they are still far from (and do not require) a deeper "understanding" of music. An ongoing project will be presented that aims to take AI & music research a bit closer to the "essence" of music, going beyond surface features and focusing on the expressive aspects of music, and how these are communicated in music. This raises a number of new research challenges for the field of AI and Music (discussed in much more detail in [Widmer, 2016]). As a first step, we will look at recent work on computational models of expressive music performance, and will show some examples of the state of the art (including the result of a recent musical 'Turing test').

References
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Getting Closer to the Essence of Music: The Con Espressione Manifesto.
ACM Transactions on Intelligent Systems and Technology 8(2), Article 19.

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PREDGOVOR

Na letošnji konferenci Kognitivna znanost sodelujejo avtorji/ice z različnih disciplinarnih področij, ki predstavljajo tako empirične rezultate svojih raziskav kot tudi teoretska raziskovanja. Osrednja tema konference je "Znanstveni pristopi k raziskovanju zavesti: premoščanje vrzeli in perspektiv". Vsak prispevek se vsaj posredno dotika ali namiguje na vprašanje zavesti in njenih vlog v najrazličnejših kontekstih raziskovanega znotraj kognitivne znanosti. Avtorji/ice so kritično razmišljali o vprašanju večih zavesti, se poglobljeno spraševali o resničnosti zavesti, o času in zavesti ter premišljevali o hipotezi bayesianskih možganov in njihove kognitivne penetrabilnosti. Poročali so o raziskovanju doživljanja prepričanj, preiskovali kvalije drugih zavesti skozi gledališko igro in preučevali vpliv opazovanja lastnega ustvarjanja znotraj vizualne umetnosti. Obravnavali so, kako različni vidiki kognicije oblikujejo bolečino, empirično preverjali motiviranost udeležencev v navidezni resničnosti za pomoč pri rehabilitaciji ter odkrivali povezave med gibanjem in kognicijo v zgodnjem otroštvu. Predstavljali so genetske algoritme in njihovo rabo v raziskovanju neveridičnega zaznavanja ter opozarjali na različne načine za stvarjenje družbeno koristne, nenevarne umetne inteligence. Raznolikost predstavljenih tem zaokrožujeta premislek o vključevanju nevroznanostvenih izsledkov v pravo ter metodološka analiza zamikov vidnih evociranih potencialov (VEP) pri elektroencefalografiji (EEG).

Upamo, da bo letošnja disciplinarno in metodološko bogata kognitivna konferenca odprla prostor za izmenjavo zanimivih misli in idej ter povezala znanstvenike/ice različnih disciplin, ki se ukvarjajo z vprašanji kognitivnih procesov.

Olga Markič
Toma Strle
Tine Kolenik

FOREWORD

2017 conference Cognitive Science boasts with authors from numerous disciplines presenting their empirical as well as theoretical work. This year's topic is "Scientific approaches in researching consciousness: building bridges above chiasms and between perspectives". Each contribution at least indirectly speaks of consciousness and its roles in various contexts of cognitive science. Authors critically contemplate the question of many consciousnesses, dig deep into whether consciousness is real or not, into time and consciousness, and assess the hypothesis on the Bayesian brain and cognitive penetrability. They survey their research on experiencing beliefs, on examining qualia of different minds through theatre performance and on the influence of self-observation on visual art creation. They discuss how cognition influences pain processing, they empirically test virtual reality users' motivation in relation to rehabilitation and they discover links between motion and cognition in early childhood. They present genetic algorithms and their use in researching non-veridical perception, and they bring attention to ways of making AI useful and safe. The thematic diversity of contributions is wrapped up with a reflection on using neuroscientific research in law practice and a methodological analysis of EEG visual evoked potential (VEP) acquisition delays.

We hope that this year's cognitive conference, being extremely diverse in disciplines and methodologies, will become a welcoming space for exchanging intriguing ideas and thoughts as well as for bringing together scientists from all the different areas exploring the questions of cognitive processes.

Olga Markič
Toma Strle
Tine Kolenik

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

Olga Markič

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Urban Kordeš

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Tine Kolenik

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Povezave med telesnimi merami, gibalnimi spretnostmi in kognitivnimi sposobnostmi v zgodnjem otroštvu

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POVZETEK

V prispevku predstavimo zasnovo raziskave o vplivu rasti in splošnega telesnega razvoja na otrokove gibalne in kognitivne spretnosti. V raziskavi vzdolžno spremljamo otroke (N = 158) tipičnega slovenskega urbano-ruralnega okolja v razvoju od rojstva do zaključene prve osnovnošolske triade (starost 8 let) ter merimo njihove značilnosti in sposobnosti ter iščemo možne povezave med gibalnimi spretnostmi, telesnim in kognitivnim razvojem.

Ključne besede

Antropometrija, gibalne spretnosti, kognitivne sposobnosti, izvršilne funkcije, zgodnje otroštvo.

ABSTRACT

In the article we present the concept of research on the influence of growth and physical development on the child's motor and cognitive skills. In the survey, we longitudinally follow children (N = 158) of the typical Slovenian urban-rural environment from birth to the first elementary school triad (8 years of age). We measure their physical characteristics and abilities. We are looking for possible links between growth (anthropometrics measures), physical performance, and cognitive development.

Key words

Anthropometry, motor skills, cognitive abilities, executive functions, early childhood.

1. NAMEN RAZISKAVE

Namen raziskave je ugotoviti, ali so pri zdravih otrocih v zgodnjem otroštvu mere telesne rasti, gibalne spretnosti in kognitivne sposobnosti povezane in če so, kako so povezane med seboj. Izhajamo iz starodavne maksime »*Mens sana in corpore sano*« ("Zdrav duh v zdravem telesu") in predvidevamo, da otroci, ki tipično sledijo rastnim krivuljam, pridobijo podobno tipično tudi gibalne in kognitivne spretnosti. V raziskavi nas zanima, kaj se dogaja z otroki, ki so za rast večji in bolj razviti, kar se praviloma povezuje z boljšimi gibalnimi spretnostmi (povezano s samimi telesnimi dejavniki, ki povečajo npr. dolžino koraka, mišično moč, navor ipd.), vendar pa kognitivne spretnosti tega razvoja ne dohajajo vedno.

Določeni pokazatelji telesnega in gibalnega razvoja se povezujejo z znanimi zdravstvenimi tveganji [1, 2]. Veliki in hkrati neprimerno prehranjeni otroci, ki imajo pretežno sedeč način življenja, niso gibalno uspešni, hkrati pa raziskave tudi v Sloveniji kažejo, da tudi učno niso uspešni [3]. Tako veliki in telesno bolj razviti otroci, ki pa jih hkrati spremlja neustrezna prehrana in sedeč življenski slog, niso nujno tudi gibalno bolj razviti; podobno verjetno velja za kognicijo. Hkrati sam učni uspeh ni nujno povezan s kognitivnimi sposobnostmi. Na kognitivni razvoj vpliva več dejavnikov, zato v raziskavi upoštevamo tudi socio-demografske dejavnike (socialno-ekonomski status – SES).

Predvidevamo, da sta glavna, med seboj sicer odvisna dejavnika, ki otrokom, ki so sicer v rasti v zgornjih percentilih, onemogočata doseganje v percentilih enako visokih gibalnih in kognitivnih sposobnostih, socioekonomski status družine in zasedenost (sedeč življenski slog). S pridobljenimi podatki želimo identificirati otroke, ki od tipičnega razvoja odstopajo ter ponuditi ustrezne intervencijske programe.

2. TEORETIČNO OZADJE

Raziskave, ki hkrati preučujejo um in telo – kognitivni in gibalni razvoj, se praviloma osredotočajo na populacije z določeno patologijo. Tako v literaturi zasledimo raziskave, ki preučujejo povezave med gibalnimi spretnostmi in kognitivnimi sposobnostmi ali pa različne intervence na omenjenih ravneh pri otrocih z Downovim sindromom [4], pri otrocih z mišično distrofijo [5], otrocih s cerebralno paralizo [6] ali otrocih z motnjo koordinacije [7]. Raziskav, ki bi iskale povezave med gibalnim in kognitivnim razvojem pri zdravih otrocih v obdobju, ki nas zanima, pa je malo. Van der Fels in drugi [8] so povzeli 21 študij, ki so preučevale otroke med 4. in 16. letom starosti in zabeležili srednje velike do močne korelacije med nekaterimi gibalnimi spretnostmi in kognitivnimi sposobnostmi. V zaključkih navajajo, da lahko pestri interventni programi, osredotočeni na gibanje, vzpodbujajo tako gibalne spretnosti kot tudi višje kognitivne funkcije pri prepubertetnih otrocih.

Gibalni in kognitivni razvoj sta neločljivo povezana. Razvoj otrokovih grobomotoričnih spretnosti sicer odseva rast in razvoj otrokovega telesa, vendar ne gre za enoznačno, linearno povezanost. Kako uspešen je sicer zdrav otrok v grobomotoričnih funkcijah je odsev koherentnega sodelovanja med njim in okoljem, ki določeno veščino spodbuja [9]. Pri razvojnih motnjah je pogosta povezava med kognitvnim in gibalnim razvojem oz. zaostankom, kar korelira tudi z mestom poškodbe. Mali možgani so danes prepoznani kot struktura, ki ni ključna le pri gibalnih pač pa tudi višjih miselnih procesih; podobno velja za striatum, ki je del omrežja, skupaj z dorzolateralnim predelom prefrontalne skorje [10].

Po drugi strani vemo, da telesni parametri določajo nekatere gibalne spretnosti. Višina, telesna masa, obseg pasu in velikost kožne gube so pokazali rahlo do srednjo obratno povezanost z gibalno koordinacijo. Biološka zrelost pa je bila statistično pozitivno pomembno povezana s posebnimi gibalnimi veščinami, npr. s poligonom nazaj. Grobomotorične spretnosti so korelirale

tudi s koordinacijo in sposobnostjo fine manipulacije ter splošnim zdravstvenim stanjem (t. i. fitnes) [11].

Pri vplivih na razvoj moramo upoštevati tudi socialne, ekonomske in demografske posebnosti proučevane populacije. V raziskavi Gadžić idr. [12] sta imeli na merjene gibalne spretnosti in kognitivne sposobnosti statistično pomemben vpliv dve socio-demografski spremenljivki, in sicer bivanjsko okolje (urbano ali ruralno) ter očetova izobrazba. Osnovnošolci, živeči v urbanem okolju, so dosegali višje rezultate tako na testih gibalnih spretnosti kot tudi kognitivnih sposobnosti. Očetova izobrazba je na rezultate vplivala posredno, preko okolja, tako da so najvišje rezultate dosegali šolarji z višjo izobrazbo očetov, ki so živeli v mestih.

3. RAZISKOVALNI NAČRT

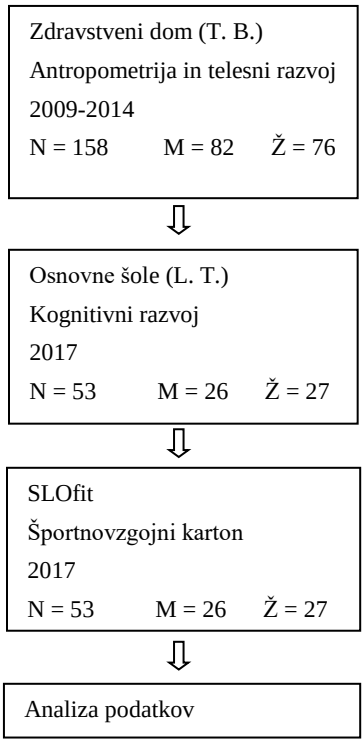
V raziskavo smo vključili vse otroke, rojene v letu 2009, vodene v primarni pediatrični ambulanti izbranega zdravstvenega doma (ruralno-urbano območje) pod vodstvom istega pediatra (T. B.). Otroci so bili redno spremljani in pregledani ob sistematičnih pregledih pri 1., 3., 6., 9., 12., 18., 36. in 60. mesecu starosti (od rojstva do vstopa v šolo). Na ta način smo pridobili antropometrične podatke, od katerih se bomo pri statistični analizi osredotočili na telesno višino in maso ter iz njih izračunan indeks telesne mase ter na podlagi tega izdelali njihove rastne krivulje (primerljivo z nacionalnim standardom). Otrok, ki imajo popoln zdravniški karton, brez manjkajočih podatkov, in ki so se torej uvrstili v nadaljnji del raziskave, je 158.

Trenutno so ti otroci v tretjem razredu osnovne šole. Da bi ohranili vzdolžen značaj raziskave, torej skozi čas merili iste posameznike, smo otroke poiskali na štirih osnovnih šolah v izbrani občini (3 manjše šole in ena večja s pripadajočima podružničnima šolama). Ker so otroci vključeni v reden, obvezen šolski program, so podatki o njihovih telesnih merah in gibalnih spretnostih (z zdravjem povezan fitnes in z gibalno učinkovitostjo povezan fitnes) že zbrani v t. i. športno-vzgojnem kartonu. Med poukom športne vzgoje je namreč na nacionalnem nivoju predviden vsakoletni preizkus otrokovih telesnih mer in gibalnih spretnosti, ki ga poznamo pod tem imenom, v zadnjem času uveljavljen tudi kot program SLOfit [13]. Podatke s kartona še pridobivamo. Zaradi interpretacije bomo podatke razvrstili v podkategorije (npr. spretnosti, vezane na lokomocijo, spretnosti, vezane na ravnotežje in stabilnost, spretnosti, vezane na ravnanje s predmeti).

V raziskavo smo se odločili vključiti še komponento kognitivnih sposobnosti otrok. Testiranje kognitivnih sposobnosti smo, za razliko od prejšnjih dveh, izvedli posebej, samo za tiste otroke, katerih starši so se za to svobodno odločili. Otrokom (N = 79) smo izven rednega pouka razdelili posebej oblikovane testne baterije, ki so jih oblikovali na Oddelku za psihologijo Filozofske fakultete Univerze v Ljubljani [14]. Testna baterija preizkuša delovni spomin in izvršilne funkcije (prepoznavanje besed, kognitivni nadzor, inhibicija). Reševanje testov je potekalo skupinsko, v skupinah do največ 20 otrok, po sprotnih navodilih testatorja (L. T.). Čas testiranja ni presegel 45 minut in za otroke ni predstavljal obremenitve, večje od običajne šolske dejavnosti.

Podatke bomo statistično obdelali s pomočjo orodij za statistično analizo (SPSS, R) in poiskali korelacije med izbranimi spremenljivkami. Pri tem bomo še posebej pozorni na povezave med različnimi gibalnimi spretnostmi in kognitivnimi sposobnostmi. Zanima nas, kako se določena izvršilna funkcija (npr. inhibicija neželenih dražljajev) zrcali v analogni gibalni spretnosti (npr. poligon nazaj) ter kako korelira z otrokovo rastjo (splošnim telesnim razvojem).

Diagram 1: Shema pridobivanja podatkov (raziskovalni načrt).



4. SKLEPI

Z raziskavo bomo poskusili opredeliti povezave med splošnim telesnim razvojem, gibalnimi spretnostmi in kognitvnimi sposobnostmi. Predvidevamo, da bomo uspeli identificirati socioekonomske dejavnike (SES), ki na te povezave najbolj vplivajo. S pridobljenimi podatki želimo prepoznati področja otrokovega razvoja, kjer bi usmerjena intervenca (npr. v gibalno dejavnost) spodbudila tudi specifično kognitivno in splošno-zdravstveno korist.

Diagram 2: Preučevane interakcije, ki vplivajo na otrokovo splošno zdravje in razvoj.

5. ZAHVALA

Zahvaljujemo se ravnatelju in ravnateljicam osnovnih šol, ki so nam omogočili, da na njihovih šolah izvedemo testiranje kognitivnih sposobnosti, prav tako pa vsem otrokom in njihovim staršem, ki so nam s podpisanim soglasjem dovolili, da jih vključimo v raziskavo. Zahvaljujemo se tudi doc. dr. Gregorju Starcu s Fakultete za šport za pripravljenost na sodelovanje.

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ASILOMAR AI PRINCIPLES

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ABSTRACT

In this paper, asilomar AI principles are presented in the original form accompanied with additional analysis. The principles present an attempt to provide guidelines for human-beneficial AI, the one that would prevent possibilities for AI to turn into human-harmful ways. The principles were defined during the Future of Life Institute's second conference on the future of artificial intelligence in early 2017. The aim of the paper is to bring these issues to our society through presentation and discussions.

Keywords

Artificial intelligence, AI principles, Future of life institute

1. INTRODUCTION

The Future of Life Institute's [3] second conference on the future of artificial intelligence was organized in January 2017. The purpose of this paper is to present, in a rather original way, the 23 asilomar AI principles [1] defined at the BAI 2017 conference, accompanied with the original discussions, the comments and analysis of the author of this paper.

While not attending the conference, the author is well familiar with the studies of the artificial intelligence [4], superintelligence [2, 5, 6] and contributions of the Future of Life institute. The opinion of the community is pretty a shared one: "a major change is coming, over unknown timescales but across every segment of society, and the people playing a part in that transition have a huge responsibility and opportunity to shape it for the best."

AI is again experiencing the golden times after so many ups and downs, but this time the stakes are much higher and the probability to achieve major changes bigger than ever. The rising awareness of AI-related changes in human society are appearing in scientific, academia and general public. Dozens of major reports have emerged from academia (e.g. the Stanford 100-year report), government (e.g. two major reports from the White House), industry (e.g. materials from the Partnership on AI), and the nonprofit sector (e.g. a major IEEE report).

2. THE PROCCESS AND DISCUSSION OF THE ASILOMAR PRINCIPLES

The first task of the organizers was to compile a list of scores of opinions about what society should do to best manage AI in coming decades. From this list, the organizers distilled as much as they could into a core set of principles that expressed some level of consensus. The coordinating effort was dominating the event, resulting in a significantly revised version for use at the meeting. There, small breakout groups discussed subsets of the principles, giving detailed refinements and commentary on them. This process generated improved versions of the principles. Finally, they surveyed the full set of attendees to determine the level of support for each version of each principle.

After the consuming and meticulous process, a high level of consensus emerged around many of the statements during that final survey. The final list retained the principles if at least 90% of the attendees agreed on them. The 23 principles were grouped into research strategies, data rights and future issues including potential superintelligence, signed by those wishing to associate their name with the list. The principles will hopefully provide some guidelines as to how the power of AI can be used to improve everyone's lives in coming years.

At the web page of the event on the web pages of the Future of Life Institute [3], the following original presentations can be obtained with additional interviews on the consequent links. This original text of the asilomar principles, which is according to the opinion of this author the most important contribution of this paper, is accompanied with additional analyses and discussion. The overall intention of the author is to spread the ideas of the beneficial AI, which can be also seen as kind of directions for the advanced civilization, to the audience of the Slovenian cognitive conference and into Slovenian public. The final goal, of course, is to design a beneficial superintelligence, and not a malignant one.

3. THE 23 ASILOMAR AI PRINCIPLES

Artificial intelligence has already provided beneficial tools that are used every day by people around the world. Its continued development, guided by the following principles, will offer amazing opportunities to help and empower people in the decades and centuries ahead.

3.1 Research Issues

1) **Research Goal**: The goal of AI research should be to create not undirected intelligence, but beneficial intelligence.

This overall goal determines the motivation for asilomar principles: to research and implement beneficial AI and not "any" AI. In extreme: suppose a scientist develops a totally original, novel bomb that can destroy our world. Would it be smart to fund, support or even allow such a research? This principle says: No, nobody should research and implement such things. The reason is pretty simple: sooner or later somebody will discover something really dangerous and potentially lethal for the whole human civilization. But as in any situation there are always exceptions: What if someday a hostile alien civilization attacks our planet and we are not familiar with the lethal technology and consequently not able to defend?

2) **Research Funding:** Investments in AI should be accompanied by funding for research on ensuring its beneficial use, including thorny questions in computer science, economics, law, ethics, and social studies, such as:

- How can we make future AI systems highly robust, so that they do what we want without malfunctioning or getting hacked?
- How can we grow our prosperity through automation while maintaining people's resources and purpose?
- How can we update our legal systems to be more fair and efficient, to keep pace with AI, and to manage the risks associated with AI?
- What set of values should AI be aligned with, and what legal and ethical status should it have?

In short: funding policies should not consider only the scientific excellence and novelty, they should take into account also relevance, safety, benefits for individuals and society, and its relation to the real world including legislation. This is how normal research funding should look anyway, but this principle is a bit more specific regarding a couple of issues.

3) **Science-Policy Link:** There should be constructive and healthy exchange between AI researchers and policy-makers.

Another principle that is beneficial for all research and science. It is too often that the officially leading part of the human society (politicians, government officials) are quite ignorant of the scientific powers and potentials. That makes government much less efficient as it should be. However, it is not clear how this feed-back from the scientists actually facing problems and the officials should work since there is no direct influence on officials – they either decide on their own or follow instructions of the politicians. Unfortunately, it is just too common that science and politics are worlds apart.

4) **Research Culture:** A culture of cooperation, trust, and transparency should be fostered among researchers and developers of AI.

It is often the case that developers of the big companies are under direct instructions from the company leadership, pursuing their specific goals. These goals are often beneficial for individuals, for capital gains, and not the society. The principle promotes better cooperation which can be only positive for faster and more beneficial AI and research in general.

5) **Race Avoidance:** Teams developing AI systems should actively cooperate to avoid corner-cutting on safety standards.

The danger in the mind of the proposers is that under time pressure, things might get out of control, be it superintelligence, general AI or and other potentially very strong technology. Therefore, avoiding creating new not fully controlled AI systems under pressure should be of great concern.

3.2 Ethics and Values

6) **Safety:** AI systems should be safe and secure throughout their operational lifetime, and verifiably so where applicable and feasible.

This is an extension of the principle no. 5. Dealing with hazardous systems or materials or technologies is not only dangerous, but also highly regulated. However, software research has not been treated as potentially hazardous and that holds for AI as well. But AI has an incredible potential and some regulations or at least caution, even only self-caution is welcome.

7) **Failure Transparency:** If an AI system causes harm, it should be possible to ascertain why.

In most AI systems, even most non-transparent, it is possible to deduct what caused a particular event – at least to a point. If the designers of the system take care of the failure transparency, i.e. explanation what went wrong in a particular case, that would not be only welcome, but more or less a necessity taking care of from the start of the design of the system.

8) **Judicial Transparency:** Any involvement by an autonomous system in judicial decision-making should provide a satisfactory explanation auditable by a competent human authority.

It is quite likely that the owners of the systems will shield themselves from any responsibility. Consider a case where an AI system is granted rights of a live being, e.g. a dog. The owner of a dog is responsible for the actions of the dog, and the dog itself takes negative consequences if, for example, a harm was done to another human. Basically, it would be a major error to give rights of live beings to the non-alive ones, so analogy with machines is a better option. A self-adapting car could become dangerous if hacked or under wrong influence, but whose error is that – of the hacker, the influence or the owner? All these issues should be resolved before actually using AI systems such as self-driving cars, but at least in the opinion of this author, legislators should not get confused and should apply direct analogy with machines. A robot, however intelligent, is still a machine.

9) **Responsibility:** Designers and builders of advanced AI systems are stakeholders in the moral implications of their use, misuse, and actions, with a responsibility and opportunity to shape those implications.

The designers and builders often say that they are not responsible for the actual use, that the owners decide how the system will be used. Our history teaches us that there are many eager to earn money without hesitation even when other people are evidently harmed. The Stanford prison and Milgram experiment showed that people are rather senseless for the suffering of others when their gains are in question if they will not get prosecuted for that. Probably that indicates also something about the social orientation that all punishments are worthless. This, ninth principle says that designers should be responsible and that at least the research society, which is quite harsh to scientific fraud (and has to be), will not tolerate excuses from those designers that intentionally or not enable creation of harmful AI systems.

10) **Value Alignment:** Highly autonomous AI systems should be designed so that their goals and behaviors can be assured to align with human values throughout their operation.

Anca Dragan says that AI systems will optimize their systems to their own criteria if we are not careful to program them in the way that they will align their machine intelligence and values to human intelligence and values.

Italian Francesca Rossi similarly says that the AI systems should behave in a way that is aligned with human values. She points out that this principle is even more important when a human and an AI system cooperate. They can be a team only if they understand each other and have aligned values.

It is like in sports. Some individuals as if "read each other minds" and that is the most effective combination. In the case of principle 10 it is about sharing at least basic viewpoints. Note that the catch is in the AI system, fully or partially autonomous. For a washing machine, it is not relevant if the human and the machine have their values aligned, because there is no freedom of choice or action. But the autonomous system will by definition work on its own and the same values should be somehow shared.

The author of this paper does not believe that the case of autonomous car is relevant for value alignment. AI researchers often point out that an autonomous car should take care to hit a pole instead of a human or an old lady instead of a young child. Or drive into river instead of hitting a human (and drowning the owner). These examples all seem unreal, non-practical. Autonomous cars are ten times safer than normal drivers. So

what if the car does not feel remorse when hitting a human if this is 10-times rarer than when human driving? There are many drunk and asocial or terroristic-oriented humans that do not care or even want to hit humans with a car.

11) **Human Values:** AI systems should be designed and operated so as to be compatible with ideals of human dignity, rights, freedoms, and cultural diversity.

This ideal is a wish, kind of social, promoting positive values into the AI systems. We humans would like that the AI systems will share positive human values with us. The rationale behind this seemingly naïve position is steel strong: when superintelligence will emerge, it should indeed better be positive to all other entities in the world, in particular to us, humans. The worst case is when one global intelligence emerges, with negative and harmful attitude towards humans, already combatting or quarreling with humans [2]. If we tend to design positive systems, it is far more likely that the superintelligence will also be of that kind.

12) **Personal Privacy:** People should have the right to access, manage and control the data they generate, given AI systems' power to analyze and utilize that data.

Guruduth Banavar insists that individuals should have the right to manage access to the data they generate. Already, the ICT (information, communication technologies) systems know far too much of us and torture us with ingenious ways of forced commercials we cannot avoid. The AI systems will be much more efficient in getting insights of individuals and institutions, personality traits, emotional make-up, lots of the things we learn when we meet each other. No doubt the web world is populated with systems getting from us individual information we do not like to share and those systems often declined services if we do not cooperate. Privacy loss is even now, without AI, insufficiently regulated and enforced.

13) **Liberty and Privacy:** The application of AI to personal data must not unreasonably curtail people's real or perceived liberty.

As mentioned, our liberty on the internet is already hampered and there is only limited AI functionality. There are even attempts to privatize the internet, which would make things far worse than today. The elites and the multinational corporations are forcing their money laundering schemata through their local interests not taking care that globally the web community and the human society suffer already.

To give a short example: when watching TV, there are lots of boring, loud and disturbing commercials. However, watching TV programs with time delay and skip or fast forward commercials, one can to a large extend eliminate them. But when using web services and mobile phones, several applications are free of charge only if they can pop up their commercials. A devil's deal!

14) **Shared Benefit:** AI technologies should benefit and empower as many people as possible.

Another social nice thought, not strongly related just to AI. However, the actual applications and the relation to the superintelligence are a bit unclear. Yes, superintelligence should be positively oriented towards the humanity, towards each human and in particular towards to the human civilization. But nice wishes can result in negative effects. Raising kids with letting them do what they want turns out negative for the childen and the parents. Forcing superintelligence to be "smiling" all the time might cause some disturbance. On the other hand, elites already control the world to their own benefit and if they get hands on the AI to serve them, that is another undesired situation. In summary: a positive principle with many scenarios possible.

15) **Shared Prosperity:** The economic prosperity created by AI should be shared broadly, to benefit all of humanity.

Yoshua Bengio considers that one of the greatest dangers is that people either deal with AI in an irresponsible way or maliciously. The superintelligence might serve one owner or a group of owners to serve for their personal gain, which is nearly by definition against the interests of the majority. He, like many others, sees a more egalitarian society, throughout the world, as a recipe to reduce those dangers. In a society where there's a lot of violence, a lot of inequality, the risk of misusing AI or having people use it irresponsibly in general is much greater. Making AI beneficial for all is very central to the safety question."

Again, one should be careful. A total Unitarian society is probably bad for the civilization progress and as discovered recently by the author of this paper, might even lead to the fall of the human civilization.

16) **Human Control:** Humans should choose how and whether to delegate decisions to AI systems, to accomplish human-chosen objectives.

This is one of safe and generally agreed principles. Control should not be freely given to autonomous AI systems. Several AI researchers argue that when superintelligence emerges, it will soon be uncontrollable due to its superior intelligence. Others argue that one can always pull-off the plug and some companies like Google have already designed such safety buttons to prevent AI get loose.

17) **Non-subversion:** The power conferred by control of highly advanced AI systems should respect and improve, rather than subvert, the social and civic processes on which the health of society depends.

Another principle pinpointing the undesired progress of AI and superintelligence.

18) **AI Arms Race:** An arms race in lethal autonomous weapons should be avoided.

Stefano Ermon warns that lethal autonomous weapons could be extremely dangerous. He thinks that the technology has a huge potential, and even just with the capabilities we have today it's not hard to imagine how it could be used in very harmful ways. AI should not do harm to other humans. AI designers should not develop weapons or to start wars or create more deadly machines than what we already have.

Toby Walsh is one of the initiators of the movement to ban lethal autonomous weapons. He is warried that the AI arms race is happening amongst militaries around the world already and finds it very destabilizing. "It's going to upset the current world order when people get their hands on these sorts of technologies. It's actually stupid AI that they're going to be fielding in this arms race to begin with and that's actually quite worrying – that it's technologies that aren't going to be able to distinguish between combatants and civilians, and aren't able to act in accordance with international humanitarian law, and will be used by despots and terrorists and hacked to behave in ways that are completely undesirable. And that's something that's happening today. You have to see the recent segment on 60 Minutes to see the terrifying swarms of robot UAVs that the American military is now experimenting with."

Prof. Toby Walsh is one of the prominent AI researchers and was most active in 2017 IJCAI conference in Melbourne, Australia.

The movement to ban lethal autonomous weapons has spread worldwide and got support of the cognitive science society and the AI society in Slovenia. The discussion is going on in the U.N.

If the information is correct, laser blinding of human soldiers is already prohibited.
On the other hand, the progress on AI and autonomous weapons is intensively going on in several armies, including autonomous ships, planes, tanks, drones and similar.

3.3 Longer-term Issues

19) **Capability Caution:** There being no consensus, we should avoid strong assumptions regarding upper limits on future AI capabilities.

Roman Yampolskiy, an author of another superintelligence book [6] says that in *many areas of computer science, such as complexity or cryptography, the default assumption is that we deal with the worst case scenario. In a similar way, AI researchers, developers and the society should assume that AI will become maximally capable and prepare accordingly. No harm if we are wrong.*
There is one issue that puzzles many AI researchers. There are famous intellectuals like Elon Musk, Bill Gates and Stephen Hawkins and including politicians like Putin that claim that the AI race to superintelligence is either on or is gaining great potentials already. Other like Toby Walsh or Facebook owner Zuckerman or Google chief developers or Kurzweil on the other hand claim that the dangers of superintelligence are nothing but a hype. Hard to depict which arguments prevail.
Dan Weld agrees with the principle no. 19, however, it concerns him because it's a distraction from what are likely to be "much bigger, more important, more near term, potentially devastating problems". He is much more worried about job loss and the need for some kind of guaranteed health-care, education and basic income than about Skynet; much more worried about some terrorist taking an AI system to kill people than about an AI system suddenly waking up and deciding that it should do that on its own." On the short term he is surely right.
20) **Importance:** Advanced AI could represent a profound change in the history of life on Earth, and should be planned for and managed with commensurate care and resources.
Kay Firth-Butterfield believes that AI will create profound change even before it is 'advanced' and thus we need to plan and manage growth of the technology. "As humans we are not good at long-term planning because our civil systems don't encourage it, however, this is an area in which we must develop our abilities to ensure a responsible and beneficial partnership between man and machine."
21) **Risks:** Risks posed by AI systems, especially catastrophic or existential risks, must be subject to planning and mitigation efforts commensurate with their expected impact.
Humans seem to be rather erratic in terms of development and use of novel systems. Not many systematic cate or regulation is thought in advance. However, for the potentially very powerful technologies such as creating black holes of superintelligence, much should be thought and regulated in advance.
22) **Recursive Self-Improvement:** AI systems designed to recursively self-improve or self-replicate in a manner that could lead to rapidly increasing quality or quantity must be subject to strict safety and control measures.
This is the core event Elon Musk sees as the superintelligence emergence. Already, many AI systems apply similar techniques, but this one is related to the general superintelligence at an initial stage, rapidly improving itself like the AI programs playing some game.
3) **Common Good:** Superintelligence should only be developed in the service of widely shared ethical ideals, and for the benefit of all humanity rather than one state or organization.
Similar to many principles, this one tries to promote positive values not only into the AI society, the superintelligence entities, but also into the human society. The last one is far-fetched for sure and such discussions in the technical AI community should be avoided.

4. CONCLUSION

While the paper practically copies the principles and the related information presented through the Future of life institute, it is important to spread the word around. The paper will hopefully spur discussion and awareness about these issues also in our country. The added discussions are here primarily to foster more attention.

The principles are not to be accepted as axioms or governmental laws, but rather as guidelines in which direction should we humans develop AI to avoid the dangers of the negative effects of the rising power of artificial intelligence. While AI often frightens general public, this author finds it a necessity to prevent degradation of human civilization. However, the potential dangers are real, not fictitious, primarily to a simple fact that any major power can be easily misused to cause harm to humans. By raising awareness, we increase the chances to ripe only the positive aspects of the future mighty AI.

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INFLUENCE OF SELF OBSERVATION IN THE PROCESS OF TWO-DIMENSIONAL CREATION IN VISUAL ARTS

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ABSTRACT

This paper presents a phenomenological case study of a fine artist and her process of self-observation in analog and digital media interaction. In the process of self-observation, the methodological questions emerged of how to explore the unconscious layers of subject's experiential nature, which also represent their source of inspiration without demolishing the creative practice. The results have shown an adverse effect of self-observation on the creative practice of an artist that draws attention to some problems of the empirical investigation in the field of art. In conclusion, contemporary scientific research needs to reconsider the issue of deepening self-awareness and the establishment of a state of mindfulness within investigations on the practice of art.

Keywords

Self-observation, phenomenology, experience, artistic process, mind wandering, awareness, creativity

1. OBSERVING THE SELF OBSERVATION PROCESS

This paper introduces a phenomenological case study of an academic painter which, through the first-person perspective, observes inner experience in interaction with analog and digital media during the creative process. The self-observation process gradually deepened self-awareness, influenced and changed the course of her painting process.

Based on the survey, there was no significant content found that explore the experiential role and the impact of self-observation of different levels of consciousness [11]. Related questions can be found in a broader context [5, 18] or in conjunction with other artistic disciplines [9] but there are only a few examples where research question is carried out and tested in collaboration with visual artists. Studies tend to focus on the object/subject of observation and ignore the methodological impact on the creative process.

Therefore, within the research process, which lasted from the inspirational phase to the initial phase of painting, a methodological question was raised: Whether or how self-observation and deepening the awareness are really compatible with the creative process?

The purpose of the contribution is therefore to illustrate the artist's experience within the self-observation process, its problematic points and the consequences that have arisen, in connection with the process of revealing her unconscious content.

2. PHENOMENOLOGICAL APPROACH

This research was constructing against the grain and delimiting itself from a prior hypothesis. The data of subjective experience was collected with the modified Descriptive Experience Sampling Method [6], by using a prototype of a mobile application that prompted the artist at random times to record her experience. After gathered samples, the experiences were "deepened" with the elicitation interview [14]. The purpose of this procedure was to get the most "pristine" structures of experience [8], the basic entities and patterns that form the individual's experience of the description, regardless of the meaning that she attributed to the experience [7].

3. OUTLINING THE EXPERIENTAL LANDSCAPE

The process of observation revealed a distinct dynamic between various ***experiential state*s** and the experiencing ***self-perception***. The dynamics of experiential process transpired between three *experiential states: sensory, emotional* and *mind wandering*. In correlation with the dynamics of experiential states, it was perceived that the experiential components that describe the perception of oneself, vary accordingly. The categories of *self-perception* were indirect descriptions of experience: *experiential space, sense of agency,* and *narrative perspective* [3].

With *experiential space* the artist defines where her attention is located during the creative process; it is either situated on the object of creation or it converts to thought processing. Based on the artist's descriptions, the "spaces" of attention were: *up there, here and now,* and *in between.*

Up there indicates the experience, which the artist describes as present in her "head". This is a "mental" phenomenon [22], which has no connection with the physical perception of this part of the body.

Here and now describes the experience where the artist experiences herself present in space and time in which she operates.

In between describes the experience where the artist is unable to define where the attention is, making the artist unaware of the experience in a specific moment.

The *sense of agency* contains reports of how the artist experiences her own causality [10, 12] working and happening. In the process, the artist experiences herself as the "agent" or things just happen to her and she is only an observer of events.

According to *self-perception*, the artist switches the position, or the perspective of description from first-person narration to

second- or third-person narration, which implies that she is trying to distance herself from occurrences and sensations that are happening in and outside of her.

Mind wandering - defined as thought processing, was either task-oriented or task-unrelated [15, 13] in the creative process. Its sub-categories were *reflective mind wandering* and *non-reflective mind wandering*, which means the artist can have a different metacognitive awareness of the current contents of thought [17]; an artist can either actively wander with her thoughts or only observe her mind wandering.

3.1 The relations and the dynamic between the categories

In the creative process, the relations and the dynamics between the categories were established automatically. According to the artist's reports, the experiences that were happening in the perception area here and now were always in correlation with the sub-category working. In this state, there was a certain coherence between the categories (emotional, sensory) which were confined to first-person narration. These reports were more explicit in comparison with the experience, which transpires in the place up there. The artist's experience of this »place« was always described from second- or third-person perspective.

There was another space between the up there and working in the here and now, that is the in-between category. This category represents the state of transition between the other two categories and connects with a second- or third-person point of view (the category: second or third person).

The dynamic runs among all experiential categories »relationally«, meaning that the change of a specific category affects the entire experiential process and thus the creative process as well.

3.2 Problematic points of observation

The specific properties of experiential categories, which were revealed as the problematic points of observation, had the ability to influence the experience of the exploration process itself and were presented along with every description of each experiential category.

The uniqueness and the complexity of the emotional experience primarily manifested in its multifaceted structure or in the parallel structure of the feelings; it was divided into two levels, that is to say, what is connected with the situation and what is connected with the content. The artist encountered some experiencing difficulties, e.g. the painting process induced the feelings of contentment, while at the same time she perceived the content of painting unpleasant.

The *sensory experience*, in the case of the artist, differentiates from the other categories because of its »vividness« or its intensity and the »presence« of this experience. The sensory experience was divided into two sub-categories; *the sensory experience with a physical component* (which mostly records unpleasant physical senses in connection with posture and body position when repeating specific movements) and the *sensory experience without a physical component*, which was recorded on a much smaller scale. Even though it seems like the latter plays a crucial role in the creative process, it is vital for the decision-making process and brings the feelings of joy and contempt. However, due to the momentary and very elusive nature of sensory experience, it is very difficult to track and observe this experience.

4. THE PROBLEMATIC POINTS OF OBSERVATION

The problematic points of specific categories had the power to influence the result of the observation process. Deepened awareness caused a reorganization of the dynamic processes, through which the amount of reflective mind wandering raised and consequentially also confirmed lowering the sensory perception [21] and higher amount of unpleasant emotional perceptions was detected. Due to increased mind wandering, the experience of the artist in the place here and now decreased and predominantly stayed in the area up there. Observation of mind wandering also encountered some problems due to its evasiveness, e.g., the problem of “fixating” the moment on a specific experiential moment, the elimination of the time component, and the transition between different forms of mind wandering takes place automatically, without awareness of the artist.

5. CONCLUSION AND FUTURE DIRECTION

The results of the study show that the self-observation and lowering mind wandering process, in this case, led to a creative block, namely to a negative influence on the artist's work, which is contradictive to some previous studies reports [13, 4]. This calls for consideration that the future studies should take the predispositions of the artist's practice and the phases of their creative process into account. Artists, as well as their creative processes, are different in sensitivity and difficulty of observation. Additionally, a caution with using contemplative techniques are needed because non-dual awareness does not always work in the favor of the individual, in fact, some studies show quite the opposite [2, 20]. The research supports the knowledge, that the balance between the conscious and unconscious states is needed for the creative process [16].

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Analysis of EEG visual evoked potential (VEP) acquisition delays

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ABSTRACT

EEG visual evoked potentials (VEP) are event related potentials (ERP), i.e., measured brain response, for visual events. In order to analyze ERPs, EEG acquired data must be supplemented with information indicating the time of stimulation events. This information may be detected by sensors or from event generation devices. Visual stimulation is most often carried out using computer monitors. The time of stimulation events is traditionally detected using monitor mounted lightness sensors. However lately, it is often obtained from visual stimulation software. In this work we tested the hypothesis that software event markers could be considered as an alternative to lightness sensor markers. We built a software application that acquires EEG data with both types of markers to measure the VEP acquisition delays and test the hypothesis. The results obtained on standard computer monitors show large discrepancy between information obtained from both marker types, not only the delay, which could eventually be compensated, but also the presence of jitter that may have a drastic influence on the analysis results. Even in the case of lightness sensors their careful positioning is required to correctly measure temporal characteristics of ERP responses.

Keywords

Electroencephalography (EEG), event related potentials (ERP), visual evoked potentials (VEP), delay, jitter

1. INTRODUCTION

Event related potentials (ERP) are measured brain responses that result from specific sensory, cognitive, or motor events[5]. Visual evoked potentials are a specific kind of ERPs that are limited to visual events. For a detailed explanation of evoked potentials, their physiological background and required acquisition system components see [1]. VEPs are one of the primary tools for cognitive neuroscience research [3] and, lately, for brain computer interfaces (BCI) [9]. There are two types of VEP used, i.e., transient VEP (TVEP) corresponding to response to individual stimulus, and steady-state VEP (SSVEP) corresponding to repetitive stimulations. Analysis of the first one needs to be performed in the temporal domain and is sensitive to synchronization between the stimulus and EEG recording. Standard computer monitors are most often used for stimulus display and rarely other (typically flashtube) devices are used instead. Delays and jitter may have drastic influence on the analysis results. As the delay may be measured and compensated, there is no evident workaround for the jitter. In medical/neuroscience setups, the synchronization is typically performed by automatic EEG labeling using display mounted lightness sensors, for an examples of such a study see [8]. This kind of synchronization is rare in the BCI setups due to increased equipment cost. Today, many setups rely on expected low delay of computers and their peripherals [6, 7], and label the events in EEG data by visual event generating software.

In this work we analyze the delays in setups that display stimuli on computer monitors. We have implemented a VEP recording system with dedicated software for visual stimulation and simultaneous recording of EEG signals supplemented with different marker signals indicating system delays.

2. ACQUISITION OF EVENT-LABELED VEP DATA

To measure delays in VEP acquisition we built a system for VEP stimulation and recording capable of storing two additional marker signals to accurately label visual stimulation event timing. The first is a software marker signal that indicates when the software renders an image. In such moments the software marker's value is set to a value defined for the specific image in a predefined visual stimulation plan, else its value is zero. The second marker signal is a digital one, and indicates when images actually appear on the monitor. Is is acquired using two lightness sensors connected to an additional digital input channel of an EEG device. Each sensor influences one of the bits of in the digital signal value.

Our system consists of several hardware and software components. The hardware setup is shown in figure 1. The system uses EEG implementation from g.tec medical engineering consisting of two EEG amplifiers g.USBamp, toge-

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ther enabling 32 EEG channels, and g.TRIGbox with two lightness sensors.

We implemented our own software on a Linux operating system using g.USBamp C-API with special care for minimizing software delays during stimulation and data acquisition. Both tasks, stimulation and data acquisition were implemented in a single software component. All the data including the visual stimulation plan and all the images were preloaded, avoiding all unnecessary processing during the data acquisition. A single handler function served for accessing data from both EEG amplifiers including 32 channel EEG data and digital data from the lightness sensors, as well as the software marker signal set by a visual stimulation function. For displaying the images OpenCV function čv::imshow"was used. All the acquired data was written to a single binary file for each EEG recording session. After the acquisition the recorded data was analyzed in Matlab.

3. RESULTS

The experiment was performed using a HP Computer with an i7 processor, SSD disk and 16GB RAM, running a Linux operating system. Two different monitors were used, HP 1702 (A) and HP Z24i D7P53A4 (B), and for each of them four different lightness sensor placements labeled 1–4 were tested, altogether yielding eight cases, labeled from A1 to B4. Sensor placements are illustrated in figure 2.

In each of the recordings two images were periodically cycled, where the first one was all black and the other one was all white. Each image was shown for 200 milliseconds and the cycle repeated 500 times, such that 1000 image renderings took place in total in each of the recording cases. The signals were recorded using 512 Hz sample rate and analyzed according to delay between the markers. The software marker signal has a non-zero value only for samples when the image display function was called, i.e., value 1 for the transition from white to black (event E1), and value 2 for the transition from black to white (event E2). The sensor marker signal was coded as two bits of a digital signal, i.e., bit 1 for the top/left sensor and bit 2 for the bottom/right one, yielding values from 0 (black screen) to 3 (white screen). For the illustration of the marker signals see figure 3.

For each event, i.e., spike in the software marker signal, the consequent changes in the digital sensor signal were found and delays τ computed. The statistical distribution of delays was estimated for each of the cases and evaluated according to average delay ($\overline{\tau}$), maximal delay (τ_{max}), delay standard deviation (σ_τ), and maximal difference between response time of both sensors (Δ_τ). The results are listed in table 1. Delay distribution for case A1 is shown in figure 4(top). We can see that delay is not constant and jitter is present. The standard deviation of delay is roughly 6 samples or 12ms for monitor A and 10 samples or 20ms for monitor B. The difference between maximal and minimal delay can be up to 60 ms, which shows that our initial idea of compensating delay with calibration is not feasible.

Despite the sensors were in case A1 located as close together as possible, the maximal difference between their response was 3 samples or 6 ms. By positioning sensors further apart, the difference increases to up to 12 samples or 23.4 ms, which

Table 1: Statistical parameters of delay for two monitors (A and B) and four sensor placements (1-4). All results are given in number of samples at 512 Hz data acquisition.

	$\overline{\tau}$	τ_{max}	σ_τ	Δ_τ
A1	22.28	48	6.53	3
A2	22.95	44	5.80	6
A3	22.49	44	6.18	12
A4	22.80	45	5.94	9
B1	27.20	54	10.54	3
B2	27.47	52	10.34	3
B3	26.27	60	10.20	5
B4	27.53	52	9.95	9

is more than the monitor refresh period (16.7 ms for a 60 Hz monitor refresh rate). In case of monitor B, this difference is closer to our expectations, up to 9 samples or 17.6 ms in case B4, exactly one monitor refresh cycle. A more detailed analysis shows that delay difference gets clustered into as many clusters as there are vertical segments of the monitor display being divided by the lightness sensors. Each of the clusters was up to 6 samples wide for monitor A and up to 3 samples wide for monitor B. The position of clusters roughly corresponds to the vertical portion of the monitor screen between the markers, and in most obvious cases A4 and B4 equals 8 to 9 samples; approximately one monitor refresh period. An example of delay difference distribution is shown in figure 5.

Detailed analysis of monitor A shows another phenomenon: different delay distributions for events E1 (white to black transition) and E2 (black to white transition), where E2 is on average 3ms faster than E1. Distributions for individual events are shown in 4(middle, bottom). This is phenomenon was less obvious for monitor B, where E1 is on average 1ms faster than E2.

4. DISCUSSION AND CONCLUSION

Our initial hypothesis was that software markers could be considered as an alternative to lightness sensor markers. Our results disprove such a hypothesis, because the delay between image rendering in software and actual image appearance on the computer monitor is not constant. The jitter cannot be compensated and this puts in question all setups that rely on software timing of events, not only for TVEP but also SSVEP analysis. Our results do not tell much about the source of the delay. Usually, the monitor refresh rate is expected to be the only factor responsible for the delay, as suggested by some of the EEG experiment setup guides [4]. In our results this cannot be the case, as 60 Hz refresh rate would reflect into at most 17 ms delay and not up to 47 ms measured in our tests. We hypothesize that delay also comes from software processing, graphic card rendering, monitor rendering and pixel response times. Due to using certified medical-grade EEG equipment, we can only expect that the delay of the lightness sensors and EEG amplifiers is small enough not to be considered. We have only tested LCD monitors and not CRT ones. As it has been reported that LCD monitors significantly increase the P100 latency compared to CRT monitors [2] one could speculate that this could be due to potentially higher delay of LCD monitors.

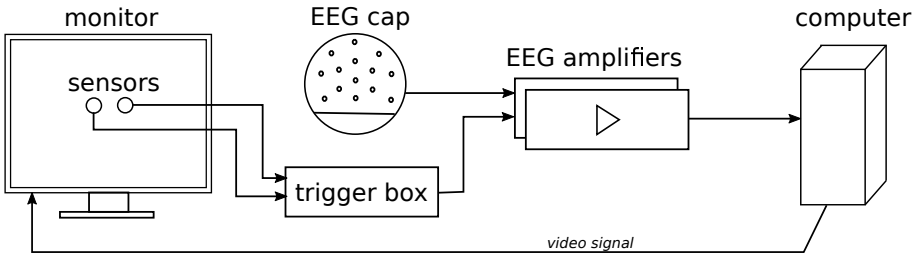
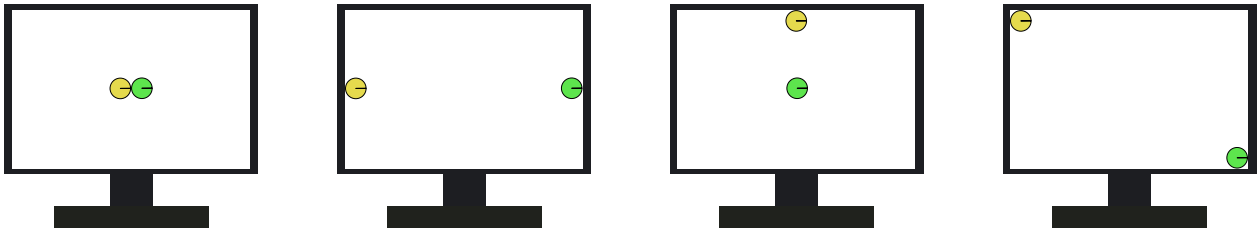


Figure 1: Hardware components of the VEP stimulation and recording system.



(1) (2) (3) (4)

Figure 2: Lightness sensor placements. Two sensors were placed in four different configurations (1–4) in order to test the influence of sensor placement on the delay between their signals.

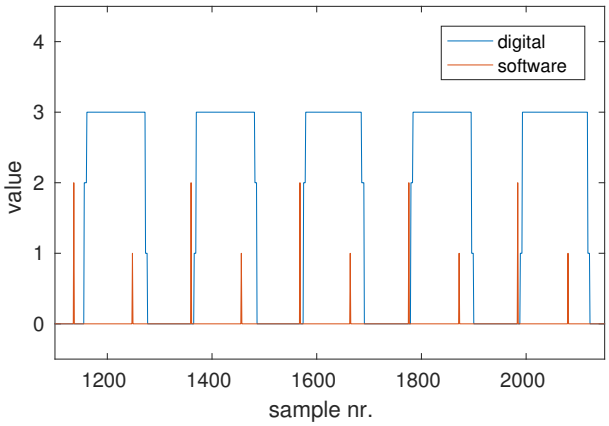


Figure 3: A section of marker signals. Spikes in the software signal correspond to moments when function for image display is called. Digital signal from lightness sensors is binary coded, each sensor contributing a single bit.

From the results of the delay difference between the lightness sensor signals we can conclude that positioning of the lightness sensors is important for TVEP analysis. Lightness sensors should be vertically positioned as close as possible to the center of the screen or the part with expected observer attention. If such positioning is not possible, the error cannot be corrected by changing the delay for the time proportional to the vertical screen displacement, because there are always two possible alternatives, with the delay difference of one monitor refresh period. The standard deviation of the clusters depends on the monitor. For monitor B it is estimated to equal one sample or 2 ms. This defines the highest possible accuracy of ERP studies.

Monitor selection turns out to be important. It influences the level of delay jitter, responsible for VEP analysis error in the case of software markers, and variation of sensor delay that limits the accuracy when using lightness sensors. In our case each of the monitors outperformed the other in one of the aspects. This suggests that with careful selection even better monitors could be found. We could only speculate how to get lower jitter, but evidently one of parameters influencing the lightness sensor marker accuracy is the monitor refresh rate. Higher is better. As the required monitor properties are similar to the ones sought by gamers, this may be a good starting point for the selection.

To conclude, the results of our work show that software markers are subjected to high visual stimulation delay and jitter when standard computer monitors are used. Consequently, such VEP recording system implementations should be avoided whenever possible, and used with extreme caution. Furthermore, even the lightness sensor markers should be used with a certain amount of care when stimulation is performed using computer monitors, especially to vertically

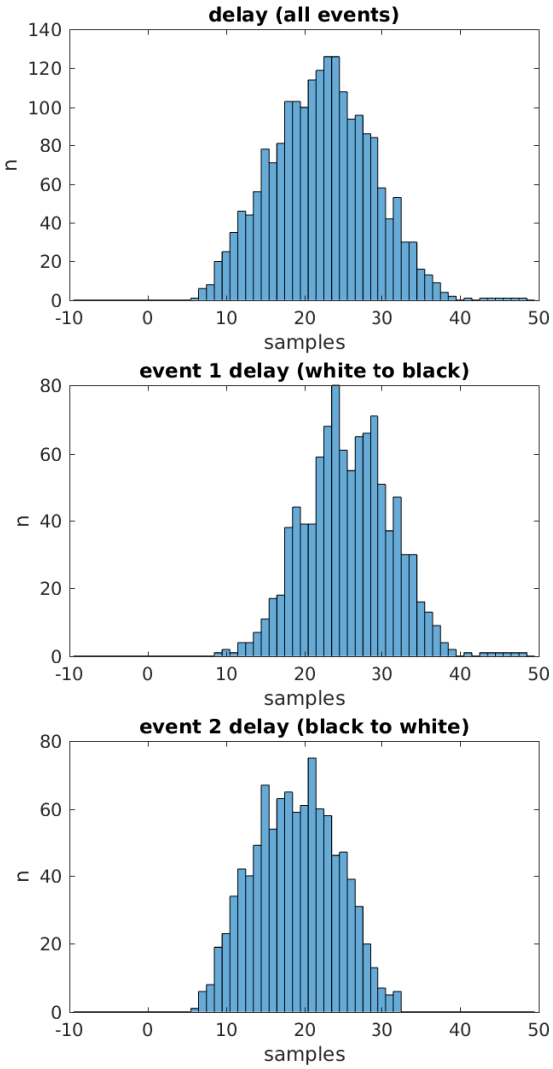


Figure 4: Delay distributions for case A1; for both events (top), event E1 (middle), and event E2 (bottom)

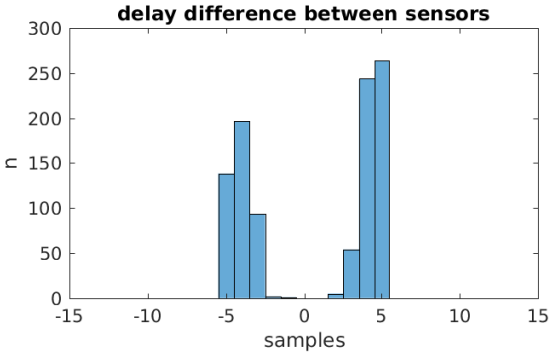


Figure 5: Distribution of delay difference between both lightness sensors for the B3 case. The distance between the clusters correspond the monitor refresh period.

align sensors with the expected center of attention.

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O fenomenologiji prepričanj, od Husserla do enaktivizma

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POVZETEK

Predstavljeni so nekateri koncepti in ideje v fenomenološki tradiciji, ki osvetlijo prvoosebni pogled na prepričanja. Husserlova ideja horizonta uvede prvoosebno obliko implicitnih prepričanj in zaznavnih procesov, ki so-določajo vsak naš doživeti trenutek. Pri horizontu je omenjena tudi pomembna vloga telesa kot kontekst za horizontna prepričanja. Utelešeno perspektivo poudari tudi Merleau-Ponty, ki argumentira, da telo daje našemu svetu pomen. Merleau-Ponty uvede tudi pojem intencionalnega loka, na podlagi katerega Dreyfus predstavi možnost učenja (ustvarjanja novih pomenov) brez reprezentacij. Na Merleau-Pontyju sloneč enaktivizem, kot ga uvedejo Varela, Thompson in Rosch, pomembnost utelešenja ponotranji. Na koncu je predstavljen še sodobni koncept opomenjanja avtorjev Di Paolo, De Jaegher in Rosch, katerega glavna značilnost je, da je telo to, kar določa norme na podlagi katerih naš svet pridobi pomen.

Ključne besede

fenomenologija, prepričanja, udejanjanje, enaktivizem, opomenjanje

1. UVOD

Prepričanje je po navadi definirano kot naravnanost »ko nekaj vzamemo za resnično«, pri čemer je ta »nekaj« izrazljivo kot propozicija. Prepričanja se tako opisujejo v obliki »S je prepričan, da P« (kjer je S subjekt, P pa propozicija), na primer: »S je prepričan, da ima naše osončje 8 planetov«. Velik del filozofske tradicije, od reprezentacionalizma preko dispozicionalizma in interpretacionalizma do funkcionalizma, razumejo prepričanja kot shranjena nekje v umu (reprezentirana), od koder inspirirajo naše vedênje. Iz vedênja pa lahko retroaktivno sklepamo na prisotnost prepričanj. (Schwitzgebel, 2015)

Prispevek na kratko predstavi fenomenološko tradicijo, ki se ne naslanja na reprezentacije in ne ugotavlja, kateri organizmi se dovolj prepričljivo vedejo, da jim lahko pripišemo prepričanja. Fenomenologija se osredotoči na prvoosebno perspektivo tega, ko nekaj vzamemo za resnično. Velik delež bo posvečen konceptu horizonta Edmunda Husserla (1913), ki je le delček njegove obsežnejše teorije prepričanj. Horizontu bo dodan še poudarek na vlogi telesa Maurica Merleau-Pontyja (1996) in njegov koncept intencionalnega loka, ki ga Hubert Dreyfus (2002) uporabi za predstavitev možnosti učenja brez reprezentacij.

Utelešena perspektiva in odmik od reprezentacij sta ključnega pomena za enaktivizem oziroma teorijo udejanjenja, avtorjev Francisco J. Varela, Evan T. Thompson in Eleanor Rosch (1991). Znotraj enaktivizma je predstavljen koncept opomenjanja avtorjev Ezequiel Di Paolo, Marieke Rohde in Hanne De Jaegher (2010), katerega glavna značilnost je, da je telo to, kar določa norme na podlagi katerih naš svet pridobi pomen.

Prepričanja nastopajo vedno pod tem imenom. Avtorji uporabljajo mnogo pojmov, ki jih je možno razumeti kot podvrste prepričanj ali kot prepričanjem sorodni fenomeni, kot na primer znanje (resnično, utemeljeno prepričanje), pričakovanje (prepričanje o tem, kaj bo v prihodnosti), pomen (prepričanje, kaj/kako neka stvar je) in učenje (»pridobivanje« novih veščin, znanj, prepričanj, pomenov).

2. HORIZONT

Husserl horizont opiše v mnogo kontekstih, eden izmed njih je kontekst doživljanja določenega predmeta. To izkustvo obdaja »temno zavesten horizont nedoločene resničnosti« (Husserl, 1913: 49) – obzorje možnih izkustev v prikazujočem se nam svetu v danem trenutku.

»Svojo pozornost lahko pustim potovati od ravno videne pisalne mize, na katero sem bil pozoren, preko ne-videne dele sobe za mojim hrbtom k verandi, na vrt, k otrokom in uti itd., k vsem objektom, za katere trenutno 'vem', kot tam in drugod v moji neposredno so-zavedani okolici bivajočim […]« (ibid.)

Horizont je torej vso znanje (*Wissen*), ki spremlja dano izkustvo predmeta. Husserl še v isti povedi to znanje opredeli kot implicitno: »[…]– znanje, ki nima nič od pojmovnega mišljenja in se šele z naklonjenostjo pozornosti in tudi takrat le delno in po navadi zelo nepopolno preobrazi v jasno opazovanje.«

Druga oblika horizonta se pojavi pri Husserlovi analizi časovne zavesti. Gallagher in Zahavi (2007) povzemata Husserlovo argumentacijo, da doživljanje ni sestavljeno iz serije diskretnih izkustev, ki si sledijo eno za drugim. Za izkustvo časovne zveznosti se moramo v vsakem trenutku zavedati tudi trenutka pred njim in slutiti trenutek, ki mu sledi. A to zavedanje ne more biti enostavno spominjanje ali predstavljanje, ne more biti enostavno reprezentacija nekega preteklega ali bodočega trenutka v tem trenutku. Gallagher in Zahavi (2007) navajata primer doživljanja melodije. Ne slišim ene posamezne note, ki potem iz zavesti popolnoma izgine, na kar se pojavi izkustvo druge note, temveč »zavest ohrani občutek prve note, ko slišim drugo, slišanje, ki je obogateno s pričakovanjem naslednje note.« (Gallagher in Zahavi, 2007: 75) To še jasneje ponazorita s primerom slišanja zaporedja treh not C, D in E. Ko se zavemo note E, se hkrati tudi zavedamo predhodnih not D in C, a ne na enak način kot se zavedamo note E. Noti D in C sta pretekli, in doživeti kot toneči v preteklost. V vsakem trenutku imamo torej horizont tako preteklega trenutka, kot tudi pričakovanje prihajajočega.

Jeffrey Yoshimi (2009) horizont predstavi kot predznanje (*Vorwissen*) in pričakovanja povezana z doživljanjem danega predmeta:

»Ko gredo stvari kot pričakovano, naše trenutno izkustvo 'izpolni' (*erfüllen*) naša predhodna pričakovanja, in ti dve izkustvi prestaneta pasivno sintezo identifikacije. […] Ko stvari ne gredo kot pričakovano, naše izkustvo 'razočara' (*enttäuschen*) naša predhodna pričakovanja (*Erwartungen*) […] in posledično se zgodi le delna sinteza (še naprej se doživlja kot isti objekt, a razumljen je drugače).« (Yoshimi, 2009: 124)

Yoshimi (2009) izpostavi pet pomembnih lastnosti horizonta.

1. Horizontna pričakovanja so tiha, implicitna in ne vključujejo aktivnega mišljenja, premlevanja ali govorjenja. Ko dvignem roko, da bi potrkal na vrata, si po navadi ne mislim »pričakujem, da bodo vrata naredila leseni zvok«. Horizontna prepričanja so prej podobna »značajskemu odnosu med možnimi dejanji, zaznavami in stopnjami izpolnjevanja ali razočaranja.« (Yoshimi, 2009: 124) Na primeru trkanja vrat bi to pomenilo, da enostavno nisem presenečen, če vrata res naredijo lesen zvok, ko na njih potrkam, med tem ko me začudi, če ga ne.

2. Horiznotna pričakovanja niso diskretne enote in se ne nanašajo na enostavno ubesedljive možne dogodke, temveč ustrezajo zveznemu razponu možnosti. Zbirajo se v manevrske prostore (Spielräume), v katerih je znotraj danih omejitev možen širok diapazon pričakovanj (Yoshimi, 2009). Ko, na primer, sežem proti kamnu, sem odprt za razno razna s kamnom povezana izkustva. Ne pričakujem točno določene teže, le približek; ne pričakujem točno določene oblike in barve kamna na hrbtni strani, mnogo različnih oblik in barv ali barvnih kombinacij sive, črne, bele, rjave… lahko zadostijo moja pričakovanja. Presenečen bi bil le, če bi se moje izkustvo nahajalo povsem izven mojega obsega pričakovanj, če bi bil na primer lahek kot pero, ali kot kos lesa; ali če bi bil na hrbtni strani povsem raven in živo-modre barve.

3. Horizont je dinamičen, neprestano se posodablja na podlagi našega toka doživljanja (Yoshimi, 2009). Če, na primer, primem kamen in namesto hladnega, grobega in težkega občutka v roki, ki sem ga pričakoval, začutim manj hladen, gladek in lahek občutek, kot da bi bil to le kos plastike, se bodo moja horizontna pričakovanja v zvez s tem predmetom ustrezno posodobila in ne bom nenehno presenečen ob držanju tega predmeta. Če ga posledično vržem, pričakujem, da leti kot plastika, ne kot kamnina.

4. Horizontna pričakovanja so osnovana na informacijah o tipu stvari, ki jo doživljamo (Yoshimi, 2009). Ko doživljam določen kamen, so moja pričakovanja o tem kamnu osnovana na tem, kar vem o kamnih na sploh – o tipu »kamen«. Husserl da primer psa: »Ko vidimo psa, nemudoma pričakujemo njegove dodatne načine obnašanja: njegov tipičen način jedenja, igranja, tekanja, skakanja in tako naprej. Ni tako, da dejansko vidimo njegove zobe; a vemo v naprej kako bodo njegovi zobje izgledali – ne v njihovi individualni določenosti, temveč glede na tip, v kolikor smo že imeli pretekle redne izkušnje s 'podobnimi' živalmi, s 'psi', da imajo stvari, kot so 'zobe', tega tipa« (Dreyfus 1984: 19; citirajoč Husserl 1973: 331)

5. Horizontna pričakovanja so vpeta v kontekst možnih okoliščin, a predvsem so določena s telesom in gibanjem. Yoshimi poda primer z vrati:

»Kaj pričakujem v zvezi z vrati, ko z njimi stopim v interakcijo, je odvisno od tega, kako se gibljem: če se premaknem desno, pričakujem da se videz vrat spremeni na določen način; če se premaknem levo, pričakujem da se spremeni na drugačen način. Husserl včasih opiše 'predzačrtane' ali 'predizračunane' (*vorgezeichnet*) videze kot odvisne spremenljivke v odnosu do gibanja telesa (ki je neodvisna spremenljivka)«. (Yoshimi, 2009: 124)

Tudi od telesnega gibanja neodvisne okoliščine določajo horizontna prepričanja. Če vidim žogo, ki z neko hitrostjo leti proti vratom, imam s tem dogodkom povezana pričakovanja, na primer kakšen zvok bo naredil trk žoge ob vrata in to, da se bo žoga od vrat odbila. Povsem presenečen bi bil, če bi se namesto tega žoga razbila kot steklo.

3. UTELEŠENA PERSPEKTIVA

Husserl že malo namiguje na to, da igra telo oziroma naša utelešena perspektiva posebno vlogo v horizontu. Obsežne fenomenološke analize doživljanja telesa se loti Maurice Merleau-Ponty (1996), ki opiše telo iz dveh zornih kotov, kot objekt doživljanja in kot perspektiva doživljanja. V kontekstu analize telesa kot objekta doživljanja omeni dva pojma: telesna slika in telesna shema. Telesna slika je »sestavljena iz sistema izkustev, naravnanosti in prepričanj, kjer je objekt teh intencionalnih stanj lastno telo.« (Gallagher in Zahavi, 2007: 146) Merleau-Ponty (1996) telo opredeli kot zaznano drugače kot so zaznani siceršnji objekti. Drugi objekti se lahko oddaljijo in izginejo iz moje zaznave, med tem ko telo tega ne more, je trajno. Pri tem Merleau-Ponty (1996) doda, da telo za nas ni prisotno kot objekt v svetu, temveč kot naša perspektiva na svet (o tem več kasneje).

Telesno shemo Gallagher in Zahavi povzameta kot »naše pred-reflektivno in ne-objektivizirajoče zavedanje telesa.« (Gallagher in Zahavi, 2007: 146) Ta karakterizacija so-doživljanja telesa v horizontu ne uvede nobenih novih idej ali razumevanj v sklopu že prej razdelanega pojmovanja horizonta. Lahko je enostavno del njega, kot je so-doživljanje sobe, ko sem osredotočen na pisalno mizo; ali kot so v horizontu pričakovanja na podlagi tipa »telo« ali »moje telo«. A Merlea-Ponty (1996) tudi tu doživljanje telesa predstavi kot doživeto drugače od drugih objektov. Na primeru pika komarja, ki ga ne rabimo iskati po lastnem telesu, temveč ga enostavno najdemo, izrazi: »Kar se tiče telesnega prostora, očitno obstaja védenje za kraj , ki ga je možno zreducirati na neke vrste so-obstoj s tem krajem, […] čeprav ga ni možno izraziti z opisom ali nemo referenco geste.« (Merleau-Ponty, 1996: 121) Prostorskost telesa torej ne doživljamo enako kot prostorskosti sveta. Zavedanje, kje v prostoru je stikalo za luč, je približno, motorično se lahko osredotočimo nanj, in ga najdemo. Lastno peto pa najdemo brez iskanja, enostavno vemo, kje je.

Drugi zorni kot, na katerega je namigovala že telesna slika, obravnava telo kot izhodiščno točko naše zaznave, kot našo perspektivo na svet. Merleau-Ponty poudari pomembnost utelešene perspektive pri zaznavi že pri naslovu enega od poglavij v knjigi Fenomenologija zaznave: »teorija telesa je že teorija zaznave« (Merleau-Ponty, 1996: 235). Vsak pogled je pogled od nekod, pri čemer je ta medij in lokus zaznave telo. Kadarkoli se mi kaže nek predmet, se mi kaže iz perspektive mojega telesa, iz lastne perspektive (Merleau-Ponty, 1996; Gallagher in Zahavi, 2007). Telo torej (so)določa naš zaznavni svet in horizont, ki ga obdaja. A pomembnost telesa gre še globlje. Telo in njegove gibalne zmožnosti imajo moč ustvarjanja pomena (*Sinngebung*), na podlagi njih za nas svet pridobi pomen (Merleau-Ponty, 1996).

4. UČENJE BREZ REPREZENTACIJ

A kako natančneje svet pridobi pomen? Se to zgodi hipoma ali je proces dolgotrajnejši? Je ta postopek res popolnoma brez reprezentacij? Hubert Dreyfus (2002a) poda razlago učenja, ki se

odmakne od (propozicionalnih) mentalnih reprezentacij. Pri tem se naslanja predvsem na Merleau-Pontyjev koncept intencionalnega loka (*intentional arc*), ki ga Merleau-Ponty (1996) označi kot to, kar poveže naše čute, inteligenco, gibalne zmožnosti ipd. v kognitivno ali zaznavno življenje z našo preteklostjo, prihodnostjo, fizično, ideološko in moralno situacijo. Dreyfus pri intencionalnem loku poudari predvsem, da »ko agent pridobiva veščine, se te veščine 'shranijo', ne kot reprezentacije v umu, temveč kot nagnjenost k odzivu na zahteve situacij v svetu.« (Dreyfus, 2002: 367)

Dreyfus (2002) svojo razlago ilustrira na primerih odraslega, ki pridobi neko veščino preko navodil, natančneje na primerih učenja vožnje avtomobila (motorična veščina) in učenja igranja šaha (intelektualna veščina). Učenje razdeli na pet stopenj, od začetnika na prvi stopnji do eksperta na peti stopnji, skozi katere se za učenca vzpostavi intencionalni lok. Prvi stopnja (novinec) še vključuje reprezentacije, pri primeru vožnje avtomobila: »prestavi v drugo prestavo, ko merilnik hitrosti kaže deset milj na uro.« (Dreyfus, 2002: 368) Vozniki začetniki vozijo in reagirajo počasi, saj se morajo neprestano spominjati (si priklicati reprezentacije) tovrstnih pravil. V nadaljnjih stopnjah Dreyfus (2002) predstavi počasen odmik od naslanjanja na propozicionalne reprezentacije. Navede primer, ko napredni začetnik poleg gledanja na merilnik hitrosti uporabi tudi zvoke motorja (ki jih ni mogoče dobro opisati z besedami) v pravilih za menjavo prestav. Pri tretji stopnji se učenje že naveže na čustva in oddalji od racionalnega premisleka. Spretno vedênje povzroča dober občutek, nespretno slab; učenec ne skuša delovati racionalno pravilno, temveč tako, da bo imel dober občutek. Pri četrti stopnji se izkušnje že asimilirajo na neteoretičen način: intuitivno vedênje zamenja premišljene odzive, »učenec enostavno vidi, kaj je treba doseči« (Dreyfus, 2002: 371). To se popolnoma ponotranji pri zadnji stopnji, ko ekspert deluje popolnoma intuitivno in brez premišljevanja. »Kar mora biti storjeno je preprosto storjeno.« (Dreyfus, 2002: 372)

Naučeno torej spreminja, kako doživljamo svet. Dreyfus (2002) z Merleau-Pontyjevo argumentacijo intencionalnega loka poudari, da naše izkušnje niso reprezentirane v umu in nato dodane trenutnemu izkustvu, ali kot piše Dreyfus: »kar učenec pridobi skozi izkušnje ni reprezentirano v umu, temveč je prezentirano učencu kot bolj in bolj razločna situacija« (Dreyfus, 2002: 373). Skozi učenje prevzamemo (ali ustvarimo) nova prepričanja, kdaj eksplicitna propozicionalna (v obliki navodil in napotkov) in kdaj eksplicitna nepropozicionalna (kot na primer zvok motorja) in jih ponotranjimo do te mere, da naš svet navdahnejo z novim pomenom (v smislu bolj razločnih situacij, ki zahtevajo bolj prefinjene odzive).

5. ENAKTIVIZEM

Bolj dosleden odmik od reprezentacij naredijo Varela, Thompson in Rosch (1991) na primeru zaznave barv. Avtorji so kritični do ideje, da:

» […] barvne površine najdemo v vnaprej danem svetu, ki je neodvisen od naših zaznavnih in kognitivnih kapacitet. A kako naj opredelimo, kaj šteje za površino? Kako naj opredelimo njene robove, meje, teksturo in orientacijo, če ne v odnosu do nekega zaznavajočega, za katerega so ta razmejevanja relevantna?« (Varela, Thompson In Rosch, 1991: 166-167)

Z metaforo vprašanja o kuri in jajcu ta objektivistični pogled, da ima zunanji svet vnaprej dane lastnosti, ki jih um odkriva in reprezentira, imenujejo »pozicija kure«. Na drugo stran postavijo »pozicijo jajca«; idealizem – pogled, da um projicira svet, ki je le odsev (ali reprezentacija) strukture uma. Tema pozicijama postavijo naproti vmesno pot. Namesto pojmovanja kognicije kot raziskovalca zunanjega sveta ali kot projektorja notranjega sveta predlagajo kognicijo kot utelešeno dejavnost oziroma udejanjenje (*enaction*; Varela, Thompson In Rosch, 1991).

S pojmom utelešeno želijo poudariti, da je zaznavanje sveta pogojeno s »telesom in njegovimi zaznavno-gibalnimi zmožnostmi, […] Te zmožnosti pa so zakoreninjene v širšem biološkem, psihološkem in kulturnem kontekstu« (Varela, Thompson in Rosch, 1991: 173; cf. Merleau-Pontyjev intencionalni lok). Z dejavnostjo pa poudarjajo neločljivo povezanost zaznave in gibanja. Iz ponavljajočih se zaznavno-gibalnih vzorcev vzniknejo kognitivne strukture, ki spet omogočajo zaznavo in gibanje. Z udejanjenjem se torej osredotočimo na to:

»kako zaznavajoči usmerja svoja dejanja v dani situaciji. Ker pa se situacija nenehno spreminja z dejavnostjo zaznavajočega, referenčna točka za razumevanje zaznave ni več vnaprej dan, od zaznavajočega neodvisen svet, temveč zaznavno-gibalna struktura zaznavajočega.« (Varela, Thompson in Rosch, 1991: 173)

Udejanjenje poudari utelešenost kot horizont in kontekst za ustvarjanje pomena sveta, kot je to izpostavil že Merleau-Ponty (1996), na katerega se precej naslanjajo tudi Varela, Thompson In Rosch (1991). Ta pogled so ponotranjili tudi sodobnejši zagovorniki enaktivizma, kot na primer Di Paolo, Rohde in De Jaegher (2010) s konceptom opomenjanja (*sense-making*). Izhajajo iz argumenta, da interakcija med organizmom in okoljem za organizem (s ciljem samoohranitve oziroma ohranitve telesa, ohranitve »mene«) nosi pomembnost (*importance*), kar za organizem ustvari normativno perspektivno na svet (nekatere interakcije ali možnosti interakcije so bolj pomembne od drugih) z osrednjim vprašanjem »kaj to pomeni (zame)?«. Tako opredelijo definicijsko lastnost kognitivnega sistema kot ustvarjanje in cenjenje pomena – opomenjanje (Di Paolo, Rohde in De Jaegher, 2010).

Di Paolo, Rohde in De Jaegher (2010) pri tem poudarijo, da organizem ni samo pasiven prejemnik informacij iz okolja, ki si jih prevede v notranje reprezentacije, jih ovrednoti in nepomembne zavrže: »kognitivni sistemi nimajo v navadi dostopati do okolja, da bi si gradili točno sliko o njem« (Di Paolo, Rohde in De Jaegher, 2010: 39). Pomen ni lastnost okolja, ki jo organizem odkrije in/ali pridobi. Pomen je rezultat trajajočega dialoga med dinamiko okolja in utelešeno dejavnostjo organizma. To razliko osvetli citat Heinza von Foersterja:

»[…] 'tam zunaj' ni svetlobe in ni barve, so le elektromagnetni valovi; 'tam zunaj' ni zvoka in ni glasbe, so le periodične variacije v zračnem tlaku; 'tam zunaj' ni vročine in ni mraza, so le gibajoče se molekule z več ali manj kinetične energije, […]« (von Foerster, 2003: 214)

6. ZAKLJUČEK

Fenomenologija torej naredi odmik od reprezentacij in behaviorizma. Husserlova ideja naravne naravnanosti opisuje naše prav vsakdanje prepričanje, da so objekti, ki jih doživljamo, enostavno tam zunaj, od nas neodvisno obstoječi. Husserlov koncept horizonta skriva prepričanja na obrobju našega doživljanja, kot védenje, kaj vse še zaobjema širši kontekst situacije, ki jo ta trenutek doživljamo (primer pisalne mize, sobe in otrok na vrtu). Horizont so prav tako pričakovanja povezana s predmetom, ki ga doživljamo (kakšen zgleda iz drugih zornih

kotov, kakšne so njegove lastnosti, ki jih še ne moremo izkusiti). To prelije tudi v doživljanje časa, kjer se v doživljanju vsakega trenutka skriva tudi paslika prejšnjega in pričakovanje bodočega.

Kot posebno obliko horizonta smo se dotaknili Merleau-Pontyjeve analize telesa kot tega, kar oblikuje našo zaznavo (in posledično prepričanja). Pri tem smo izpostavili vlogo telesa pri ustvarjanju pomena v svetu – prepričanj, kakšen svet je. Naprej smo si pogledali Dreyfusovo idejo učenja brez reprezentacij, ki je osnovana na Merleau-Pontyjevem konceptu intencionalnega loka. Po Dreyfusu se učenje začne z reprezentacijami in eksplicitnimi prepričanji, ki se z vajo ponotranjijo in integrirajo v intencionalni lok oziroma kognitivno strukturo. Z združitvijo dosedanjih konceptov v idejo udejanjenja avtorjev Varela, Thompson In Rosch, pa smo lahko odpravili reprezentacije v celoti, saj bi z udejanjenjem prepričanj lahko argumentirali, da tudi eksplicitna, propozicionalna prepričanja niso reprezentirana, temveč udejanjena v dani situaciji.

Nazadnje smo se pomaknili globlje na področje enaktivizma, kjer smo spoznali koncept opomenjanja. Ko opomenjamo, udejanjamo svet, udejanjamo 'to, kako je', 'to, kar vzamemo za resnično'. S tako razlago lahko pojmujemo prepričanja v najširšem možnem smislu kot življenjski svet, ki ga udejanjamo. Če zdaj skušamo razlikovati med prepričanji in sorodnimi fenomeni, najdemo le zabrisane meje, ki jih moramo ponovno začrtati.

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The Use of Genetic Algorithms in Researching Non-Veridical Perception

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ABSTRACT

Synthetic approach to (cognitive) science – researching (cognitive) phenomena with computer and robot models – has been called upon by various field authorities, such as Froese, Ziemke and Harvey, to tackle the problem of opposing theories that have pestered Western philosophy for centuries, especially those of epistemic nature. One synthetic methodology can offer comparison of such theories under the mechanism of natural selection – genetic algorithm. Specifically, genetic algorithms can be deployed to research non-veridical perception, the viewpoint held by various paradigms (e.g., constructivism) that the world we experience is not a representation of the world out there. One such theory that boasts empirical proof is the interface theory of perception. However, genetic algorithms, although bearing an ecologically viable modeling platform in the form of natural selection, can be, due to yet undiscovered biological realities, largely manipulated with arbitrarily set parameters and methods to get biased results. What's more, GA-based research on non-veridical perception does not seem to include full computational, algorithmic and implementational materials. This begs a carefully set protocol for such research.

Keywords

genetic algorithms, non-veridical perception, methodology, natural selection, constructivism

1. INTRODUCTION

The use of genetic algorithms (GAs) as a methodology in cognitive science has always been tentative. Being generally used as an optimization technique [1], GAs seem to rely too much on most often than not arbitrarily and trivially set parameters [2] to be sufficiently rooted in biology, while at the same time mostly being useful when having fixed expectations in a limited set of phenomena. The rise and pervasiveness of artificial neural networks as a methodology for researching cognitive phenomena is partially a consequence of such limitations of GAs. The latter, however, innately possess the mechanism of natural selection, which can be exploited in researching what phenomena, under this specific mechanism, pass the test of adaptation and survival, especially when comparing different paradigms and theories. This notably holds true for phenomena which can hardly be researched analytically, i.e. through observation and experimentation, and therefore have to be subjected to synthetic approaches, i.e. by making computer and robot models [3]. Such phenomena have a certain epistemic impenetrability, which is why numerous established researchers [4][5] have already given research in AI "the rather privileged position of being able to help resolve theoretical disputes which have plagued the Western philosophical tradition for decades if not centuries" [6, p. 6] through "understanding by building". One such theoretical dispute is whether perception (or cognition, for that matter) is veridical or not. The idea of non-veridical perception in cognitive science can be most notably traced to the paradigms of constructivism [7] and enactivism [8][9], while most recent successful attempts at putting it in the forefront of research can be attributed to the field of predictive coding [10]. The main commonality between these paradigms is the claim that we do not perceive and cannot know the world as it really is. Consequently, they deal with the connection and discrepancy between the external world and the subject's internal world, dynamics, experience and knowledge. Genetic algorithms can therefore serve as a way to determine what kind of perception performs viably under the pressures of natural selection.

2. GENETIC ALGORITHMS – A VIABLE METHODOLOGY?

Conceptually, GAs encompass all of the most general attributes of the Darwinistically-inclined natural selection and gene recombination with mutation. In practice, an individual organism is represented by one chromosome that is made of several genes, i.e. a string of bits, integers, characters, etc. A very basic Pythonic function that produces such an individual can be seen in the Image 1 below, as well as one potential output with arbitrarily set arguments in the Image 2.

```
def individual(size, min, max):
    return [ randint(min, max) for x in range(size) ]
```

(Image 1)

```
[1, 5, 4, 1]
```

(Image 2: A randomly produced »chromosome« (list) with »genes« (integers) that constitutes an individual.)

By running such a function a number of times, a population is produced. The environmental pressures on the organisms is hidden in the fitness function. The fitness function represents a way to determine which organism fares best in the environment or milieu. Image 3 follows the examples from the Images 1 and 2 and shows a possible implicit milieu (hidden in an ideal individual) and the fitness function:

```
def fitness(individual, milieu):
    return abs(sum(individual) - milieu)
```

(Image 3: The fitness function calculates the difference between an individual organism and the fitness required for them to survive. In such a case, the bigger the fitness score, the better the organism.)

```
[10, 10, 10, 10]
```

(Image 4: An implicit possible milieu, an ideal organism, with fitness score 40.)

Through genetic crossover and mutation, the population strives to adapt to the milieu by coming closer and closer to it (or rather, its fitness score). This can happen by taking a certain percentage of the best-performing organisms, pairing them together and creating an offspring that takes the first half of the chromosome from one parent and the second half of the chromosome from the second parent. The probability of a mutation of a random gene is also specified. For diversity, a certain probability of an »unfit« organism creeping into the selection can also be specified. Image 5 and 6 showcase a part of this process.

```
Parent 1: [6, 5, 2, 1]
Parent 2: [3, 2, 7, 9]
Offspring: [6, 5, 7, 9]
```

(Image 5: Genetic crossover. The offspring has higher fitness than its parents in relation to the milieu in Image 4.)

```
def evolve(population, milieu, survive=0.2,
           diverse=0.05, mutate=0.01):
```

(Image 6: A function declaration for the population evolution. It specifies the described probabilities. Argument »survive« specifies the probability of exact copies in the next generation.)

A shared woe of computer modelling in cognitive science is the inescapable problem of how to computationally represent some non-trivial real-life phenomena without making the model trivial through reduction. This woe is even bigger when the inevitable reduction is coupled with overtly reductionist paradigms. In the case of GAs, the main problem lies in paralleling real-world evolution to formal mechanisms of natural selection to a degree where no distinction is left – where a paradigm becomes the reality, which is something that has happened under symbolic and connectionist paradigms of cognitive science [6]. Such overreaching inductive practices should therefore be taken with caution.

However, GAs also face pragmatic obstacles which are more likely to be solved through good practices. The most problematic are GA's parameters of the evolutionary aspect, which are a critical part of GAs when used in researching cognitive phenomena. This especially holds true for crossover and mutation. Even before setting the probability (1 minus argument »survive« for crossover and »mutate« for mutation in Image 6), methods for crossover and mutation have to be set. This mostly encapsulates the numerous ways of a child organism to inherit its genes and the way the latter are subsequently mutated. Optimal results can be quickly gained by fine-tuning these two parameters even in more non-trivial problems. When researching phenomena related to biological realities, parameters have to be set to represent them. In complex and dynamic systems like cognitive phenomena, the facts themselves are still largely undiscovered [11][12]. This is why GAs are primarily used for applied optimization – the fine-tuning of given parameters makes sense for such usage. Research bias is therefore almost ineliminatable. Research conduct protocol has to be set before specifying parameters. Ideally, parameters have to be set in advance through rigorous research of biological counterparts. In the case of GAs, research on quantitive aspects of evolutionary mechanisms and their manifestation in nature is needed. The protocol should deny researchers tweaking and subsequent running of GA-based models as well as ensure transparent reporting, similar to analytic research reporting – computational, algorithmic and implementational material should always be fully disclosed. Synthetic research that deals with non-veridical perception seems to lack such transparency, which obstructs further research through repetition [13][14][15][16][17].

Questioning viability of using GAs for researching cognitive phenomena therefore seems to be warranted. Given their stochasticity, the settings should be ecological as much as possible. Where undiscovered biological properties are concerned, it remains unclear how to proceed in order to remain as unbiased as possible.

In researching non-veridical perception, additional difficulties arise – one has to be even more careful when delineating a paradigm and reality, as aligning with a constructivist paradigm while claiming certainties in the outside world that we can discover (e.g., Darwinistic evolutionary processes and their connection to cognition, especially when taken in a vaccuum) can be problematic. Remaining on the level of formalized mechanisms seems to be the proper way to explore non-veridical perception with GAs.

3. NON-VERIDICAL PERCEPTION

> "Let us consider what happens in instrumental flight. The pilot is isolated from the outside world; all he can do is manipulate the instruments of the plane according to a certain path of change in their readings. When the pilot comes out of the plane, however, his wife and friends embrace him with Joy and tell him: 'What a wonderful landing you made; we were afraid, because of the heavy fog.' But the pilot answers in surprise: 'Flight? Landing? What do you mean? I did not fly or land; I only manipulated certain internal relations of the plane in order to obtain a particular sequence of readings in a set of instruments.'"
>
> [18, p. 42]

The pilot in the quote is an analogy for an organism with non-veridical perception. The instruments are the world he experiences, perceives and acts in. It could be said they are his mental states in a non-dualistic manner. These instruments are completely different from the world outside of the plane, yet they still bear a certain (albeit unknown) correspondence to it. They ensure that the pilot (the organism) can operate and survive in the world. This is what is mostly meant by non-veridical perception, especially in paradigms that advocate for it [7][8]9][10][18]. To sum up: The experience we have of the world we are perceiving is not its faithful, isomorphic representation.

Despite this, the prevalent view of perception, especially human perception, seems to be the opposite [19][20]. The belief is that the function of perception is "that of generating a fully spatial virtual-reality replica of the external world in an internal representation" [21, p. 1]. Similarly, traditional Bayesianists advocate that perceptual estimates faithfully representing the truth are of greater utility than those that do not [22].

The two irreconcilable paradigms seem to fall into the previously mentioned category of theoretical disputes of Western philosophy as labeled by Froese. Each of them come from a different epistemic viewpoint, which would make a scientific comparison of the two an example of empirical epistemology. Aside from empirical phenomenology [23], artificial intelligence methods seem to be the only way to do such research. GAs provide a way to study the performance of organisms with either veridical or non-veridical perception and compare their faring under the pressures of natural selection. One of the few if not the only research that studies non-veridical perception with GAs is Hoffman et al.'s work [13][14][15][16][17] on Hoffman's interface theory of perception (ITP).

4. GENETIC ALGORITHMS IN THE INTERFACE THEORY OF PERCEPTION

ITP does not only propose that non-veridical perception is the more sensible of the two competing paradigms, but also tries to empirically answer two fundamental questions: 1) Do our perceptual apparatus have the necessary components to actually describe the objective truth and if so, do they do it?, and 2) If the perceptual apparatus for whatever reasons do not describe the objective world as it really is, what advantage does that kind of system have? Its main point is this: "The perceptions of an organism are a user interface between that organism and the objective world" [14, p. 7]. Hoffman et al. [13] use an analogy of a computer to describe non-veridical perception: "A desktop interface makes it easy to use the computer. To delete or copy files, for instance, one simply needs to drag icons around on the desktop. But a desktop interface does not make it easy to know the true structure of a computer — its transistors, circuits, voltages, magnetic fields, firmware and software. Indeed, it's in part by hiding this complex structure that the desktop makes it easier to use the computer" [Ibid, p. 28]. This analogy is very similar to Maturana's analogy of the pilot and his flight. Hoffman et al.'s user interface seems to have the exact same function as the plane's set of instruments. The most interesting part of the theory is therefore the empirical work, which seems to be a thoroughly novel achievement and therefore worth and needing of an overview.

This, however, presents an obstacle. Hoffman as the principal author of the theory has produced a number of papers where the GAs used for empirical work are referenced and conceptually described, but it seems that there is no complete report of computational, algorithmic and implementational data available for possible scrutiny, replication and further research. The GA used is based off of Mitchell's GA [24] that features Robby the Robot who has to learn how to effectively pick up soda cans in a grid space. Hoffman's Robby, however, is not surrounded by soda cans, but by a various amounts of water that range from 1 to 10, with extreme numbers giving the least amount of fitness point (bad for Robby) and the middle numbers giving the most (good for Robby). Furthermore, Robby does not see water at all – it sees either red or green. It then has to learn to assign red or green to different amounts of water in a way that brings him the most points. Through many generations, Robby devises a survival strategy that sees squares with high scoring profit as green and squares with low scoring profit as red, or vice versa. Robby's perceptions are in no way connected to the world out there, but only to his internal fitness dynamics. Compared, Mitchell's Robby needed 1000 generations to evolve a comparably effective strategy, while Hoffman's Robby only needed 500 generations [17].

The various papers by Hoffman do feature some information on the GA used. There is some description of DNA encoding, namely that it encodes the possible perceptual states, the number of water quantities and the colors; it also gives the number of genes for these encodings. The encoding of perceptual states is described. There is some information on crossover, i.e. that each pairing produces two children with randomly spliced parent genes, and each offspring has a version of it. Information on mutation is vague, only written as "A small amount of mutation is applied" [13, p. 26]. The population number is always set at 200, but there is no stated reason behind it (other than it may be a common GA population number in computer science).

As discussed before, a special attention should be paid to the stochastic parameters, which can be arbitrarily set; to the ways genes crossover and mutate; and to the definitions of fitness evaluation and DNA encoding. This is important as by fine-tuning, changing the methods of recombination and mutation, and adapting fitness and encoding, different outcomes are produced.

5. CONCLUSION

Viability of GAs as a biologically-rooted cognitive science research methodology seems to be a two-edged sword. On the one hand, their groundedness in mechanisms of evolution offers a great modelling platform that, at least formally, possesses a number of ecological structures (e.g., genetic recombination and mutation). On the other hand, given its stochasticity, a number of features ingrained in these structures depend on arbitrarily set numbers (e.g., various probabilities) and calibrations (e.g., the methods of doing crossover). Biological systems, be they related to evolution or cognitive phenomena, are still largely unexplored, which pushes the translation from biology to computer models beyond the usual reduction and into the realm of bias. This is especially true when researching non-veridical perception, given its epistemologically strenuous nature. However, aside from empirical phenomenology, synthetic research seems to be the only way of scientifically verifying various theories regarding non-veridicality of perception, which is echoed by notable field figures such as Froese, Ziemke and Harvey. ITP by Hoffman seems to be doing just that, as it is an empirically tested theory. Unfortunately, it does not fully address the issue of arbitrariness in GAs and their relation to biology in general and particularly the phenomenon at hand, neither does it offer full data on the GA conceived for proving the theory. In turn, this stifles scrutiny, replication and further research. This is why a protocol should be established when using GAs to research cognitive phenomena, especially non-veridical perception.

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What is it like to be a bat/man: consciousness and performance studies

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ABSTRACT
In this paper, I would like to underline some possibilities of engaging consciousness studies in theorizing acting as conscious process. It is a proposal of dialogue between the disciplines of theatre and neuroscience in order to re-think the understanding of the nature of actor's work.

Keywords
consciousness, acting performance, qualia, subjectivity

1. INTRODUCTION
"What is it like to be a bat?"

In the history of consciousness studies, this one is the most famous questions. First posed in 1950 and became famous in 1974 in American philosopher Thomas Nagel's paper in The Philosophical Review. [11]

Nagel said: "Consciousness is what makes the mind-body problem really intractable." but on the other hand "without consciousness mind-body problem would be much less interesting." [11, p. 435,436] "The most important and characteristic feature of conscious mental phenomena is very poorly understood." [11, p. 436]

Mystery stays alive even some twenty years later, when Daniel Dennett, also an American philosopher says: "With consciousness we are still in a terrible muddle. Consciousness stands alone today as a topic that often leaves even the most sophisticated thinkers tongue-tied and confused." [6, p. 22]

An Australian philosopher, David Chalmers said: "There is nothing we know about more directly than consciousness, but it is far from clear how to reconcile it with everything else we know." [4, p. 3]

Colin McGinn, the British philosopher: "You can look into your mind until you burst, and you will not discover neurons and synapses and all the rest; and you can stare at someone's brain from dawn till dusk and you will not perceive the consciousness that is so apparent to the person whose brain you are so rudely eye-balling." [10, p. 47]

We can go on with the problem, but by now it is evident that the phenomenon of consciousness is the hardest one, though it does not have to be protected from science. Rather comforting, as McGinn suggests, it has something (or everything) with brains. So, let us make this starting point - brain. We can agree that consciousness is locked in brain, but again, the very same McGinn raises the question can the mind be fully explained by the brain. Hardly; we do know a lot about the brain, but link between mind and brain still lies in mystery.

Catherine Malabou, the French philosopher, agrees that "discovery of the synapses and its functions was as revolutionary as the discovery of DNA" [9, p. 8] as it puts Jean-Pierre Changeux in 1979, but almost disappointed, Malabou asks what have we done knowing all that, and what should we do with our brain.

Maybe it is true that our intelligence is wrongly designed for understanding consciousness, as McGinn puts it. [10, p. xi]

Susan Blackmore asks how do we know that the way someone sees yellow paint would be the same for other. We don't. And that's what we mean by consciousness, a very private experience. "No one else can know what it is like. No one else can get it from you." [1, p. 9] Nagel calls it subjective character of experience and every subjective phenomenon is essentially connected with a single point of view. [11, p. 436,437]

2. CONSCIOUSNESS PROBLEM
Neuroscientists did not get far either when it comes to consciousness problem. Joseph LeDoux says that neuroscientists traditionally have avoided confronting that problem. But times have changed, discussions on subject are on rise, maybe overemphasized, and the major question for LeDoux is not how does consciousness come out of the brain, but rather how does our brain make us who we are. [8, p. 10]

For Antonio Damasio the problem of consciousness is a combination of two related problems; the problem of understanding how the brain engenders the mental patterns, "the images of an object"[1], and the problem of how, in parallel with first one, the brain engenders a sense of self in the act of knowing. [5, p. 23]

So, again, consciousness is a private moment, but it does not exclude *the other* and awareness of other. These two phenomenons are not mutually exclusive, but incessantly present and interfering, and we never make mistakes in assessing who is who. Or?

In the discussion on subjectivity we can introduce the term *qualia*. Although it is a philosophical term, everyone has it, that is, everyone has that private experience of what something *is like*. Blackmore gives an example: "the feel of the wind on your cheeks as you ride your bike" [1, p. 25] or as Damasio defines: "qualia are the simple sensory qualities to be found in the blueness of the sky or the tone of sound produced by cello…" [5, p. 23] He believes these qualities will be eventually explained neuro-biologically.

[1] By *object* Damasio means "entities as diverse as a person, a place, a melody […]" and by image "a mental pattern in any of the sensory modalities, e.g., a sound image, a tactile image, the image of a state of well-being". [5, p. 22]

On the other hand, Dennett does not believe in qualia at all. [6]

3. BAT/MAN PROBLEM

In terms subjectivity, let us go back with Nagel's question "How is it like to be a bat?". Nagel chooses bats because they are so different than humans; "their brain are designed to correlate the outgoing impulses with subsequent echoes, and the information thus acquired enables bats to make precise discriminations of distance, size, shape, motion, and texture comparable to those we make by vision. But bat sonar, though clearly a form of perception, is not similar in its operation to any sense that we possess, and there is no reason to suppose that it is subjectively like anything we can experience or imagine". [11, p. 438] Our own experience provides the basic material for our imagination, whose range is therefore limited. As Nagel illustrates, "it will not help to try to imagine that one has webbing on one's arms, which enables one to fly around at dusk and dawn catching insects in one's mouth; that one has very poor vision, and perceives the surrounding world by a system of reflected high-frequency sound signals; and that one spends the day hanging upside down by one's feet in an attic" [11, p. 439]. Such behaviour tells us only what it would be like to behave as a bat behaves. But that is not the question. Nagel wants to know what it is like for a bat to be a bat.

These (bat's) experiences also have a specific subjective character that it is, by all means, beyond our ability to conceive. After all, Nagel admits that he didn't have to go with this exotic bat case; the problem exists between two persons as well.

So, what does actor do? How he embodies someone else's realities and subjectivities. He does wear bat's costume to look like bat. He also can hang upside down all day in the attic, but inside him he experiences his own subjectivities. If in any case his performance stays within *act as if*, then the performance misses terms such as truth, real, natural… Actor does not describe. He experiences. He must be open for new, surprising solutions.

4. ACTING AND NEUROSCIENCE

Neuroscientist Antonio Damasio describes string of associations arising in the body first as emotion (as physiological state of the body) which is translated into feeling (as emotional state). Those strings create brain. Damasio uses term "somatic markers" [5] to describe how body-state become linked with our conscious responses to or interpretation of them. These markers become our repertory of emotional responses in guiding our choices of reactions to new situations. This hypothesis presents an intellect not as separate, but as aspects of a single organic process.

Actor in the costume of a bat reacts within his own somatic marker, not with somatic marker of a bat or some other person. If he trusts his own reactions, those surprising, new solutions, mentioned above, can occur. If he let his own arousal of emotion, performance will be truthful. Or, at least, he will allow himself to respond with varying degrees of habit of spontaneity.

In similar directions in defining mind, consciousness and cognition point Joseph LeDoux, who distinguishes between consciousness and cognition. "Consciousness can be thought of as the product of underlying cognitive processes" [8, p. 191] while mind is: "an integrated system that include, in the broadest possible terms, synaptic networks devoted to cognitive, emotional, and motivational functions. More important, it involves interactions between networks involved in different aspects of mental life. [8, p. 258]

Rhonda Blair, American scholar who is particularly looking at applications of cognitive science to the acting process suggests that in considering how brain structure and function are materially related to the nature of consciousness and self, we can move toward a more concrete sense how the actor works. [3, p. 170]

Referring to Marco De Marinis's term of an *embodied theatrology*[2], Gabriele Sofia sees the concept of consciousness as a circular process between the human body and the environment. She proposes the hypothesis that consciousness is not a product of the brain but emerges from the relationship between one's own body and the environment. "Each time we ′perceive′ the world, we are actually *acting* upon it, that is we are modifying the object that we intend to perceive. […] then there is no pre-determined world that can be perceived ′as it is′." [12, p. 51]

If we agree on subjectivity or private experience as "the hard problem"[3] how is it possible to integrate the study of one's own experience in the analysis of a performative event, asks De Marinis. In order to do that Sofia suggests that one would first have to analyse the sensorimotor mechanisms that subtend such an experience, which is primarily the ′performative′ experience of the spectator. [12, p. 55] Consequently, spectator should not be left out from analyses of performative event, nor acting process as well.

5. CONCLUSION

Considering all above, in order to re-think and re-define some petrified "knowledges" of acting processes there is a vast unfilled spots that should be engaged in theatre and performance studies and it deserves further research. "Terrible muddle" [6] in defining consciousness is not any smaller in defining acting process. Can we discuss on acting phenomenon not knowing how consciousness works?

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Consciousness – one, two or many?

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ABSTRACT
Introductory papers on consciousness, whether within philosophy, psychology, or neuroscience, do not forget to point out that it is at once the most familiar and mysterious phenomenon. Indeed, we know it intimately, but it is extremely difficult to describe and explain it. It does not help matters that the words "consciousness" and "conscious" can mean different things and that this richness is also preserved in the scientific talk. This complex and multifaceted phenomenon – some even argue that we are dealing with many distinct phenomena – is a subject of interdisciplinary research, and it often seems that researchers talk past each other. This is most obvious in the interaction of empirical researchers and philosophers. In this paper, I will introduce some of the relevant notions of consciousness, explain to what aspect of consciousness refers the "hard problem" philosophers speak of and what importance it has for the research of consciousness in general.

Keywords
concepts of consciousness, mystery of consciousness, hard problem of consciousness

1. INTRODUCTION
In introductory papers and book introductions on consciousness, writers like to point out its mysteriousness. For example, Dennett in *Consciousness Explained* states: "Human consciousness is just about the last surviving mystery. … [It] stands alone today as a topic that often leaves even the most sophisticated thinkers tongue-tied and confused." [1; p. 21–22] Similarly, Susan Schneider and Max Velmans in the "Introduction" to *The Blackwell Companion to Consciousness* point out: "…anything that we are aware of at a given moment forms part of our consciousness, making conscious experience at once the most familiar and most mysterious aspect of our lives." [2; p. 1]

But what is this consciousness that is at once so familiar and mysterious to us? The term "consciousness" is quite multifaceted and can mean different and quite diverse things. In everyday life we hear that an ill friend regained consciousness, that certain activists try to raise the political consciousness of the working class or warn about the dangers of consciousness-enhancing drugs. We enjoy reading a book in which the main character is at one point very conscious of the sound of the howling wind and very familiar with conscious efforts to give up some harmful habit.

The original meaning of the word "consciousness" was knowledge or awareness, either private or shared, but in the seventeenth century philosophers and other enlightened writers started to use the word specifically to refer to our inner awareness of our own mental states, such as thoughts, perceptions, sensations, feelings. As John Locke put it, "[c]onsciousness is the perception of what passes in a man's own mind." [3; p. 98] In our modern uses of the word both meanings are preserved in everyday talk as well as in theoretical writings.

For quite some time philosophers equated consciousness with mind, and the same is true of the early psychologists. For example, William James identified consciousness with the stream of thought [4]. But in the previous century researchers confirmed that not all mental states are conscious and that actually a lot of processing in perception, memory, action and learning is unconscious, automatic. One such flashy example is subliminal perception. John Kihlstrom named such states "cognitive unconscious" [5].

It also became clear that we are still conscious or aware of certain mental states although we do not deliberately focus on them and attend to their features (what the seventeenth century philosophers had in mind with consciousness as "inner perception" and what is today referred to as an introspective consciousness). For example, I can have a slight headache and do not pay much attention to it, but it is still present and it has a certain feel to it. There is something it is like for me to feel this particular pain, which is different from how intense toothache feels like, or how it feels like to see a clear blue sky. Philosophers refer to this kind of consciousness as phenomenal, qualitative and/or subjective consciousness. Another important aspect of consciousness that interests philosophers is its intentionality, namely its directedness to something.

Scientists are also interested in many aspects of consciousness. Beside the aforementioned study of the relation of conscious to unconscious processing in perception, memory, action and learning, they are interested in determining the function of consciousness, the neural correlates of consciousness, how information is disseminated within the human brain, what conscious experiences are and so on. For clinicians it is very important to be able to tell whether patients are conscious, and they start with the understanding of consciousness as the ability to respond appropriately to external stimulation, but the possibility of unconscious processing complicates things. Cognitive psychologists opt for a more comprehensive definition of consciousness as the awareness of oneself and one's surroundings, and the ability to respond to and to interact with the environment. Recently, scientists have also conducted research on emotional consciousness. Moreover, they are not only interested in human consciousness, but also in animal consciousness and consciousness of artificial intelligence.

To sum up, the terms "consciousness" and "conscious" are used in many different ways in everyday, but also in scientific, talk. The phenomenon itself is very complex, with many aspects, or maybe there are even many distinct, though closely related, phenomena that are grouped under one label. The study of consciousness is interdisciplinary, every discipline having its own special interests, terminology and investigative methods. Not surprisingly, this

often results in scientists not understanding each other and actually talking past each other. This is particularly common in discussions between philosophers and other researchers, which mainly stems from the different approach to consciousness.

While psychologists, neuroscientists, biologists and computer scientists build on observations, on the collection and classification of data, and on the execution and interpretation of experiments, philosophers try to determine the overall picture, how all the empirical findings fit together, the research assumptions and paradigms along with its strength and plausibility, how the findings connect with previous ideas and research programs and where they could lead in the future, and what potential obstacles there are. The difference is especially obvious in their distinct approach to the mystery of consciousness and to the related hard problem of consciousness.

2. THE MANY CONCEPTS OF CONSCIOUSNESS

When an expression has multiple meanings, it is important that we always clearly specify which meaning we have in mind when we use it. If all researchers working on consciousness followed this rule, a lot of problems and difficulties would melt away.

First, we can talk about all organisms – human beings, animals, robots – being conscious, or we can ascribe consciousness to particular mental states or processes. This is a distinction between creature consciousness and state consciousness [6].

Within the creature consciousness we can further distinguish between intransitive and transitive consciousness [7]. A creature is transitively conscious when it is conscious of something, either by seeing, hearing, touching it, or by having a thought about it being present. Philosophers also speak of intentionality: being directed at an object, namely at the object of which the creature is conscious of. But more basic[1] is the intransitive notion where consciousness is treated as a non-relation property of a creature.

Under this rubric fall many senses mentioned in the previous section. In the most generic sense a creature is conscious or sentient if it is able to sense and respond to its environment. In a more demanding way, the ability as such does not suffice is not enough, and the creature must be actually exercising the ability. In this sense, a creature is conscious only if it is awake and alert, i.e. responsive to sensory stimulation. Accordingly, a creature asleep, anesthetized or in a coma is not conscious in this sense. In another, more demanding sense, a creature is conscious if it is aware not only of its surroundings, but also of its awareness. Consciousness is interpreted as a form of self-consciousness, where the requirement can be interpreted in various ways. The conceptual self-awareness might be required or just implicit self-awareness. Under this rubric falls Locke's previously mentioned notion. Yet another concept is the aforementioned phenomenal consciousness. A creature is conscious in this sense if there is "something that it is like" to be that creature, as Nagel phrased it somewhat awkwardly [10]. What is meant by this is simply that there is some subjective way that the world appears to a creature, for example, to a bat or a person or a cat. The main characteristic of this kind of consciousness is its perspectival subjectivity. Some authors also call it qualitative or subjective consciousness, although it can also be argued that these three notions slightly differ.

Similarly, there are many concepts of state consciousness. A conscious mental state can be simply a state one is aware of being in [7]. In parallel with phenomenal consciousness, there are phenomenal states and closely related, often equated, qualitative and subjective states. These kind of states, primarily called qualitative states, have special qualitative or experiential properties, named "qualia" or "raw sensory feels." In general, what we try to capture here is how a given experience feels from the inside. For example, the visual experience of a ripe tomato is distinctly red, freshly roasted coffee beans have a distinct smell, and an intense toothache hurts in a particular way. The defining characteristic of phenomenal states, when being considered as distinct from the qualitative ones, is interconnectedness, how they all connect and form a continuous experience of a self, situated within a world of objects, ordered in time, space and tied with causality. And in the case of subjective states, beside their experiential feels, their subjectivity is also emphasized, the fact that it is quite plausible that this experience can be fully comprehended only from the first-person perspective.

Some philosophers, for instance Wilkes [11], argue, at least in part due to conceptual multiplicity, that the idea of consciousness is wrongheaded and should be eliminated. However, I agree with Van Gulick [12; p. 166] that the complex nature of conscious mentality can only be explained by a pluralistic diversity of concepts that capture all its many aspects. The plurality of concepts is, therefore, not a flaw, but a virtue as long as one clearly states which sense one has in mind and does not conflate one concept with another.

3. THE MYSTERY OF CONSCIOUSNESS AND THE NATURALISTIC WORLD VIEW

Concerning the mystery of consciousness, what puzzled and still puzzles the researchers is precisely its phenomenal aspect, the feel of conscious experiences. It is generally quite hard, often impossible, to describe a particular experience in a way that really conveys what it is like to someone who had never experienced it. For instance, how are we to explain to a blind person what the experience of seeing a crimson red patch feels like? The ineffability of conscious experience is closely associated with its subjectivity. It is argued that its particular feel can only be appreciated from within, i.e. from the first-person perspective. Moreover, it often seems totally arbitrary that an experience of a particular thing feels like it does. Why should freshly ground coffee beans produce in us the smell that they do? Alternatively, why should they produce any smell at all? And how do we know that the same stimuli produce the same experience in everyone? What if the phenomenal character of experience has nothing to do with what it represents and is just the intrinsic, i.e. non-relational, property that experience possesses independently of everything?

More generally, the special character of consciousness, its distinct nature makes it difficult to explain it in naturalistic terms, namely, to plausibly explain its link to the brain without resorting to miracles and ad hoc solutions. The link undoubtedly exists – changes in the brain can affect consciousness and certain brain damage can erase it permanently. The task is therefore to scientifically explain the link and the way in which consciousness arises from brain processes, and substantial progress has been made by adopting the functional and computational explanation of mental states and processes as well as of the conscious ones. Scientists only try to determine what causal role they play and in

[1] Some philosophers argue though that the transitive concept is the basic one, but they are in minority [8], [9].

what way a particular information processing is implemented in the brain.

Cognitive scientists therefore try to determine what consciousness does, what its function is. In order to achieve this, they can compare conscious and unconscious types of information processing and look for differences which would suggest what the role of consciousness is. One possibility are priming experiments, especially semantic ones (e.g. [13]), another is the study of disorders, especially caused by brain damage, which affect consciousness. Extensively studied disorders are blindshight [14] and unilateral spatial neglect [15].

These are just two of many avenues of research being pursued, which are proving quite successful. However, some philosophers complain that this does not contribute at all to a better understanding of phenomenal consciousness.

4. THE HARD PROBLEM OF CONSCIOUSNESS AND ITS RELEVANCE FOR THE STUDY OF CONSCIOUSNESS

The explanation of cognitive abilities and functions in terms of computational or neural mechanisms that can perform them does not help us to understand why conscious experiences accompany the performance of these mechanisms. The difficult question here is rather why and how conscious experience arises from a physical basis. To put the issue succinctly: it is not about what consciousness does, but how consciousness feels.

One philosopher who doubts that cognitive science, equipped with its computational and neural explanations, can explain phenomenal consciousness is David Chalmers [16, 17]. He termed this problem the hard problem and all the other problems concerning consciousness as the easy problems [16]. According to him, the latter are relatively easy because they seem directly susceptible to the standard methods of cognitive science, which is not the case with phenomenal consciousness because it resists the explanation in these terms and it is not clear how to approach it. Chalmers does not deny that phenomenal consciousness could have some function. It is even reasonable to assume that it does. But there is more to it than just the performance of functions and this "more" is the crux of the matter. To make his idea clearer, Chalmers enumerates some examples of easy problems, like providing explanation of the reportability of mental states, the ability of a system to access its own internal states, the integration of information by a cognitive system etc. [16; p. 4]

These issues are obviously not easy, scientists work hard on solving them, therefore many object to his division. To be fair, Chalmers himself points out that he does not underestimate their importance as well as difficulty and that he uses terms in a comparative sense. He just wants to emphasize a principled difference between the two kinds of problems, the first can be approached with the usual methods of cognitive science, but not the problem of phenomenal consciousness since what needs to be explained is not a function, but a subjective phenomenal quality that accompanies information processing. The problem is that we do not know what method to use. However, appearances matter, and it would have probably been better had he named the two problems differently, thus avoiding offending inadvertently scientists who work on the first kind of problems.

We have already encountered the complaint that researchers are not careful in distinguishing different senses of "consciousness," thus creating confusion. Chalmers rightly complains that often researchers start by stating the "hard problem" of consciousness, but then offer an explanation of another aspect of consciousness, such as reportability or introspective accessibility of information [17; p. 26]. Chalmers claims that these aspects of consciousness are psychological in nature as they play a causal or explanatory role of behavior exhibited by conscious creatures. To avoid conflation, he proposes to reserve the term "consciousness" for the phenomenal aspect and to call the other aspects "awareness." Awareness is thus "a state wherein we have access to some information, and can use that information in the control of behavior"[2] [17; p.28], and can be therefore explained in functional terms.

According to Chalmers, this terminology change is only a matter of convenience which does not make any real difference. However, the use of different words makes it easier to accept that we are not dealing with multiple aspects of one phenomenon, but with multiple phenomena. Indeed, Chalmers wrongly concludes from the grammatical difference that there is also an ontological difference. He views consciousness and awareness as two different phenomena, and considers the existing relation between the two. He concludes that consciousness is always accompanied by awareness, but awareness does not need to be always accompanied by consciousness. By positing two different phenomena, he can argue that due to its distinct nature consciousness in principle cannot be explained in the same way as awareness. However, he leaves out another plausible alternative, namely that we simply have two kinds of neural processing, which differ in such a way that one is also accompanied by the phenomenal feel, while the other is not, and that this difference can be functionally, or in some other scientifically acceptable way, explained. There is no reason to suppose that what he calls awareness and consciousness are two independent processes. The fact that awareness can be present without consciousness shows that awareness is a fundamental process, but consciousness could be just an extra characteristic of certain awareness processes, but not an independent process itself. But in this case, one cannot argue that solving "easy" problems will not help with the "hard" problem as Chalmers does.

5. CONCLUSION

To conclude, researches need to be careful and clearly state which aspect of consciousness they are investigating and not to unjustifiably claim that their findings also apply to other aspects of consciousness. Chalmers' claim that phenomenal consciousness cannot be explained in functional terms should be taken seriously, and the used methods should be carefully scrutinized. On the other hand, one should not despair. His argument is not definitive and there is a good chance that the functionalist explanation is possible. And even if it were not, it is a fair assumption that a better understanding of information-processing aspects of consciousness will help us to ascertain the limits of this kind of account and to look for new avenues of research.

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POVZETEK

Kakšna je povezava med zunanjim, »fizikalnim«, objektivnim časom in notranjim, subjektivnim časom zavesti? V prispevku bom najprej prikazala značilnosti doživljanja časa, nato bom predstavila A-in B-teorijo časa in ontološke različice, ki so zaznamovale diskusije o filozofiji časa. Zaključila bom z optimističnim pogledom na raziskovanje, ki se odpira znotraj kognitivne znanosti.

Ključne besede

čas, doživljanje časa, A-zaporedje, B-zaporedje, tek časa

1. UVOD

»Kaj je torej čas? Če me nihče ne vpraša, vem; če pa ga hočem na vprašanje razložiti, ne vem.« [1: XI/14] Slavni citat iz Avguštinovih Izpovedi nas opozori, da se kljub temu, da smo vpeti v različne časovne okvirje, v katerih preživljamo svoj vsakdan, znajdemo v zadregi, ko bi morali o času povedati kaj več. Avguštin je nato nadaljeval. »Vendar si upam z gotovostjo trditi, da bi ne bilo preteklega časa, če bi nič ne prehajalo, da ne bi bilo prihodnjega časa, če ne bi nič prihajalo, in ne sedanjega časa, če ne bi bilo nič pričujoče.« [1: XI/14]

Uganka, s katero se spoprijemajo umetniki – pesniki, pisatelji, glasbeniki, filmarji, gledališčniki, znanstveniki – fiziki, biologi, psihologi, kognitivni znanstveniki, antropologi in filozofi se razpleta na zelo različne načine, odvisno od zornega kota in raziskovalnega vprašanja, na katerega se raziskovalec osredotoča. Kakšna je povezava med zunanjim, »fizikalnim«, objektivnim časom in notranjim, subjektivnim časom zavesti?

Aristotel je povezal čas s fizičnim gibanjem »število gibanja glede na prej in pozneje« [2: 219b2]. Tako pojmovanje časa je omogočilo merjenje, na primer kroženje nebesnih teles, nihanje različnih nihal. Kot ugotavlja Marko Uršič [3] se Aristotelovo opredelitev časa običajno razume kot filozofsko definicijo fizikalnega in/ali kozmološkega, »zunanjega« časa v nasprotju z »notranjim«, fenomenološkim časom zavesti, duše, o katerem govori Avguštin: »Kolikor je doslej jasno in očitno, je to, da niti prihodnost ne biva niti preteklost. Potemtakem pravzaprav ne moremo reči: trije časi so pretekli, sedanji in prihodnji. Natančneje bi se reklo takole: trije časi so – sedanjost glede na preteklost, sedanjost glede na sedanjost in sedanjost glede na prihodnost. Zakaj le v duši bivajo časi kot te vrste trojstvo, drugje jih ne vidim: sedanjost glede preteklosti je spomin, sedanjost glede sedanjosti je vpogled, sedanjost glede prihodnosti je pričakovanje.« [1: XI/20]. Vendar Uršič dodaja [3], da sam Aristotel ni postavil ostre ločnice med zunanjim in notranjim časom, saj na vprašanje »Ali bi čas bival, če ne bi bilo duše?« odgovarja: »Če v naravi ne šteje nič drugega kakor duša oziroma um duše, potem ni mogoče, da bi čas bival, ko ne bi bilo duše«[2: 223a23-25]. Tak pogled je blizu Uršičevemu panteističnemu stališču in morda lahko ponudi rešitev zagonetke, a sloni na za mnoge sodobne znanstvenike in filozofe vprašljivi predpostavki »v naravi ne šteje nič drugega kakor duša oziroma um duše«. Kaj pa, če te predpostavke ne sprejmemo in izhajamo iz naturalističnega stališča? V prispevku bom najprej prikazala značilnosti doživljanja časa, nato bom predstavila A-in B-teorijo časa in ontološke različice, ki so zaznamovale diskusije o filozofiji časa. Zaključila bom z optimističnim pogledom na raziskovanje, ki se odpira znotraj kognitivne znanosti.

2. DOŽIVLJANJE ČASA

Ernst Pöppel (1978) [4] je navedel naslednje značilnosti kot temeljne značilnosti doživljanja časa:

1. trajanje
2. ne-simultanost
3. red
4. preteklost in sedanjosti
5. sprememba, vključujoč tek časa

Vsaka od teh značilnosti se na prvi pogled morda zdi očitna, a dejansko odpira nadaljnja vprašanja. Na primer, ko rečemo, da je prvi interval daljši od drugega, kaj je dejansko opisano kot kratko ali dolgo trajanje. Spomnimo se Avguštinovega citata - ne more biti preteklost, saj je ta nehala biti in kar ne biva, ne more imeti lastnosti v sedanjosti. Avguštin je našel odgovor glede na to, kaj merimo, ko merimo trajanje dogodka ali intervala časa, v pomnjenju. Iz tega je sklepal, da preteklost in prihodnost obstajata zgolj v duševnosti. Lahko se strinjamo, da je zaznava časovnega trajanja pomembno povezana s spominom, a iz tega mnogi ne bi izpeljali tako radikalnega sklepa kot Avguštin. Zdi se združljivo, da merimo interval, ki je neodvisen od naše duševnosti, toda to počnemo s pomočjo nekega psihološkega procesa. [4]. O posebni vrsti trajanja je govoril William James, ko je izraz »varljiva sedanjost« (angl. specious present) opredelil kot kratko trajanje, ki ga občutimo neposredno in neprekinjeno. To stalno zavedanje določenega trajanja varljive sedanjosti, ki gre od nekaj sekund do minute in kjer je vsebina zaznana tako, da ima en del prej in en del kasneje, je po njegovem prava intuicija časa. Kot ugotavlja LePoidevin, je Jamesova opredelitev dvoumna, saj jo je mogoče razumeti kot:

1. razpon v kratkoročnem spominu,
2. trajanje, ki je zaznano, ne kot trajanje ampak kot trenutno,
3. trajanje, ki je neposredno zaznano – ne skozi posredovanje številnih drugih, morda vmesnih trenutnih zaznav,
4. trajanje, ki je zaznano kot sedanje in kot razširjeno v času.

Po njegovem mnenju je najbolj verjetno četrto razumevanje. Sedanjost izkustva je »varljiva«, saj naj bi se nanašala na interval in ne na netrajajoč trenutek, kar naj bi bilo v nasprotju z objektivno sedanjostjo. Čeprav ni uporabil istega izraza, pa je na podoben način o fenomenologiji časa razmišljal tudi Edmund Husserl, ki je,

kot ugotavljata Andersen in Grush, poznal Jamesovo delo, predvsem pa so skupni predhodniki, ki so vplivali na oba [5]. V razpravi Predavanja k fenomenologiji notranjega zavedanja časa pravi takole: »Ko na primer zveni neka melodija, posamezni ton ne izgine popolnoma, ko preneha dražljaj [npr. zvok ob nihanju strune] oziroma z njim povzročeno živčno vzburjenje. Ko zazveni nov ton [v melodiji], tedaj prejšnji ne izgine brez sledi, sicer ne bi mogli opaziti medsebojnih razmerij med toni, ampak bi imeli vsak hip le en sam ton in eventualno v času med dvema tonoma pavzo, nikoli pa ne bi imeli predstave /Vorstellung/ neke melodije« [citirano po 3: 289] V obeh primerih gre za to, da zaznavamo nekaj razširjenega kot sedanjost.

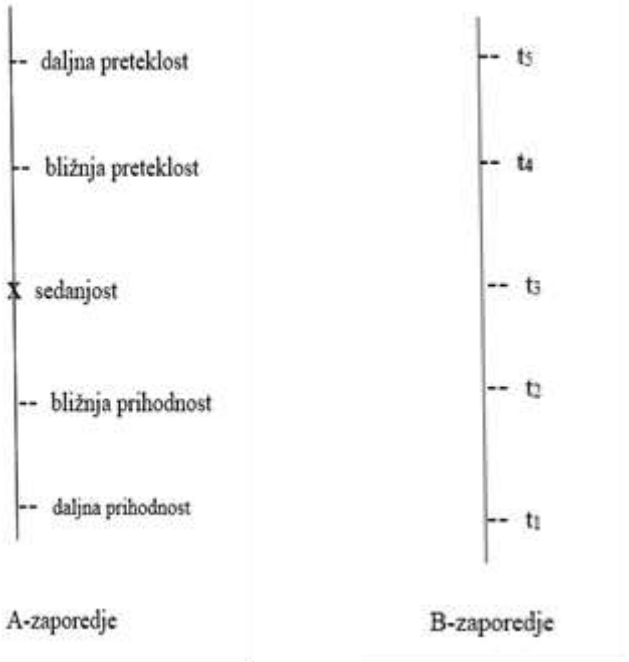
Ta kratek prikaz seveda ne more izčrpati stališč in vprašanj, ki so jih odprli Avguštin, James in Husserl, v tem prispevku pa služi predvsem kot ilustracija, kako pomembno je razlikovati med »zaznavati sedanjost« in »zaznavati nekaj kot sedanjost«. [4] Prav to je bistvena razlika, kljub sicer mnogim podrobnostim, med tem kako zaznavamo predmete v prostorskih relacijah, na primer, blizu in daleč. Kajti ko zaznavamo preteklost, je ne zaznavamo kot preteklost, ampak kot sedanjost (preko spomina). Če sprejmemo Jamsov pristop z »varljivo sedanjostjo« ali Husserlovo tripartitni pogled o izkustvu časa, pa nam to spoznanje samo po sebi še ne more razložiti tega, da se naše doživljanje »kot sedanjosti« (as-of the present) stalno spreminja. Kot ugotavlja LePoidevin [4] sprememba v našem izkustvu ni isto kot izkustvo spremembe. Prav tek ali morda navidezen tek časa pa je tista značilnost, ki bi jo radi vsaj nekoliko podrobneje raziskali, predvsem z vidika ujemanja metafizičnih teorij zaznavanja časa, sodobnih fizikalnih teorij in prvoosebnega doživljanja časa.

3. METAFIZIČNE TEORIJE

3.1 A-zaporedje in B-zaporedje

Kako razumeti stavek »čas beži«, s katerim pogosto opišemo naše doživljanje časa. Tako takrat, ko se oziroma nazaj, na vse, kar smo preživeli in kar se odmika v preteklost, kot takrat, ko gledamo v prihodnost, ki se nam hitro bliža. Toda ali čas res »teče«? Angleški filozof z začetka prejšnjega stoletja John Ellis McTaggart [6, 7] je dokazoval, da nas pojmi, s katerimi opisujemo naše izkustvo časa, na primer tek časa, vodijo v protislovje. Ubral je podoben način dokazovanja (reductio ad absurdum) kot Zenon, ko je dokazoval, da nas na prvi pogled nevprašljiva resnica (npr. obstoj množtva), vodi v protislovje. Iz tega je nato sklepal, da je potrebno tako trditev zavrniti. McTaggert dokazuje, da je podobno z obstojem časa in da nas sprejemanje te trditve vodi v protislovje.

Pri dokazovanju, da je čas nerealen in zgolj velika iluzija, ki jo je proizvedel človeški razum, je uporabil dva različna načina za opisovanje časovne določenosti dogodka. Pri prvem, imenujemo ga A-zaporedje, dogodke časovno razvrščamo glede na njihov odnos do »zdaj« kot pretekle (včeraj, prejšnji teden, lani), sedanje (danes, letos) in prihodnje (jutri, naslednji teden, drugo leto). V primeru B-zaporedja pa ni odlikovanega »zdaj«, gre preprosto za urejeno zaporedje trenutkov ((t1, t2 , t3, t4 , t5 ,...). Tako lahko rečemo, da se je dogodek v času t2 je zgodil pred dogodkom v t3 in po dogodku t1, ne moremo pa reči, da je dogodek v t2 pretekli dogodek ali prihodnji dogodek. Na primer, ko rečem (i) »Slovenska košarkarska reprezentanca je včeraj osvojila naslov evropskih prvakov« ali »Slovenska košarkarska reprezentanca je 17. 9. 2017 osvojila naslov evropskih prvakov«, sem isti dogodek opisala na dva različna načina . V prvem stavku je časovna določenost dogodka - »včeraj« odvisna od premikajočega se »zdaj«, v drugem pa je odvisna od »objektivnega« datuma. Zaporedji A in B urejata dogodke enako glede na časovno razdaljo in trajanje dogodkov, vendar je med njima pomembna razlika. A-zaporedje je dinamično, B-zaporedje pa je statično. Ker se »zdaj« stalno premika, se spreminjajo tudi A-časi. Na primer, zmaga slovenske reprezentance se vse bolj odmika v preteklost. Kot ugotavlja Danilo Šuster: »V dinamičnem A-zaporedju dogodki in stvari nastajajo in minevajo. Gre za spremembo, ki so ji stvari in dogodki podvrženi zgolj s tem, da so »v času«. Včasih tek časa označujejo prav kot tezo o premikajočem se »zdaj-u«, tek časa je v nenehnem spreminjanju A-časa, ki ga zaseda določena stvar ali dogodek v A-zaporedju.«[8] Po drugi strani pa dogodki v B-zaporedju svojega položaja v času ne spreminjajo, »so« v nekakšnem brezčasnem smislu. Odnosov med dogodki tu ne opredeljujemo glede na preteklost, sedanjost in prihodnost, gre za relacije, ki bi jih lahko primerjali z relacijami v prostoru. Na primer, na metrskem traku je oznaka »20 cm« pred oznako »30 cm« in za oznako »10 cm«. B-zaporedje tako uvaja pojmovanje časa, ki je blizu prostorskemu pojmovanju in s tem razumevanju časa v sodobnih fizikalnih teorijah [3]. (Več o razlikah in podobnostih v pojmovanju časa in prostora v naslednjem razdelku).



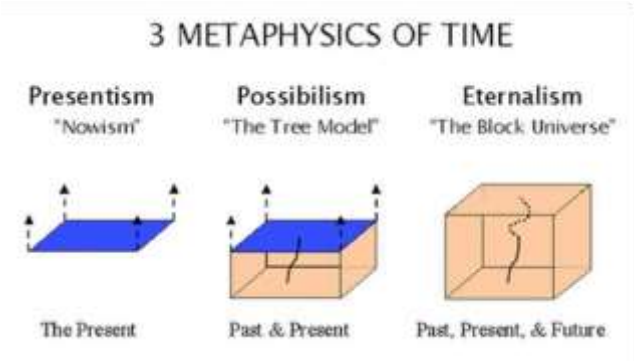
Slika 1: A- in B zaporedje

McTaggert je dokazoval, da so A-določila, t.j. biti pretekel, biti sedanji in biti prihodnji, protislovna, saj ni mogoče, da bi bil isti dogodek lahko obenem pretekli, sedanji in prihodnji, oziroma, da bi imel isti dogodek (Zmaga slovenske reprezentance na evropskem prvenstvu v košarki) vsa tri določila. Šuster v svojem članku opozarja, da enostaven ugovor realista glede časa, »da nič ne more hkrati posedovati nezdružljivih lastnosti, noben dogodek ni takrat, ko je sedanji tudi pretekel. Dogodki imajo te lastnosti zaporedoma, najprej so prihodnji, potem sedanji in nazadnje pretekli. Gre za zaporedje v času, v tem pa ni nobenega protislovja.« [8], ne omaje antirealista. Kot smo videli, za McTaggarta časovni odnosi med dogodki niso prvobitni, ampak jih analizira s pomočjo A-zaporedja. Toda, trditev, da dogodek poseduje A-določila zapored, v času, predpostavlja obstoj časa, kar pa vodi v blodni krog. McTaggartov dokaz je sprožil diskusijo, katere prikaz bi presegel okvir tega prispevka [3, 8, 9, 10], njegova razdelitev na A in B zaporedje pa je zaznamovala razprave o filozofiji časa [11, 12].

3.2 Ontološke različice

A-zaporedje in B-zaporedje torej opisujeta isto zaporedje fizičnih dogodkov, vendar lahko A-zaporedju pripišemo A-določila, kot biti sedanji, n sekund pretekli ali n sekund prihodnji. V A-zaporedju ima tako vsak čas edinstveno A-določilo, ki ga umešča v edinstveno mesto znotraj zaporedja. Na ta način lahko čase uredimo v skladu z njihovimi A-določili. Vsak čas v A-zaporedju ima absolutno pozicijo. Časi v B-zaporedju so prav tako urejeni, toda njihova urejenost je določena z relacijami prej kot in kasneje kot, časi so torej urejeni glede na medsebojne relacije. Kot ugotavlja Simon Prosser [13], lahko vpeljemo še razlikovanje med A-teorijo in B-teorijo: po A-teoriji je realnost najbolje opisana z izrazi A - zaporedja, B-teorija pa z izrazi B-zaporedja. V skladu z A-teorijo obstaja samo en čas, ki je dejansko (realno) prisoten. To je prvobitno, objektivno dejstvo, ki je od nas neodvisno. Toda, kateri čas je prisoten, se s tekom časa nenehno spreminja. V nasprotju s tem pa pri B-teoriji ni A-določil, nič nima objektivnega, A-zaporednega mesta. Vsi časi imajo enak status. V skladu z B-teorijo tako ni teka časa, ni »gibanja« sedanjosti vzdolž časovne črte. [13: 3]

Kot smo videli, B teoretiki čas vzporejajo z dimenzijami prostora. Tako kot ni posebnih prostorskih lastnosti (npr. biti severno), ampak so zgolj prostorske relacije (biti severno od), tudi ni posebnih A-lastnosti. A-teoretiki pa vidijo bistvene razlike med prostorom in časom, saj tudi če sprejmemo, da ni pravih prostorskih lastnosti, obstajajo prave A-lastnosti. Za razliko od prostora za čas dejansko lahko rečemo, da mineva. Obstaja pa še en pomemben vidik, zaradi katerega se po mnenju A-teoretikov razlikujeta prostor in čas. Nekateri zagovarjajo stališče, da obstaja zgolj sedanjost (presentism) – nujno je vedno resnično, da obstajajo zgolj sedanji objekti. [14] Preteklost je bila, a ni več, prihodnost bo prišla, a je še ni.



Slika 2: Tri metafizične teorije časa [15]

Na sliki je to stališče prikazano s štirimi puščicami, ki ležejo navzgor in konvencionalno predstavljajo smer prihodnosti. Predstavljajo dinamični vidik časovnega nastajanja in teka časa. Srednji diagram predstavlja stališče, po katerem je prihodnost razvejana struktura alternativnih možnosti (model drevesa, growing block view). Ta pogled se v veliki meri ujema z našim vsakdanjim pogledom, da obstaja nesimetrija med preteklostjo in prihodnostjo, ki je v prvem stališču ni. Tretje stališče, ki ga implicira B-teorija, pa je stališče večnosti (eternalism, the block universe). Glavna problema tega pristopa sta, kako razložiti intuicijo o nesimetriji med preteklostjo in prihodnostjo ter vprašanje zanikanja teka časa, ki se zdi v nasprotju z našim izkustvom. Pa vendar se tako Parmenidovsko stališče zdi najbolje podprto s sodobno fizikalno teorijo, predvsem Einsteinovo relativnostno teorijo. Ali je med izkustvom, doživljanjem časa in objektivnim, fizikalnim časom tak prepad, da ga ne moremo premostiti?

4. SKLEPNE MISLI

Razprava med A-teoretiki in B-teoretiki ter med zagovorniki različnih ontoloških stališč se nadaljuje. Oba tabora se lahko sklicujeta na prednosti, a morata hkrati odgovoriti na vprašanja, ki jih sproža njihov pristop. V prispevku sem na kratko predstavila osnovna stališča. A-teoretiki se pri iskanju podpore za svoje stališče pogosto sklicujejo na izkustvo in doživljanje časa. A kot pravi Prosser, je zelo čudno, da bi lahko filozofsko razpravo odločilo zgolj gledanje oziroma doživljanje [13: 23]. Kaj pa, če razlogi in argumenti, ki jih navajajo kritiki A-teorije, držijo? Če je na podlagi znanstvenih izsledkov in filozofskih argumentov najbolje podprta B-teorija in eternalistično stališče? V tem primeru je naloga tako filozofov kot kognitivnih znanstvenikov, da pokažejo, zakaj doživljamo tek časa, zakaj se zdi naša časovna zavest v opreki z izsledki fizike. Prosser meni, da obstajajo vidiki duševnega življenja, »kako je biti za nas« (fenomenalna zavest, Nagel, Chalmers), tako da se sprejemamo kot zavestni o teku časa. »Vsak, ki trdi, da mu izkustvo pripoveduje, da čas teče, sprejema, da je nekaj v karakterju naših duševnih življenj, kar nam to odkriva, karkoli je že lahko to »nekaj« [13: 26]. Sama menim, da je trenutno najbolj zanimivo področje raziskav, ki skuša povezati prvoosebno izkustvo z raziskavami v nevroznanosti. V zadnjem času smo priča raziskavam, ki kažejo, kako bi lahko sodelovanje med fenomenološkimi pristopi (npr. Husserlovim opisom časovne zavesti, retencije in protencije) in računskimi modeli nevronskih mrež osvetljevalo in dopolnjevalo oba, na videz nasprotna si pristopa. [16, 17, 18]

5. ZAHVALA

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Cognitive modulation of pain: how do cognition/mind influence pain processing?

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ABSTRACT
Pain is somatic perception with a strong cognitive component and arises from physiologic (e.g. nociception), psychic (e.g. sadness) or social/environmental factors (e.g. neglect). This multidimensional phenomenon helps with precise preservation of the homeostasis, stabile internal environment, and presents a precondition for survival. The information from and about the human's inner and outer world are accessible consciously and/or subconsciously. The final control is usually attributed to the brain. This fascinating organ is seen as a mysterious instrument that displays a remarkable intelligence and ability to adapt. This possibly understandable and sophisticated mechanism governs cognition and thought with neural and psychological underpinnings.

The studies of how cognition is realized in the brain enables researchers and professionals to explain the most complex thought processes. Psychical and physical modifications of mental processes operate at different stages of processing and can to some extent be observed or at least empirically probed. The scientific investigation by means of the methods of the natural and social sciences confirms the cognitive influence on perception of somatic sense (pain).

General Terms
Management, Measurement, Documentation, Human Factors, Theory.

Keywords
Cognition, Pain, Perception, Psychophysics, Psychocognition

1. INTRODUCTION
Somatosensation and its most ubiquitously appreciated and attention-seeking mode – pain – is challenging. The contemporary knowledge and science of pain, especially the humanistic kind, demands and allows the creative and unlimited brainstorming on all levels. The rules and doctrines have to be generally valued and person/individual oriented at the same time. The principles for elimination of confusion and the emphasis of the importance of cognitive determinants of somatic sensation (pain) are proposed.

2. PAIN
Pain is a multidimensional and multifunctional phenomenon. As a highly subjective perception, it is characterized by complex and often non-linear relationship between nociceptive input and pain perception. The study and management of this unpleasant symptom, syndrome or disease *per se* is demanding. The scientific and professional approaches range from the study of the peripheral structures, processes and mechanisms [1] to the last considerations where brain processes are being considered in the analyses of human cognition [2].

Components of pain processes are sensory, perceptual and cognitive. Sensory processes take place peripherally and are measurable with physical instruments and metrics. Perceptual and cognitive processes are processed within the organism, without necessary reliance on physical metrics or instruments with predetermined protocols, and could be followed with more sophisticated devices [3-5].

The disciplines concerned with pain as a health problem are medicine, psychology, pharmacology and bio-technical disciplines. The treatment and management of pain requires more health care resources than the treatment of diabetes, heart diseases and cancer combined [6]. The mechanisms of pain management are based on the ways in which physical sciences process relatively simple or highly variable electrical impulses evoke sensation and manage them with the sophisticatedly evolved complex alternations of perception. The final goal of investigations is a steady development of universal trans-disciplinary tools for the effective and explanatory mechanism-based management.

3. FROM SENSATION TO COGNITION AND VICE VERSA
Physiological, psychical and environmental processes are usually explained as linear functions. Universal solutions for the explanation of those intertwined operations demand sophisticated instruments [5]. Contemporary knowledge is organised in a multidisciplinary way, but gaps are most effectively bridgeable through a trans-disciplinary approach [7-9]. Conscious organisation and processing of thought is scientifically approached by cognitive psychology, an integrative interaction of brain and mind [2].

Pain processing is in medicine and related disciplines acknowledged biologically (physiologically), although the generally accepted definition mention psychical factors too [10]. Their influence is better explained in Price's definition [11]. Recognition and evaluation of cognitive contents and processes remain undervalued and disregarded. The number of sensory informations per sec is 10^9 bit, and 10^2 bit of them arrives to brain centres [12], where they elicit perceptions of senses (including pain). Perceptual experience is elicited by sensation, initiation of physiological processes by sensory stimuli (i.e. prick) and the process of accepting the environment. Perception, the process of attaining awareness of sensory information, happens simultaneously with sensation. We cognitively (consciously, mentally) interpret the sensory stimulus and understand sensory information (i.e. we are aware of it) [13].

Sensory processes in the appropriate centres integrate and interpret the arrived informations and turn them into appropriate responses [14; 15]. Neuromatrix serves as a treasure of basic patterns that could be changed and modified [16]. Recognition of received information is a function that categorises percept sense and serves as a diagnostic tool, which identifies factors that influence and burdens health status.

Modern scientific fields in neurology are devoted to investigation of neural mechanisms underlying the complex cognitive processes. It is well known that a variety of cognitive processes influences pain perception and biases nociceptive processing in the human brain [17-19] and the modulation of sensory information is an emerging field in pain (somatosensitivity) research [17; 18].

Cognition, referring to the mental process by which external or internal input is transformed, reduced, elaborated, stored, recovered, and used, has different and for physical metrics inaccessible underpinnings. Such an intellectual query demands and allows exclusively highly sophisticated approaches. It involves a variety of functions such as perception, attention, memory coding, retention, and recall, decision making, reasoning, problem-solving, imaging, planning and executing actions [20; 21].

The sensory, perceptual and cognitive information are additionally profoundly interconnected with unique individual psychical factors, e.g. emotional, which modulate anticipated experience [22]. Descending and afferent pathways, e.g., reciprocally influence the nociceptive input or elicited pain response. Cognitive psychology is thus the foundation on which all other social sciences stand, in the same way that physics is the foundation for the other physical sciences; neurological mechanisms are physiological [23], preserved in the neuromatrix [16].

Cognition and consciousness as well as the complex structure and functionality of the brain is intensively investigated and drives researchers toward exploring the mysteries of human thought. They are beyond the realms of human scientific understanding and reasoning [24]. The approach should exhibit universal solutions for similar queries. The neurodynamical processes are the basis of perception, cognition, and behavioural decision making, and is recorded with neurophysiological instruments [25; 26]. Psychophysical evaluation of sensory processes is accessible with psychophysical tests [27-29]. For the comprehensive understanding of human perception, new protocols are suggested [30; 31].

4. COGNITIVE MODULATION (PLASTICITY) OF PAIN

Pain sensation, perception and biased nociceptive processing are influenced by two aspects of cognitions: variety of cognitive processes [17] and cognitive content [32]. Cognitive processes characterize how individuals think about pain, whereas cognitive content establishes what individuals think or believe about their pain.

4.1 Cognitive processes

Cognitive processes involved in pain recognition and management are distraction, enhancement, suppression, dissociation, nonjudgment, acceptance, reappraisal, absorption and rumination [33]:

- distraction divides and diverts attention away from pain, to more pleasant perception,
- enhancement diverts attention to positive thoughts [34],
- suppression diverts thoughts by conscious suppression and captures a form of cognitive avoidance,
- dissociation and reappraisal either distance the person from the pain or make the pain more tolerable,
- nonjudgement include the experience, without unnecessary evaluation of characteristics as “good” or “bad”,
- acceptance actively allows experience to solely be an experience, without a need for it to be different,
- absorption implies intense, hypervigilant intentional or unintentional focusing on pain and
- rumination signifies unintentional preoccupation with pain.

4.2 Cognitive content

Cognitive content involved in pain recognition and management include self-efficacy, catastrophizing, beliefs about pain, expectations:

- self-efficacy – the belief that one can manage pain,
- catastrophizing – focusing on negative aspects and consequences of pain and ruminating about negative beliefs,
- belief that pain represents a threat,
- expectations and
- predictions.

5. INVESTIGATION OF COGNITIVE PROCESSES AND CONTENT

Classical psychophysics relates physical stimulus energy to psychological sensation. The ideal psychophysical process is the function of a single variable and the perceived sensation is appreciated as the function of the intensity of the physical stimulus. Other factors that affect sensation are mostly neglected or considered as a nuisance or as context variables that should be eliminated to isolate the true psychophysical relation [5].

The explanation of many comprehensive issues, which emphasise multidimensional phenomena such as sensations (i.e. pain), should be grounded on the important cognitive determinants. Psychocognition (integration psychophysics) integrates separate functions, such as sensation of two or more variables, into a unitary perception. Variables may be sensory, perceptual, and cognitive. Because of many-variable forms, integration psychophysics can work entirely within the organism. The principles that govern the conceptions of psychophysics, are realistic, physical and necessarily rely on the physical metrics. Psychocognitive, on the other hand, typically lie at a stage beyond sensory processing, within the mental realm [2].

The contemporary neurophysiologic (electrophysiologic) and neuroimaging studies of neural mechanisms underlying more complex cognitive modulation indicate that modulations of pain are likely to share the general mechanisms and substrates of sensory processing. The pain modulatory systems complement, interact and overlap with general cognitive (mental) control systems [2; 16].

Neurology has many common points with neurophysiology and psychology shares many methods and instruments with psychophysics. Cognitive psychology integrates mechanisms and principles.

6. COGNITIVE APPROACH TO CHRONIC DISEASES

Chronic diseases are long-lasting and frequently exhausting conditions and can be often overloaded with an additional, for now incurable, health problem: pain. This unpleasant phenomenon arises as a symptom or sign, as an entity *per se* or complication [35]. Patient-oriented health care of patients with somatosensory disturbances, including pain, seems to increase costs related to improvement of common chronic conditions. But the determination

of a connective link/program leads to the development of increasingly sophisticated scientific methods for understanding the workings of the brain and the very nature of consciousness. The advanced techniques for monitoring the brain and psychical processes require the development of novel methods of theoretical analysis and interpretation tools. Our work is part of these endeavors.

Such comprehensive approach would be useful for:

- understanding the similarities and differences between existing and "cognitive" pain treatments,
- guiding the evaluation of patients with chronic pain,
- improving the management and
- giving clinicians greater flexibility for including new and improved interventions.

We continuously prove the efficacy of a trans-disciplinary approach to pain management. We are convinced that the gaps in visions and perspectives between scientific and professional areas and disciplines are artificially created. Our successful evidence-based everyday work and academic and professional clinical achievements are the basis for a new, trans-disciplinary, patient-oriented approach, where cognitive factors will play a connective role.

Our studies and practices range from purely neurologic/ neurophysiologic or psychological, to psychophysically developed and psychocognitive [7; 30; 31; 36-42].

7. CONCLUSION

Cognition is the basis for the development of a conscious way to manage pain and other somatic sensations. Sensory informations are sets of processing steps that evolve from sensation to perception and beyond. The documentation and demonstration of influence and effectiveness is difficult. The approach is two-fold, physiologic with physics as the foundation for the other physical sciences and psychological with cognitive psychology as the foundation on which all other social sciences stand.

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Modeling the Model: the World Beyond the Immediate Sensorium

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ABSTRACT

The paper explored the hypothesis that there might be a certain type of probabilistically acquired embodied calculus that meditates our sensory perception. Our intention is to reflect upon some problems connected to modeling consciousness while weighing sensory and social perception against each other in the theater of action where Bayesian brain "plays us" while playing with itself.

Keywords

consciousness, modeling, Bayesian probability

1. INTRODUCTION

This paper is organized around the hypothesis that there might be a certain type of probabilistically acquired embodied calculus that meditates our sensory perception. That would imply that what we cognitively perceive and what we like to call "our reality" is already a *model*. We can literally "see" the model (without being aware of it) in such moments when "non-stimulus-driven inputs allow early neurons to respond even to stimuli which are inferred but not directly presented to the retina" [1, p. 1]. Our intention here is to reflect upon some problems connected to modeling consciousness while weighing sensory and social perception against each other in the theatre of action where Bayesian brain "plays us" while playing with itself. In the first part of the paper, which reflects upon some recent approaches to modeling consciousness, we pose a plethora of questions important for the chosen topic: - Should we favor mathematical abstraction and its "beauty" and use topological insights[1], or combine complex reality models with Bayesian ones, or give more emphasis on the development of bio-inspired models? How effective is the topological hypothesis in resolving still unresolved problems concerning our psychological activities, such as mind-wandering, memory retrieval, consciousness and dreaming state? Maybe we should combine useful insights from different model-paradigms, but how? By optimizing the practice of already established models that proved their efficacy in experimental work, or from "above" from the explanatory unification paradigm and its claims about explanations contributing to our understanding of the world by embedding phenomena into general nomic patterns that we recognize in the world? To what extent our methodological choices connected to the controversy about the concept of the unification of knowledge help/limit our insights into the phenomena that we explain [4][5]. Are we (still) satisfied with bayesian calculation of epistemological «virtues» of unification [6]? Can we compare explanatory relevance [7] and constitutive relevance [8]? Is Elsasser's proposal to overcome reduction by the formalization of complexity through the undifferentiated heterogeneity of logical classes [9] still relevant? Are we "in the gird" of some sort of a "fearful symmetry"[2] because we are unable to get outside of the complex "reality" of the model?

2. A REALITY MODEL

Suppose it is impossible for us to be "outside" the texture of the dynamics and the dynamics of the texture in which we partake,

[1] See, for example Tozzi's paper "A Symmetric Approach Elucidates Multisensory Information Integration" in which he argues that the Borsuk-Ulam theorem is a general principle underlying nervous multisensory integration claiming that topological tools not only shed new light on questions concerning the functional architecture of mind and the nature of mental states, but also provide an empirically assessable methodology [2, p.1-14]. Another example could be recent research focusing on the link between neural network structure and its emergent function where the scientists attempt to describe such a link by "taking the direction of synaptic transmission into account, constructing graphs of a network that reflect the direction of information flow, and analyzing these directed graphs using algebraic topology" [3, p. 1-16].

[2] "Fearful symmetry" is a widely quoted, differently interpreted and for different reasons, and in different contexts used and misused syntagma, borrowed from the poetic/philosophical system of William Blake. The religious interpretation of the poem containing this syntagma should not be taken for granted. Mentioning «fearful symmetry» we refer to the first and the last symmetrically positioned quatren of the poem «The Tyger» composed of six stanzas. Contrary to the most of the already established interpretations of Blake's philosophical views, we strongly argument in favor of his methodological naturalism and we recognize the anticipatory value of Blake's functionalist insights into developmental potentials of the human brain as a sophisticated pattern-seeking instrument. The poem was published in 1795 in the *Songs of Experience* collection, as a counterpoint to the poem «The Lamb» published in the previous collection titled the *Songs of Innocence*. Blake was an admirer of Swedenborg's methodological naturalism but his position of Swedenborg's theological though oscillated from the satire in *The Marriage of Heaven and Hell*, across the phase of interest in Swedenborg's science and philosophy, to the phase of his criticism of The New Jerusalem Church. Blake also knew (an illustrated) the work of Darwin's grandfather – Erasmus Darwin – who formulated one of the first formal theories on evolution in *Zoonomia, or, The Laws of Organic Life* (1794-1796). Blake's disillusionment with Swedenborgian church already happened in the years when he wrote *The Book of Experience*, but this paper is not the right place to discuss in detail Blake's peculiar blend of spiritual naturalism, non-theism, simultaneous deism and anti-deism, and radical revolutionary ideas.

but what we can is to assume virtual *outsiders' perspectives* in order to assess the degree of the "reality" of the model that we co-create by taking part in its dynamics. Suppose that the potential for *perspective-assuming* is already present in the first focusing of attention of a child in the pre-speech phase of its cognitive development, then it will be true – as Graziano & Kastner hypothetize – that *awareness is best described as a perceptual model, not merely a cognitive or semantic proposition about ourselves that we can verbalize, but instead, a rich informational model that includes, among other computed properties, a spatial structure* [10, p. 99]. Graziano & Kastner believe that their explanation of consciousness as a construct of the social perceptual machinery is contrary to the hypothesis that consciousness is an emergent property of the brain caused by neuronal complexity, and they have some serious concerns about the "rival" theory: first, they think that such as emergent property may lack adaptive value[3], and second, they don't see how the complexity theory could give answers to vital questions on how consciousness emerges, and from what specific neuronal process. We are prone to think that a peculiar sort of dynamism of *reality-as-a-reality-model* in which we partake, is a type of functional complexity that goes beyond both perceptually experiential and cognitively perceptual human scale. It is our intuition that the complexity of human reality as a reality-model should be (at least) the function of component complexity and system complexity. Here under system complexity we refer to the complexity resulting from the relationship between the functional processes like communication, concurrence and multi-instance which have their internal "component complexity". However, imagine for a moment the situation where what we experience as our realty turns to be a bio-emergent topological complexity. Biological development "takes advantage" of certain (physical or chemical) manifestations of mathematical possibilities usable for the dynamical development of a certain form; it adopts these possibilities and turns them to its own purpose. The opposite type of "getting an inspiration from" is not so rare in biology. In this context, for example, various models have been developed to solve the problem of patterning of living organisms, starting in the 50s from Turing's "tiger stripe" theory, a brilliant idea that two kinds of reacting chemicals with different diffusibilities – two morphogens that work together as an "activator" and "inhibitor" – could form a steady-state spatial pattern. Take into consideration the example of the cellular slime mold *Dictyostelium discoideum* as an organism interesting both for biologists and for physicists. This unicellular species was chosen as a model organism for biomedical research because it could be used for a model system for the study of cellular morphogenesis and the study of pattern formation. The synchronization mechanism of oscillatory production of cyclic adenosine 3'5'-monophosphate in *Dictyostelium* might be a universal feature that can explain synchronization in other organisms[4]. In their recent research, Tozzi and Peters hypothesize that brain functions are embedded in an imperceptible fourth spatial dimension and propose a method to empirically assess its presence. In order to achieve that, they use a concept from topology, the 4D space of a "hypersphere's torus" to understanding brain functions. The torus is undetectable by observers living in a 3D world and they compare it with a video game with biplanes in aerial combat: when a biplane flies off one edge of gaming display, it does not crash but rather it comes back from the opposite edge of the screen. Tozzi and Peters think that "our thoughts exhibit similar behavior, i.e. the unique ability to connect past, present and future events in a single, coherent picture as if we were allowed to watch the three screens of past-present-future 'glued' together in a mental kaleidoscope." [13, p. 189].

The idea that we cannot perceive un-modeled reality is highly disturbing in a philosophical sense, and the very thought that we do not "exist" outside of the "reality" *(co)modeled* for us and by us, makes us cognitively biased in favor of the interpretation of the superiority of the top-down, "perceptually cognitive" insight into what makes the conceptual *stasis* of a particular quale. In the text titled "Why cognitive penetration of our perceptual experience is the most plausible account?" Newen & Vetter claim that our perceptual experience is influenced by higher cognitive phenomena like beliefs, desires, concepts, templates, but they are not sure to what extent and how exactly. They claim that the weak impenetrability claim cannot account for (1) extensive structural feedback organization of the brain, (2) temporally very early feedback loops and (3) functional top-down processes modulating early visual processes by category-specific information. They admit that the strong impenetrability claim could incorporate these data by widening the ''perceptual module" such that it includes rich but still internal processing in a very large perceptual module. They argue that this latter view leads to an implausible version of a module.

Contrary to them, in the second part of this paper, we argue that topological models – concretely the concept of 4D space of a "hypersphere's torus" proposed and experimentally used by Tozzi

[3] It seems that emergent property of the brain caused by neuronal complexity may have adaptive value after all. See an adaptive network model of synchronization proposed by Assenza et al. [11]. The role of synchronization in nature, society and technology is valuable. However, real world systems change their interaction patterns in time. Assenza et al. analyzes synchronization features in networks in which structural and dynamical features co-evolve: "The feedback of the node dynamics on the interaction pattern is ruled by the competition of two mechanisms: homophily (reinforcing those interactions with other correlated units in the graph) and homeostasis (preserving the value of the input strength received by each unit). The competition between these two adaptive principles leads to the emergence of key structural properties observed in real world networks, such as modular and scale–free structures, together with a striking enhancement of local synchronization in systems with no global order" [Ibid, p. 1]. In such systems – "on one hand, local synchronization and consensus coexist with a lack of global order while, on the other hand, modularity and scale-free interaction patterns are core features of their backbone" [Ibid, p: 4]. Assenza's research team claims that their *adaptive network model* reproduces respectively at the mesoscopic and microscopic level, two universal properties of real networks. In addition to this, the two structural properties occur when the system displays a large degree of local synchronization in the absence of global dynamical order" [Ibid, p. 4]. This research team claims that in such way their findings are in agreement with either dynamical or structural features observed in real neural and social systems.

[4] See "Modeling the model organism *Dictyostelium discoideum*" by Nagano: "Since the Belousov-Zhabotinskii reaction pattern, a well-known non-linear phenomenon in chemistry, was observed during aggregation of *Dictyostelium* amoebae, *Dictyostelium* has been one of the major subjects of non-linear dynamics studies. Macroscopic theory, such as continuous cell density approximation, has been a common approach to studying pattern formation since the pioneering work of Turing. Recently, promising microscopic approaches, such as the cellular dynamics method, have emerged. They have shown that *Dictyostelium* is useful as a model system in biology". [12, p. 541-50]

& Peters for better understanding brain functions – could offer a very large *''perceptual module" such that it includes rich but still internal processing*. Because of our limited, three-dimensional perception, Tozzi & Peters' type of realism may not be readily accepted, but these authors offer a method to empirically assess the presence of the model of an imperceptible fourth spatial dimension of brain functionality. A four-dimensional brain, or a three-dimensional brain that operates in four dimensions? – it does not really matter as long as the model of "topological brain" could elucidate syntactic and semantic processing. Newen & Vetter offered a couple of other arguments against cognitive impenetrability hypothesis, and in that context they mentioned visual illusions (those that remain stable even if we are fully informed about the illusionary status of our experience) as the most striking evidence in favor of cognitive impenetrability. They agreed that such illusion allow us to discover construction principles of perception which remain active in everyday perception as well. They also agreed that construction principles revealed by stable illusions exist and that they remain active, but they disagreed that these construction principles can never be influenced by higher cognitive processes. They expressed one worry: "Why should we accept the generalization of exceptional cases of visual illusions to any case of everyday perceptual experience?" [14, p. 28] We find their argument based on the supposed *exceptionality* of visual illusion cases superficial and limited, because how then to explain the experimental statistics of the strange-face-in-the-mirror illusion which shows that some illusions are standardly effective (and typisized) only on healthy subjects, and less effective (and unstadardized) in patients diagnosed with some psychological problem or a psychiatric illness. We analyse findings of G. B. Caputo [15][16] related to the strange-face-in-the-mirror illusion as an example to prove that Newen & Vetter's second argument against cognitive impenetrability is not true [14]. Caputo's experiments show that in healthy, average observers gazing at one's own face in the mirror for a few minutes, at a low illumination level, produces the apparition of strange faces. All examined "normal" observers see distortions of their own faces which they describe roughly in 5 categories ranging from monsters, "archetypical" faces, faces of relatives and deceased, and animals. In one of Caputo's experiments, patients with depression were compared to healthy controls with respect to strange-face apparitions. Apparitions of strange faces in the mirror were much reduced in depression patients compared to healthy controls. Depression patients compared to healthy controls showed shorter duration of apparitions; minor number of strange faces; lower self-evaluation rating of apparition strength; lower self-evaluation rating of provoked emotion. While these decreases in the effect of the illusion in depression Caputo explained in psychiatric terms as a result of "deficits of facial expression and facial recognition of emotions, which are involved in the relationship between the patient (or the patient's ego) and his face image (or the patient's bodily self) that is reflected in the mirror". We could perhaps agree so far with Caputo, but the psychoanalytical, Jungian attempt at resolving the "mystery" about the way illusion functions in the "healthy" control group does not seem convincing enough – at least not scientifically. In the elaboration of this problem we develop different argumentation, backing up our hypothesis about the functionality of "filling in" the missing information by Bayesian modeling of sensory "reality" on some relatively recent experiments on visual processing in the human brain [1][17][18][19], and on some new theories of hippocampal memory construction of the "world beyond the immediate sensorium" [20], as well as on a range of Bayesian models.

3. CONCLUSION

The overall theme of this paper is connected to some *neither-illusionary-nor-real* "circumstances" in the dynamics of "perceptual experience" and "perceptual cognition". In the concluding part we attempt to provide some argumentation for our belief that the degree of the modeled *neither-illusionary-nor-real* "circumstances" in the dynamism of that model opens the possibility to interpret one dynamic fuzzy set "level" interconnected to another dynamic fuzzy set "level" as more or less *convincing* and, at the same time, more or less *illusionary* on a scale that we use to *interpret* a degree of *human reality*. However, at the very end of this paper, the important question about what could be the best model for modeling a model – remains unanswered.

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Psihološki in fiziološki odzivi ob robotski vadbi v različnih pogojih navidezne resničnosti

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POVZETEK

Naš namen je bil ugotoviti, v kolikšni meri lahko prek fizioloških odzivov sklepamo na stopnjo motiviranosti in prisotnosti udeleženca za igranje računalniške igre, ki bi bila uporabna pri rehabilitaciji zgornjih okončin. Z znanjem o povezanosti fizioloških odzivov in psiholoških stanj bi rehabilitacijo lahko prilagajali tako, da bi bolnik pri njej vztrajal čim dlje. Fiziološki odzivi, ki smo jih merili, so bili srčni utrip, temperatura in prevodnost kože, zbrali pa smo tudi subjektivne ocene zanimivosti, težavnosti igre, vživetosti vanjo ter želje po nadaljevanju igranja. Srčni utrip se je med različnimi pogoji pomembno razlikoval. Najvišji je bil ob kognitivno in fizično zahtevnejših pogojih ter težjih nalogah, najnižji pa ob manj zahtevnih. Prevodnost kože je bila prav tako občutljiva na različne pogoje, vendar se je bila manj zanesljiva mera. Temperatura kože je bila na razlike med pogoji zelo malo občutljiva. Rezultati kažejo nizke korelacije med prevodnostjo kože in motiviranostjo za nadaljevanje igre ter med srčnim utripom in natančnostjo vožnje avtomobila. Na motiviranost za vztrajanje pri igri in občutek prisotnosti je pomembno vplival kognitivni napor, na natančnost vožnje pa poleg kognitivnega tudi fizični napor. Lahko zaključimo, da je pri izdelavi učinkovite računalniške igre za rehabilitacijo poleg ustreznega načrtovanja fizične vaje ključna tudi izbira primerne vsebine kognitivnih nalog.

Ključne besede
rehabilitacija, fiziološki odzivi, motivacija, prisotnost, računalniška igra

ABSTRACT

Our aim was to determine to what extent can the knowledge of the psychological responses help infer the level of motivation and the presence of a participant playing a computer game, which would be useful for rehabilitation of the upper limbs. Relying on the correlation between physiological and psychological states we can adjust rehabilitation so that the patient persists in doing the exercise as long as possible. The physiological responses we have measured were heart rate, skin temperature and conductivity. From the psychological responses we have assessed the point of interest and the difficulty of the game, participant involvement in the game and desire for its continuation. Heart rate was significantly different under different conditions. It was the highest under cognitively and physically more demanding conditions and when performing more difficult tasks and the lowest at less demanding ones. Skin conductivity was also sensitive to different conditions, but this was a less reliable measuring tool. Skin temperature had a very low sensitivity to changing conditions. I found low correlations between skin conductivity and motivation to continue playing the game and between heart rate and accuracy of driving the car. The motivation for persisting and the sense of presence in the game were highly influenced by the cognitive effort. Accuracy of driving was influenced by both, cognitive and physical effort. When creating an efficient computer game for rehabilitation it is very important to plan appropriate physical exercise and cognitive tasks.

Keywords
rehabilitation, physiological responses, motivation, presence, computer game

1. UVOD

Bolniki lahko s pomočjo interaktivnih in intenzivnih vaj z robotom izboljšajo svoje gibalne sposobnosti. Treba pa je upoštevati, da v rehabilitaciji uporabniki niso vajeni takšne interakcije, imajo pa tudi slabše gibalne sposobnosti. Zato je za uspešno rehabilitacijo pomembno, da robot s svojim vedenjem čim bolj ustreza osebnosti in čustvenemu stanju človeka [3].

Mnogo raziskav za namene rehabilitacije preučuje povezanost fizioloških sprememb s čustvenimi stanji. Med najbolj pogostimi merami sta srčni utrip in prevodnost kože, sledita pa mu temperatura kože in dihanje. Raziskave v [4] in [5] so naredile obsežen pregled povezav čustev s fiziološkimi odzivi. Za anksioznost so npr. značilni povišan srčni utrip, nivo (SCL) in odziv (SCR) prevodnosti kože ter znižana temperatura na prstu. Za zabavo so bili v različnih raziskavah značilni zvišanje, znižanje ali pa nobena sprememba v srčnem utripu, zvišana ali znižana električna prevodnost kože (SCL in SCR) in zvišana temperatura na prstu [4]. Raziskave preučujejo tudi povezanost fizioloških odzivov s prisotnostjo oz. občutkom, da je del neke resničnosti (npr. navidezne resničnosti med gledanjem filmov, branjem knjig itd.). Rezultati npr. kažejo, da med odzivanjem v resničnem in navideznem okolju najbolje diferencira srčni utrip, ki v navideznem okolju visoko naraste, medtem ko je temperatura kože na spremembe okolja manj občutljiva, prevodnost kože pa ni kazala konsistentnih učinkov okolja [7].

Navidezna resničnost, vpeljana z igranjem računalniške igre, ki je interaktivna in posameznika stimulira prek več različnih čutnih kanalov, je lahko pomemben dejavnik motivacije v motorični rehabilitaciji [8]. Npr. ko bolniki postopoma nadgrajujejo svoje sposobnosti, je pomembno, da so gibalne naloge vse bolj zapletene oz. da zahtevajo vse več koordinacije različnih gibov. Tudi kognitivne naloge naj bi bile prilagojene stopnji kognitivnih sposobnosti, s čimer se izognemo dolgčasu in približamo zanosu. Dobro je tudi, da so igre zabavne, pri čemer pomagajo različni zvoki, vizualni učinki, in da vsebujejo rdečo nit (zgodbo), saj so bolniki tako bolj motivirani za igro [1].

Rehabilitacija negibljive okončine je lahko zelo naporna in če v njej ne vidimo vsaj malo smisla, toliko prej odnehamo. Vztrajanje v rehabilitacijski dejavnosti pa je ključnega pomena za izboljšanje gibalnih sposobnosti. Osebo lahko morda spodbudimo k vztrajanju, če ponavljajoči se rehabilitacijski aktivnosti (gibanju okončine) dodamo kognitivno nalogo, tako da posameznik med fizično vadbo osredotoča pozornost na nekaj drugega, s čimer se prekinja zaznana monotonost vadbe in zmanjša dolgčas. Uspešnost virtualnega okolja pa temelji tudi na tem, kako dobro lahko pri uporabniku vzbudi prisotnost – občutek, da je del tega okolja, ne pa resničnega, kjer je tudi njegovo telo [9]. Posameznik misli, čuti in se obnaša tako, kot da je v drugem svetu, in da so resnični tudi dogodki, ki se dogajajo.

Namen naše raziskave je bil preveriti, kako se pri udeležencu z dodajanjem različnih kognitivnih nalog k osnovni nalogi rehabilitacijske vadbe, tj. premikanju okončine, spremeni motiviranost za vadbo, prisotnost in subjektivna ocena težavnosti izvajanja vadbe. Poleg tega je bil namen tudi preveriti, kako se motiviranost za vadbo, prisotnost in subjektivna ocena težavnosti izvajanja vadbe razlikujejo pri različnih vrstah kognitivnih nalog.

Merili smo tri fiziološke odzive – srčni utrip, prevodnost in temperaturo kože – ki so v raziskavah najpogosteje uporabljene fiziološke mere za preučevanje psiholoških stanj. Raziskave večinoma raziskujejo povezanost fizioloških odzivov in čustvenih stanj, vendar smo raje vključili koncepte motivacije (zanimivost, odločitev za ponovno igro), prisotnosti (vživetost) in težavnosti, ki dajo več informacij o tem, ali bi udeleženec še vztrajal ob določeni dejavnosti ali ne.

2. METODA

Raziskavo smo izvedli s 43 udeleženci (24 moškimi in 19 ženskami), starimi povprečno 25,2 let (SD = 4,4; min = 18, max = 35). Kot pripomočke smo uporabili enostavno obliko navidezne resničnosti, to je štiri variante dvodimenzionalne računalniške igre, v kateri so morali udeleženci čimbolj natančno voziti avto po cesti. Uporabili smo tudi vprašalnike za merjenje subjektivne zanimivosti igre, težavnosti igre, vživetosti v igro in željo po nadaljevanju igre. Za merjenje fizioloških odzivov smo uporabili merilnike srčnega utripa, prevodnosti in temperature kože, vgrajene v robotsko ročko.

Deli igre so se razlikovali po prisotnosti/odsotnosti kognitivnih nalog (tj., kognitivni obremenitvi) in visokem/nizkem uporu robotske ročke (tj., fizični obremenitvi). Uporabili smo 2 x 2 eksperimentalni načrt. V pogoju 1 kognitivnih nalog ni bilo (K−) in upor robotske roke (F−) je bil tako majhen, da osebi ni oteževal manevriranja avtomobila v računalniški igri. V pogoju 2 so bile prisotne kognitivne naloge (K+), fizično obremenitev pa je prav tako predstavljal le majhen upor robotske roke (F−). Pogoj 3 je vseboval kognitivne naloge (K+), upora robotske roke ni bilo, dodana pa je bila sila vztrajnosti (F+), zaradi katere je bilo težje manevrirati vožnjo avtomobila v računalniški igri. Pogoj 4 je bil brez kognitivnih nalog (K−) in brez upora robotske roke, z dodano silo vztrajnosti (F+).

Udeleženci so s premikanjem robotske ročke usmerjali vožnjo avtomobila. V križišču so se morali odločiti za eno od poti, in sicer glede na rešitev kognitivne naloge. Odločati so se morali med dvema odgovoroma in zaviti v smer, kjer je bil predvajan pravilni odgovor. V nalogah so iskali sopomenke (npr. parfum je „vonj“ ali „dišava“, reševali račune (npr. 7 * 9 – 22 = „30“ ali „41“) in zrcalili slike. Kognitivne naloge so morali udeleženci reševati čimbolj pravilno, hkrati pa čim bolj natančno voziti po zaviti cesti. Po vsaki odigrani igri so udeleženci izpolnili vprašalnik, v katerem nas je zanimalo, kako zanimiva in težka je bila igra, kako so se vživeli vanjo in ali bi jo igrali še enkrat.

Za analizo podatkov smo uporabili dvosmerno ANOVO za odvisne vzorce ali neparametrično Friedmanovo ANOVO z Wilcoxonovim post hoc testom. Za primerjavo nalog smo uporabili enosmerno ANOVO za odvisne vzorce s Sidakovim post hoc testom. Povezanost med psihološkimi in fiziološkimi odzivi smo opredelili s Pearsonovim koeficientom korelacije. Za ugotavljanje razlik v fiziologiji smo od vseh fizioloških odzivov v eksperimentalnih pogojih in kognitivnih nalogah odšteli odzive, izmerjene v stanju mirovanja.

3. REZULTATI

3.1 Primerjava različnih eksperimentalnih pogojev

3.1.1 Fiziološki odzivi v vseh štirih eksperimentalnih pogojih

Udeležencem smo, medtem ko so reševali kognitivne naloge in vozili avtomobil, merili različne fiziološke odzive. Rezultati so prikazani v Tabeli 1.

Tabela 1. Opisna statistika fizioloških mer (v primerjavi s stanjem mirovanja) v štirih pogojih (N = 39)

		M	*SD*		*M*	*SD*
Srčni utrip		4,42	7,88		6,13	7,66
SCL	Pogoj 1	0,44	1,45	Pogoj 2	0,64	1,63
SCR	(K– F–)	10,85	10,33	(K+ F–)	6,98	7,80
Temp. k.		0,55	1,47		0,31	1,35
Srčni utrip		8,53	7,10		5,32	6,25
SCL	Pogoj 3	0,51	1,53	Pogoj 4	0,49	1,28
SCR	(K+ F+)	8,80	7,61	(K– F+)	10,15	8,20
Temp. k.		0,06	1,60		0,55	1,57

Pogoji so se med seboj statistično pomembno razlikovali v srčnem utripu, $\chi^2(3) = 24{,}29$, $p < {,}001$, v prevodnosti kože (SCR), $\chi^2(3) = 8{,}32$, $p = {,}040$, in temperaturi kože, $\chi^2(3) = 13{,}09$, $p = {,}004$. Tabela 1 prikazuje rezultate Wilcoxonovega post hoc testa za preverjanje enakosti fizioloških odzivov med posameznima dvema pogojema (meja statistične pomembnosti je $p = {,}050 / 6 = {,}008$).

Tabela 2. Primerjava fizioloških odzivov v štirih pogojih (rezultati Wilcoxonovega post hoc testa in Cohenov d)

		1-2	1-3	1-4	2-3	2-4	3-4
srčni	*Z*	–1,91	–4,54	–0,78	–3,73	–0,29	–3,99
utrip	*p*	,056	< ,001	,435	< ,001	,769	< ,001
	d	–0,61	–1,50	–0,34	–0,88	0,30	1,24
SCR	*Z*	–2,97	–1,31	–0,41	–1,81	–2,76	–1,66
	p	,003	,190	,679	,070	,006	,097
	d	1,28	0,69	0,23	–0,65	–1,12	–0,48
	Z	–2,19	–2,57	–0,84	–0,54	–1,83	–2,70
Temp.	*p*	,028	,010	,933	,586	,068	,007
	d	0,20	0,20	0,00	0,21	–0,16	–0,39

Pogoj 3 se je od vseh ostalih pogojev statistično pomembno razlikoval v srčnem utripu; pri vseh treh parnih primerjavah je šlo za velik učinek pogoja. Srčni utrip je bil torej najvišji v primeru, ko so udeleženci reševali kognitivne naloge, fizična obremenitev pa je bila višja (K+ F+), najnižji pa nasprotno ob najnižjih obremenitvah (K– F–). Pri parnem primerjanju ostalih pogojev

sicer nismo našli statistično pomembnih razlik, ne smemo pa zanemariti majhne in srednjih velikosti učinka v teh primerjavah. Tudi parne primerjave prevodnosti kože (SCR) v različnih pogojih je pokazala na majhne, srednje ali velike velikosti učinka, vendar sta statistično pomembnost dosegli zgolj razliki med pogojema 1 in 2 ter pogojema 2 in 4. Vendar pa je bila za razliko od srčnega utripa prevodnost kože (SCR) najvišja ob kognitivno in fizično najlažjem pogoju, nižja pa v pogojih z višjimi obremenitvami (pogoja 2 in 3). V lažjih pogojih je temperatura kože udeležencem bolj naraščala kot pa v pogojih z višjimi obremenitvami. Vseeno pa med pogoji ni bilo statistično pomembnih razlik, razen med 3 in 4, ki sta se razlikovala po prisotnosti/odsotnosti kognitivnih nalog. Razlikovala sta se tudi v majhni velikosti učinka. Vpliv fizične obremenitve je bil majhen oz. ga sploh ni bilo, če primerjamo pogoj 1 s pogojem 4 (ki sta bila oba brez kognitivnih nalog, z različno fizično obremenitvijo).

3.1.2 Subjektivne ocene v vseh štirih pogojih

Tabela 3. Opisna statistika ocen zanimivosti (Z), vživetosti (V), nadaljevanja igre (N) in težavnosti (T) v pogojih (N = 43)

		M	*SD*		*M*	*SD*
Z		7,37	2,21		8,56	1,3
V	Pogoj 1	7,23	2,48	Pogoj 2	8,30	1,37
N	(K– F–)	6,65	2,64	(K+ F–)	7,74	1,94
T		4,44	2,51		7,00	2,04
Z		8,21	1,61		7,67	2,09
V	Pogoj 3	8,40	1,68	Pogoj 4	7,51	1,98
N	(K+ F+)	7,58	2,17	(K– F+)	6,63	2,34
T		7,12	2,00		5,86	2,14

Pogoji se statistično pomembno razlikujejo v zanimivosti, $\chi^2(3) = 33{,}31$, $p < {,}001$, vživetosti, $\chi^2(3) = 13{,}63$, $p = {,}003$, želji za nadaljevanje igranja, $\chi^2(3) = 23{,}34$, $p < {,}000$ in težavnosti, $\chi^2(3) = 50{,}00$, $p < {,}001$. Pregled Tabele 4 nam razkrije, da so med pogoji brez kognitivnih nalog in pogoji s kognitivnimi nalogami (1–2, 2–4, 1–3, 3–4) v večini primerov statistično pomembne razlike. Meja statistične pomembnosti je $p = {,}050 / 6 = {,}008$. Razlike se pojavljajo pri primerjanju pogoja vožnje brez nalog (pogoja 1 in 4) s pogojem vožnje z nalogami (pogoja 2 in 3) v primeru, ko je bila fizična obremenitev pri obeh tako enaka kot različna.

Tabela 4. Primerjava subjektivnih ocen med pogoji (rezultati Wilcoxonovega post hoc testa in Cohenov d)

		1-2	1-3	1-4	2-3	2-4	3-4
	Z	–4,44	–3,32	–1,73	–2,20	–3,36	–2,34
Z	*p*	< ,001	,001	,084	,028	,001	0,02
	d	–0,66	–0,43	–0,14	–0,24	0,51	0,29
	Z	–3,06	–3,25	–1,08	–0,86	–2,35	–2,45
V	*p*	,002	,001	,278	0,388	,019	0,01
	d	–0,49	–0,51	–0,09	0,07	0,43	0,48
	Z	–3,91	–2,86	–0,41	–0,93	–3,44	–2,85
N	*p*	< ,001	,004	,685	,351	,001	,001
	d	–0,47	–0,38	0,01	–0,08	0,52	0,42
	Z	–4,66	–4,61	–3,79	–0,09	–2,98	–3,25
T	*p*	< ,001	< ,001	< ,001	,931	,003	,001
	d	1,12	1,18	–0,61	0,06	–0,55	–0,61

Velikosti učinka v primerjavi pogojev 1 in 2 preko ocen zanimivosti, vživetosti, želje po nadaljevanju igre in težavnosti so pokazale na srednje do velike razlike. Udeleženci so npr. težavnost pogojev s kognitivnimi nalogami ocenili kot izrazito višjo kot pa težavnost pogoja, kjer so samo vozili avtomobil. To pomeni, da ima prisotnost oz. odsotnost naloge pomembno vlogo pri dojemanju igre kot težje oz. lažje. Enako lahko rečemo za ostale tri vrste ocen, le da je bil učinek manjši kot pri težavnosti. Če primerjamo še drugi pogoj brez kognitivnih nalog, torej pogoj 4, s pogojem 3, kjer kognitivne naloge so (pri obeh pa je enaka fizična obremenitev), prav tako pridemo do podobnega zaključka, torej o pomembnem vplivu kognitivnih nalog, le da je velikost učinka tu manjša (od majhna do srednje velika). Vpliv fizične obremenitve ni tako pomemben kot vpliv naloge, saj primerjava pogojev z različnimi fizičnimi obremenitvami (npr. 1 in 4 ter 2 in 3) ne pokaže niti na majhen učinek.

3.1.3 Povezanost fizioloških parametrov, subjektivnih ocen in natančnosti vožnje pri različnih eksperimentalnih pogojih

V veliko primerih so bile korelacije zelo nizke, nekaj pa je bilo šibkih in srednje visokih. Npr. v pogoju 2 (K+ F−) je bila opaznejša korelacija med odklonom od poti in željo po nadaljevanju pogoja, $r = {,}34$, $p = {,}024$, enako tudi med odklonom od poti in zanimivostjo pogoja, $r = {,}32$, $p = {,}036$. To pomeni, da slabše kot so udeleženci izvajali gibalno vajo, bolj jim je bil pogoj zanimiv in bolj so si želeli, da bi nadaljevali z igranjem računalniške igre v pogoju, kjer so bile prisotne kognitivne naloge in manjša fizična obremenitev. Prevodnost kože (SCL) v pogoju 1 (K− F−) je srednje visoko korelirala s subjektivno oceno zanimivosti pogoja, $r = {,}44$, $p = {,}005$, in željo po nadaljevanju igre, $r = {,}48$, $p = {,}002$. Tudi v pogoju 2 je bila povezana z oceno zanimivosti, $r = {,}42$, $p = {,}007$. Povezave kažejo na to, da prevodnost kože (SCL) v določeni meri odraža motiviranost udeleženca pri igranju igre. Prav tako je bilo najti korelacije med srčnim utripom in natančnostjo vožnje – v pogoju 1, $r = –{,}57$, $p < {,}001$, in pogoju 2, $r = –{,}45$, $p = {,}004$. Srčni utrip se je torej povečal v primeru, ko so bili udeleženci manj natančni pri opravljanju svoje naloge in s tem verjetno tudi bolj anksiozni. Lahko zaključimo, da slabše kot so udeleženci izvajali gibalno vajo, bolj jim je bil pogoj zanimiv in bolj so si želeli, da bi nadaljevali z igranjem računalniške igre v pogoju, kjer so bile prisotne kognitivne naloge in manjša fizična obremenitev.

3.2 Primerjava tipov kognitivnih nalog, predvajanih v pogoju z nizko fizično obremenitvijo

3.2.1 Pravilnost odgovorov pri različnih tipih nalog

Udeleženci so statistično pomembno bolje reševali naloge sopomenk v primerjavi z ostalima dvema nalogama, sploh v primerjavi z računi. Pravilnost odgovorov je povezana s težavnostjo naloge, zato sklepamo, da so bile sopomenke najlažja, slike malo težja in računi najtežja naloga.

3.2.2 Fiziološki odzivi pri posameznih tipih nalog (relativno glede na stanje mirovanja)

Srčni utrip se je pri različnih vrstah kognitivnih nalog statistično pomembno razlikoval, $F(1{,}78, 71{,}38) = 4{,}10$, $p = {,}024$. Najvišji je bil pri računih, nižji je bil pri zrcaljenju slik in najnižji pri sopomenkah. Rezultati za prevodnost in temperaturo kože ne kažejo statistično pomembnih razlik med nalogami.

3.2.3 Subjektivne ocene vseh tipov nalog

Račune so udeleženci zaznali kot statistično pomembno manj zanimive od ostalih dveh nalog, hkrati pa tudi težje. Vendarle pa zanimivost računov ni bila tako nizko ocenjena (povprečje točk je bilo nad 7 od 10 možnih), zato jo lahko obravnavamo kot zanimivo nalogo), prav tako sopomenke in slike. Naloge so bile v povprečju ocenjene visoko (nad 7 točk od 10 možnih) tudi glede vživetosti in želje po nadaljevanju igre.

3.2.4 Povezanost fizioloških parametrov, subjektivnih ocen, natančnosti vožnje in pravilnosti odgovorov pri različnih tipih kognitivnih nalog

Preverjali smo, ali obstaja povezava med fiziološkimi odzivi in na drugi strani zanimivostjo nalog, vživetostjo vanje, željo po nadaljevanju igre z določeno nalogo ter zaznano težavnostjo nalog. V večini nismo našli pomembnih povezav. Omeniti pa moramo dve korelaciji – med srčnim utripom in vživetostjo v reševanje nalog zrcaljenja slik, r = ,35, p = ,024, in srčnim utripom ter željo po nadaljevanju reševanja že omenjenih nalog, r = ,35, p = ,025. Z drugimi besedami, bolj kot so bili udeleženci motivirani in prisotni v igri, višji je bil srčni utrip. Tudi v primeru koreliranja fizioloških mer z natančnostjo pri vožnji in številom pravilnih odgovorov glede na nalogo večina korelacij ni bila pomembno visokih, razen korelacija med odklonom in srčnim utripom v primeru sopomenk, r = –,54, p < ,001, in računov, r = –,40, p = ,010. Korelaciji pomenita, da je udeležencem ob slabši vožnji bolj narastel srčni utrip. Najti je moč tudi srednje visoke korelacije med odklonom in vživetostjo v naloge sopomenk, r = ,46, p = ,002, računov, r = ,45, p = ,002, in slik, r = ,34, p = ,047.

4. RAZPRAVA

V večini primerov pomembnih korelacij med različnimi merami fizioloških odzivov in motivacijo ter prisotnostjo ni. Izjema je prevodnost kože (SCL), ki je v dveh pogojih v manjši meri pozitivno korelirala z motiviranostjo udeleženca pri igranju igre. Kar nekaj raziskovalcev je našlo povezavo npr. med doživljanjem zabave in povišanjem prevodnosti kože (pregled v [4]), kar se sklada z našimi ugotovitvami, vendar pa jih je nekaj poročalo tudi o znižanju prevodnosti kože.

Več skladnosti z literaturo najdemo v analizi srčnega utripa. Ta je v dveh pogojih in dveh nalogah srednje visoko koreliral z natančnostjo vožnje (ob večjih odklonih vožnje od sredine poti je narastel). Udeleženci so bili ob slabši vožnji bolj vzburjeni. Z zvišanjem srčnega utripa se povezuje dvig vzburjenosti organizma [4]. Srčni utrip je srednje visoko koreliral tudi z vživetostjo in željo po nadaljnjem reševanju nalog zrcaljenja slik. Višji srčni utrip torej, kot kaže, ni povezan samo z anksioznostjo, ampak tudi z motivacijo in prisotnostjo v nalogi. Prav tako je višji utrip odražal višji kognitivni in fizični napor, nižji pa manj zahtevne pogoje. Udeleženci so imeli ob najtežji nalogi (računih) najvišji srčni utrip in ob najlažji (sopomenkah) najnižjega.

Bolj kot natančnosti vožnje so udeleženci morda pozornost posvečali nalogam, saj so subjektivne ocene nalog srednje visoko korelirale z vživetostjo pri kognitivnih nalogah. Slabše kot so udeleženci kontrolirali robotsko roko za krmiljenje avtomobila, večji je bil njihov občutek, da so del navidezne resničnosti (igre). Predvidevamo, da so se bolj vživeli v kognitivne naloge in s tem zanemarili vožnjo po sredini ceste. Vživetost v igro je sicer pokazatelj dobro pripravljene virtualne resničnosti in vztrajanja v rehabilitaciji [8], vendar pa ne smemo pozabiti, da je cilj rehabilitacije dvigniti gibalne sposobnosti na višji nivo.

V nadaljnjih raziskavah predlagamo dovrševanje računalniške igre, bogatejše dražljaje ter preizkus še drugih kognitivnih nalog. Razmisliti bi bilo tudi treba, kako večkrat zapored zanesljivo in veljavno meriti motiviranost in prisotnost med meritvami. Za merjenje fizioloških odzivov predlagamo uporabo srčnega utripa, ki se je izkazal kot najbolj občutljiv na različne kognitivne naloge in pogoje, korelira pa tudi z motivacijo in prisotnostjo. Predlagamo tudi merjenje EKG-ja na gibalno manj aktivnih delih telesa in daljši časovni interval izvajanja posameznih nalog, da bi se spremembe temperature lahko bolj veljavno odrazile. Pomembno je, da v nadaljnjih raziskavah sodelujejo bolniki, ki potrebujejo rehabilitacijo. Ti bi verjetno bili bolj motivirani za (natančno) opravljanje gibalnih vaj kot pa zdravi.

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Semantic Implication of Traditional Values in Conscience of Modern Teenagers[1]

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ABSTRACT

The article presents comparative analysis results pertaining to ingrained functionality demonstrated by Russian, Slovenian, and Slovak teenagers in explanation of the commandment *Love Thy Neighbor As Thyself*. In the present article, the authors do not detect any desemantization elements to the traditional Christian virtue and ask the question *What is going to happen to Europe, Russia, and world tomorrow?* They also hope that next generations aim at friendship and mutual understanding, and are ready to learn of each other, understand, and accept.

PREFACE

Let us define a discourse as the aggregate of actualized connections to reality and consider the process taking place inside its axiological component. As it is known, concepts of reality and values themselves are ephemeral. The things that were sacred for majority yesterday seem to be trivial today. To European civilization, the Christian commandments have remained the most durable for a long time despite the test of time, e.g. "the refugee crisis" that caused confusion within the EC.

The decision by Angela Merkel, a member of CDPG, to invite a million of refugees to the country did it shatter Europeans' confidence in consistency of traditional virtues? Certainly, the German Chancellor was pushed towards that act by necessity to solve economic, social, and political issues faced by the country. However, "invasion" instead of disciplined emigration in German tradition allows assuming that this decision was determined not only by the course of history that declared Germans guilty. Getting to the worldview structure [6], one can see that this decision, most probably, has originated from the worldview religious level (society consciousness), the level that is responsible for emotions and assessment of moral condition and actions of individuals or environment. Thence there is a wish to act in accordance with Christian nurture i.e. to help the destitute in defending the suffered, etc. Undoubtedly, such action the political leader to Europe -- which first passed a way of "God-deprivation" [2] that «does not exclude religious commitment; on the contrary, thanks to her, attitude towards gods for the first time becomes a religious experience» [2] -- seemed not only normal but the only one possible. Responding to the German leader's call, the Europeans prepared for refugee admission: they provided meals, rendered medical care to diseased, brought warm clothes and food, vacated trains and buses for them… until the unavoidable culture clash happened. Regardless of what this crisis results in, the Europeans have faced a problem of "what's next?" What "old" and "new" inhabitants of the Old World may count upon? Is the commandment *Love thy neighbor…* still valid for contemporary efficient population?

The purpose of our research has been to detect evidence of desemantization of the commandment *Love thy neighbor as thyself* in Slavic languages and the native language speakers' perception.

The semantic-and-style method used for processing the questionnaire data includes statistical and comparative analyses.

The desemantization (Latin prefix *de-* means *removal*; Greek *sћmantikos* means *having significance*) is the process of losing the word meaning.

One of the monotheistic world's traditional values expressed by the phraseological unit *Love thy neighbor as thyself* (Leviticus, 19:18) its semantics is derived as a sum of component meanings.

As it is known, a personality is formed mostly by his/her family; moreover, a young person between ages of 10 and 13 -- when it comes time to have an independent opinion -- becomes a translator of values acknowledged by parents and closer family members and formed in school. The growing person "follows carefully everything that is disapproved or approved. …actions on demand are approved, but in case the others dislike them, the person is made to correct his actions by observing the others" [5].

Neurophysiologic research results indicate that the human brain completes its development by age of 20-22, and only then, it is possible to speak of e.g. responsibility for the said words [3]. Answers to our questionnaire correlate to opinion by certain part of population of Russia, Slovenia, and Slovakia. These countries are Christian. Slovenia and Slovakia are populated with Catholics mostly, and Russia with Orthodox Christians, although most of the population is still unchurched. However, churched citizens may be considered virtually Christians in orthodox way.

The research was conducted for children and teenagers of 10-13 years old from three cities: Saint Petersburg, Russia; Košice, Slovakia; and Ljubljana, Slovenia. In total, 150 persons joined the study: 87 in Russia, 33 in Slovenia, and 30 in Slovakia.

The following questions were asked: Are you familiar with the commandment *Love thy neighbor as thyself*? How do you understand the word "*love*"? Whom can you call your neighbor? And more? In your opinion, can we call all the people on the planet the neighbors? Why do you think so? Whom would you like to exclude from "neighbors"? What can make a person be your neighbor? What in your consciousness prevents you from accepting a person as your neighbor? Who can help a person to overcome prejudice against *another*?

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FUNCTIONING OF PHRASEOLOGICAL UNIT *LOVE THY NEIGHBOR AS THYSELF* IN SLOVENIAN AND SLOVAK LANGUAGES

The question *Are you familiar with the commandment "Love thy neighbor as thyself"?* was answered *No* by a single Slovenian kid, which amounts to 3% of 33 respondents. All Slovak schoolchildren are familiar with the commandment. The question *How do you understand the word "love"?* was answered variably and the most frequent answers by Slovenians are: *as the word "dear"* and *the person I love*, 27% each; there were also answers: *become his/her friend* and *the one who I consider mine or respect*, 18% each. There were interesting isolated answers that cannot be accounted for this study: *the one who supports you*, *the one whom I think highly of*. Slovaks' answers were vaguer, but still more definite: *love*, answered 27% schoolchildren; verb *to love* was used by another 40%. The above amounts to 67% of all answers. Answers *God, Jesus loves us, love God* amount to 17%. One interesting isolated answer is: *to help each other*.

The Russian verb *любить / возлюбить (obsolete) / the same as полюбить* [7] (to love) as well as corresponding Slovenian *ljubiti / rad imeti* and Slovak *milovat'* all have the same meanings: 1. Deep affection, strong gut feeling; 2. Deep disposition towards someone/something, self-sacrificing and sincere devotion; 3. Permanent strong addiction, enthusiasm for something; etc. Collins English Dictionary gives similar definitions: **to love**: 1. to have a great attachment to and affection for; 2. to have passionate desire, longing, and feelings for; 3. to like or desire (to do something) very much; etc.

Orthodox and Catholic theologists define love as something high-spirited and self-sacrificing. "The love that Christ brought into our world has another new and more spiritual meaning: it is the love as Jesus understood it, sacrificing one's life for neighbors" [8].

As we can see, understanding of the term by Slovenian and Slovak schoolchildren is very close to that describe in dictionaries. All shades of meaning that respondents mentioned in their answers may be found in First Epistle of Paul the Apostle to the Corinthians, Chapter 13 [9].

To the question *Who can you call your neighbor?* Slovenians named their family members and relatives (64% respondents), *friends* and *those who are close to me* (27% respondents); *everyone* (18%). Slovak schoolchildren rather repeated the same answers: *family* was chosen by large majority (73%); and *classmates* (23%). Some Slovaks mentioned God as their neighbor (13%), that Slovenians failed to do. Since the respondents mentioned several neighbors, total sum is over 100%; *friends* were mentioned in 10% answers.

To the question *And more?* Slovenians answered: *acquaintances and friends*, 27%; *relatives*, 18%; *God*, 18%; *no answer*, 31%. Slovak students added to neighbors: *family*, 27%; *classmates*, 33%; *friends*, 20%. 13% pollees consider God their neighbor. Among isolate answers, we can mention: *those who I can trust / to whom I have deep friendly feelings / all classmates except for the Gypsies*. Although some Slovaks' classmates are Gypsies who are treated negatively, probably due to some adults' disparagement, only Slovaks distinguish the special group of classmates. Slovenians speak of friends only.

The question *Can we call all the people on the planet the neighbors?* was answered *Yes* by 18% Slovenian respondents, *No* – by 54%; *all kind ones* – by 3%. No answer was received from 26%. Slovak respondents slightly differ from their Slovenian colleagues. Their answers are: *yes, because we belong to the same family, 33%; no, it's hard* / *no, because some of them are evil people / no, because they have their own families / no, because not all of them are my relatives or friends*, 60%. 7% respondents have given no answer. As we can see, the most complicated component of the phraseological unit in question is not desemantized. It has absolutely the same meaning as in religious texts, without any semantic addition. Despite solitary rejection of other ethnic groups, Slovak respondents are more susceptible -- than Slovenians -- to the idea of calling all people the neighbors.

The latter question and the following ones were introduced to clarify presence or absence of phraseological unit spiritual value desemantization and called for thinking over the idea contained in the commandment.

The question *Why do you think so?* was answered by Slovenian schoolchildren as follows: *kindness connects us*, 18%; *for we all are the same*, 18%; *because some of the people are not good ones*, 27%; *because I don't know them,* 18%; *because we cannot trust everybody*, 10%. Of isolated answers, one is interesting: *all people are valuable.* Slovak children answered: *for we are all the same, 26%; because some of the people are not good ones*, 10%; *because I cannot embrace the whole planet / they are not my family / I don't know,* 10% each; *no answer*, 50%.

The question *Who would you like to exclude from "neighbors"?* was answered by Slovenian schoolchildren in typical ways: *thieves and villains*, 27%; *those who are against me because I don't know them / strangers / those who sins / those who doesn't like me / nobody*, 3% each; there were also unexpected answers: *relatives* and *friends*, 18% each; no answer, 9%. Here are some single answers: *Japanese, they are far away; Chinese*. Slovak children have a different approach to the world: *nobody*, 23%. Single answers include: *terrorists; some of the classmates; Gypsies.* In their answers, Slovenian kids apparently tend to substitute concept of *neighbor* by *nearby*. Here we can again observe negative attitude to other ethnic groups: "bad ones" are Japanese and Chinese for Slovenians, and Gypsies – for Slovaks. Such answers are solitary.

Slovenians' answers to the question *What should happen to make a person your neighbor?* include: *it is necessary to become friends*, 36%; *to do good, to trust*, 9%; *to know him/her better*, 36%; *we have to confide in each other*, 6%. Here are some single answers: *wonder*; *he should feel affection to me.* Slovak students are sure that: *he has to be tender/happy*, 7%; *he has to protect me / help me / play with me / take care of me / be close to me / to love me* and *to be a Christian*, 13%. *Kind*, 43%; *well-mannered*, 10%; *sweet*, 17%; *having a nice heart*, 7%. Here are some single answers: *merciful; with God in his heart*. Note the "ought to" focus shift from the subject to the object: someone else ought to, not me.

Slovenians' answers to the question *What in your consciousness prevents you from accepting a person as your neighbor?* include: *nothing*, 27%; *hostility*, 18%; *deception*, 9%. There are some interesting isolated answers: *temper*; *his malignity*; *that we cannot understand his malice*; *we see the world differently; ill acts; he is misbehaving;* no answer, 18%. Slovak kids answered somewhat differently: *I don't know*, 10%; *they are bad and proud*, 17%. There are a lot of solitary answers, among those: *he is a friend of someone I don't like / his behavior / he is Gypsy / if he hates each another / he cheats / he has no good heart / they are lazy / he's bad: he doesn't love me / he is unjust, greedy, criticizes other people*. These are sincere answers by little persons who are sure that relationship concord is spoiled by external reasons only. Surely, this is result of children's perception of the world where the child is the center of his/her family, society, and the Earth. But how soon this naïve egocentrism will disappear from minds of adult people, parents, politicians?

The question *Who can help a person to overcome prejudice against* another*?* Slovenian respondents answered: *relatives*, 27%; *God / friends*, *family*, *truth / has to know Him*, 18% each. Among solitary answers: *all together*. Slovak respondents answered: *angels*, 17%; *Mary*, 10%; *God*, 60%; *Jesus*, 37%; *senior priest*, 7%; family, 10%; *neighbor*, 10%. Interesting isolated answers: *has to know Him; truth.*

Answers by Slovenian and Slovak students demonstrate no desemantization of the entire phraseological unit or its components. When discussing the commandment's essence, there is substitution of action subject for object. The Scripture says that your neighbor is not only the one who cares about you (Luke 10; 25-37), but also the one whom you should care about. The students' answers show that the former is more important than the latter. Schoolchildren are sure that to make humankind to feel like a monolithic society it is necessary for people to get closer, be friends, know each other better, do good to each other; but the other should also protect, help, play (that means "to be a friend"), care, be close, and love. Many pollees are not prevented from acceptance another for his/her neighbor at all, but it has to be a Christian. Some isolate answers indicate seedlings of nationalism.

FUNCTIONING OF PHRASEOLOGICAL UNIT "LOVE THY NEIGHBOR AS THYSELF" IN RUSSIAN LANGUAGE

Without a doubt, the "God-deprivation" process goes on with variable success. Science and modern technologies on the move greatly facilitate it. For example, our study has demonstrated that in Russian mega-metropolis, despite the introduction of mandatory school course "Basic principles of religious culture and secular ethics", over than half of the respondents are not familiar with the commandment in question, whereas in the provincial Slovak town all students know the commandment. In more educated Slovenia [11], where we questioned students from the capital city and provincials both, there was received only one negative answer to the question *Are you familiar with the commandment?*; but answers by other respondents (3 students of 6th grade) make clear that *Yes* answer does not always reflect the real situation. In some cases, the pollees know the commandment itself, but they never bothered about it.

Of Russian high-school students, 87 persons participated in the study: 59 fourth-graders and 28 fifth-graders. 57.5% Russian schoolchildren are not familiar with the commandment "Love thy neighbor as thyself", and 42.5% are familiar, accordingly.

For this reason we have divided the pollees' answers into YES-group (those who are familiar with the commandment) and NO-group (those who are not) to make assessment if the results demonstrated by secular-educated children differ from those by children brought up as a Christian.

First question, *How do you understand the word "love"?* In YES-group, the verb "*love*" was the most widely used and variably presented in 43% answers; *respect;* 17%; *to accept the person, his/her point of view, etc.*, 14%; *to be friends*, 34%; *family relations, treat as yourself, good fellowship, equal attitude to all people*, 18% total. Single answers: *commence listening.*

In NO-group, the answers were as follows: answers including the name *"love"* amount to 52%; *to catch fancy, friendship*, 6% each. Single answers include: *understand, get to know*. Table 1: Answers to question *How do you understand the word "love"?* by YES-group and NO-group

Answers to the question *Whom can you call your neighbor?* by YES-group: *family/ relatives*, 63%. *Friends*, 37%; *people of Russia / all of the people around / all people / all people are alike*, 6%. Answers given by NO-group: *relatives*, 71%; *friends*, 17%; *those who are spiritually close to me*, 7%.

Answering first and second questions both, NO-group disregarded friendship. As opposed to those who are familiar with the commandment and indicate friends and friendship (37%), the pollees who answered *No* to the first question indicate friends only in 17% answers. In other cases results of two groups show little difference.

The question *And more?* was answered as follows: *friends* was again the most popular answer in YES-group with 37%, and in NO-group it amounts to 25%. The answers make clear that the students intuitively correctly divide *neighbors* into outer circle and inner circle. *Relatives* and *acquaintances* received 14% each. 5% answers mention animals and 8% pollees give no answer to this question. In NO-group leading answers are: *relatives*, 31%; *nobody*, 25%; *classmates*, 20%; *everybody*, 13%. Some of isolated answers include: *teachers, coaches; those who are attached to me; God; those who are not against us; those who understands us*.

Pay attention here to 13% answers containing word *everybody* in anticipation for the next question.

Answering to the question *Can we call all the people on the planet the neighbors?*: agreed to include *all the people*, 20%; *no*, 70%; *yes, but not all of them*, 3%; *yes and no*, 7%. The answer "*yes and no"* was accompanied with the following comments.

In YES-group, practically all the answers complement one another: *all of us are alike*, 51%; *we all trace origin from the same entity*, 27%; *all of us are people*, 10%; *we all live on the same planet*, 8%.

Isolated answers are also aligned: *we have to help one another; we are a chain of acquaintances and everybody knows everybody; we can change the bad people; because we all live on the same planet*. In NO-group, the answers comprise: *we are not acquainted*, 45%; *some people are ruthless/wicked*, 14%; these answers pretty stay within traditional child-rearing practices. Interesting is the solitary answer: *mercenaries, killers, collectors* that witnesses that the kid is involved in modern society information realm and these widely discussed topics could not help but sticking in the kid's mind. *All of us are different*, 5%; *scum of society / I don't like them*, 4% each.

Neighbor category should exclude: *nobody*, 23%; the categories excluded most frequently are *scum of society*, 20%; *strangers*, 10%; *enemies*, 10%. 5% answers contain ambiguous information: *everybody except for… traitors / those who don't understand me / who treats be badly / everybody whom I don't love,* 7% each..

Most of the pollees understand that to make a person your neighbor it needs: *to make friends with him/her* (26%); *to get to know another* and *to win confidence*, 10% each; *consensus / to get through hard times together / intercommunication*, 8% each; *confidence* and *to prove that I'm worthy of friendship*, 7% each. However, there are some answers that shift the responsibility for getting closer entirely to other shoulders: *to change the other's temper/behavior*, 5%; *he has to do something for me*, 5%; *he has to be liked by me / he has to become my own one / the person has to change*, 7% each. Of singular answers worth mentioning: *good deeds; equality; to make friends with me*. Note that Russian schoolchildren's have given more answers where responsibility for actions is undertaken by respondent than Slovenians and Slovaks, yet it is obvious that here again subject to object relationship leave much to be desired.

Acceptance of another person is also hindered by: *uncertainty on positive attitude*, 19%; *nothing*, 7%; the same percentage *he's bad,* 7%; *stranger / mistrust / wariness*, 7% each; *lack of friendship*, 5%. Answers to this question reflect doubts and reflections over this issue or it may be brought up by discussion during a social science lesson. Children again, like Slovenians and Slovaks, lodge claims to another person: *he's bad / I don't know him / I don't trust him,* etc., but there are also signs of thinking: thus, *uncertainty of positive attitude* was mentioned by 19% respondents. Note that singular answer: *wider public*. It is hard to remain Christian-way tolerant in the atmosphere of total mistrust.

The question *Who/what can help a person to overcome prejudice against another?* shifted kids' minds to constructive stand. 29% answers indicate *friendship*, but responsibility is pinned entirely to *the person-actor*, 22%. 16% still bank on *neighbor*. 5% answers each describe fairly grown-up thinking: *confidence, understanding*, and *psychology*. Yet 3% answers reflect fatality in Russian way: *nobody*.

CONCLUSION

The conducted research allows for the following results:

- Neither of the polled groups has demonstrated desemantization of main idea of biblical commandment **"**Love thy neighbor as thyself";
- Slovenian, Slovak, and Russian schoolchildren understand words "love" and "neighbor" in full compliance with basic ideas of Catholic and Orthodox churches and secular society brought up within European civilization;
- Secular education with addition of course in "Basic principles of religious culture and secular ethics" allows thinking over essential questions of life without emasculating moral bearings.

We can be sure that next generations aim at friendship, mutual understanding, are ready to learn of each other, understand, and accept. Let us give them that chance!

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Problematičnost integracije nevroznanosti v pravne kontekste

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POVZETEK

V prispevku bom najprej predstavil porast vključevanja nevroznanosti v pravo (npr. uporabe nevroznanstvenih dokazov na sodišči) in na nekaterih primerih prikazal zaupanje, ki ga vzbujajo nevroznanstveni dokazi, razlage in opisi. Zagovarjal bom stališče, da moramo biti pri združevanju objektivistične in redukcionistično usmerjene nevroznanosti ter prava, ki temelji na vrednotah in odločitvah odločevalcev in javnosti, previdni. Namreč, nevroznanost v svojem raziskovanju pojavov, ki so relevantni za pravo (npr. osebnosti, volicije, samo-kontrole, odločanja, ipd.), in s svojim redukcionistično-mehanicističnim pogledom na človeško naravo spreminja naše intuicije in prepričanja o pojavih, ki jih raziskuje ter s tem vpliva prav na same naštete in sorodne pojave. To drži še posebej v kontekstu naraščajočega trenda integracije nevroznanosti v javno domeno, kot je pravo, ki nadalje spreminja naše intuicije in prepričanja o preučevanih pojavih in tako potencialno spreminja mišljenje ter delovanje ljudi. Pogled nevroznanosti na človeško naravo in integracija le tega v pravne kontekste tako vodita do krožnosti nevroprava, kjer nevroznanost in nevropravo pravzaprav vplivata na same (prihodnje) izsledke nevroznanosti. To pa pomeni, da nevroznanosti ne moremo jemati kot objektivne znanosti o človeški duševnosti in vedenju, na podlagi katere bo pravo končno lahko sklepalo pravilne in nepristrane odločitve.

Ključne besede

Moralna odgovornost, nevropravo, prepričanja, samo-kontrola, svobodovoljna dejavnost.

1. TREND INTEGRACIJE NEVROZNANOSTI V PRAVNE KONTEKSTE: OD NEVROZNANSTVENIH DOKAZOV DO ZAUPANJA V NEVROZNANOST

Uporaba dokazov in izsledkov nevroznanosti v kontekstu prava z namenom boljših in bolj "objektivnih" pravnih odločitev – npr. odločitev o zmanjšanju ali vrsti kazni obsojenih ali odločitev o bolj splošnih zadevah, ki se tičejo kazenske odgovornosti[1] – je v zadnjem desetletju in pol v močnem porastu. Na to kažejo mnoge sodobne analize uporabe nevrobioloških dokazov na sodiščih.

Analiza Farahanyjeve (2016) razkriva močan porast uporabe nevrobioloških dokazov na ameriških sodiščih med letoma 2005 in 2012. Farahanyjeva na primer ugotavlja, da je leta 2012 (250), v primerjavi z letom 2007, več kot dvakrat več pravnih mnenj navajalo nevrobiološke dokaze kot strategijo zagovora kriminalnih dejanj z namenom pokazati, da so možgani tisti, ki so obtoženega (vsaj delno) "prisilili" v dejanje X (Farahany, 2016) in tako le ta ni oz. je manj odgovoren za svoje kriminalno dejanje (glej npr. Church, 2012; Catley, 2016 za specifične primere).

Ne le, da odvetniki obtoženih kriminalnih dejanj uporabljajo nevroznanstvene dokaze v obliki slik raznih jasnih možganskih poškodb, ki jih poskušajo (tudi na podlagi pričevanj nevroznanstvenikov) uporabiti na primer za zmanjšanje trajanja kazni, ampak vedno bolj uporabljajo tudi funkcionalne dokaze (npr. pridobljene s FMR ali EEG tehnikami slikanja možganov). Le ti naj bi na primer kazali, da obsojeni z dozdevno "abnormalno" delujočimi možgani pač naj ne bili ali pa naj bi bili vsaj manj odgovorni za svoja dejanja.

Nadalje, nevroznanstveni dokazi niso uporabljeni le kot strategija zagovora obsojenih na najhujše zločine (kot je npr. umor ali posilstvo), ampak se vedno boj uporabljajo kot orodje za zagovor zločincev obsojenih ropov, prevar in preprodaje mamil. Farahanyjeva (2016) v svoji analizi ugotavlja, da je slednjih primerov približno 60 %. Čeprav je njena analiza omejena na ZDA, porast uporabe nevroznanstvenih dokazov na sodiščih ni omejena le nanje ali na države z anglosaksonskim oz. običajnim pravom (angl.: *Common law*), ki temelji na precedenčnih primerih in ki, vsaj v ZDA, v pravne odločitve bistveno vključuje porote, ampak je takšno porast zaslediti v mnogih evropskih in ne-evropskih državah (glej npr. Catley, 2016).

Porast vključevanja nevroznanosti v pravo pa je vidna tudi izven neposredne uporabe nevroznanstvenih dokazov in izsledkov na sodiščih. Vedno več pravnih odločevalcev (tako znanstvenikov kot pravnih ekspertov) se vključuje v diskusije in raziskovanje nevroloških osnov sodnih odločitev in pristranosti, ki jih spremljajo (na primer v diskusije o in raziskovanje mehanizmov presojanja in odločanja porot, sodnikov, prič, odločitev o pogojnih izpustih, ipd.). Prav tako so v porastu raziskave in diskusije o možnostih uporabe FMR ali EEG tehnik za detekcijo laži (v Indiji so bile slednje na primer že uporabljene; glej Church, 2012), o možnostih ustvarjanja direktnih možganskih intervencijskih terapij za zločince, ipd. Na skrajnem spektru

[1] Nevroznanstveni dokazi in izsledki so bili na primer že uporabljeni kot osnova za pravne odločitve, ki se nanašajo na bolj splošne zadeve, povezane z moralno odgovornostjo. V primeru Graham *versus* Florida leta 2012 je vrhovno sodišče ZDA tudi na podlagi nevroznanstvenih dokazov presodilo, da bo kategorično prepovedalo obsodbo mladoletnih oseb na dosmrtno kazen brez možnosti pogojnega izpusta v primerih, ko ne gre za umor (iz Morse, 2015).

uporabe nevroznanosti v pravu je zaslediti trend diskusij in raziskav o t. i. nevro-osnovani predikciji (angl.: *neuro-based prediction*), katere namen je na podlagi podatkov o možganih storilcev kaznivih dejanj vnaprej predvideti potencialno možnost kriminalnih dejanj (za nedavno raziskavo glej Aharoni et al., 2013), tudi npr. v kontekstu odločitev o vrsti kazni, pogojnem izpustu, varščini, ipd. (Jones et al., 2013a). V tem kontekstu si ni težko zamisliti nekakšne distopične prihodnosti, kjer bi bila nevroznanost uporabljena kot orodje za kaznovanje "zločina misli", kot to lepo opiše Orwell v svojem distopičnem romanu *1984*.

Ne nazadnje se zdi, da nevroznanstveni dokazi in razlage v prejemnikih vzbujajo nekakšno posebno zaupanje, ki je po mojem mnenju delno odgovorno za hiter porast vključevanja nevroznanosti v pravne kontekste. Takšno posebno zaupanje je lepo vidno v nekaterih sodnih obravnavah in odločitvah porotnikov. Leta 2005 je bil Grady Nelson obtožen brutalnega umora svoje žene. Njegov odvetnik je zagovarjal zmanjšanje kazni na podlagi QEEG podatkov, ki naj bi kazali na relevantne abnormalnosti v delovanju njegovih možganov, ki naj bi bile – ne pa on sam[2] – odgovorne za njegovo kriminalno dejanje (primer je vzet iz Jones et al., 2013b). Pomenljivo sta v sodnem procesu dva od šestih porotnikov (vse skupaj jih je bilo v sodnem postopku udeleženih dvanajst), ki so glasovali proti smrtni kazni, naknadno poročala, da sta spremenila svoje prvotno mnenje zaradi QEEG dokazov (sprva sta bila za smrtno kazen; iz Jones et al., 2013b).[3]

Vedno boljše in natančnejše razumevanje delovanja možganov, hiter razvoj ne-invazivnih tehnik slikanja možganov in vedno večje zaupanje v objektivistično nevroznanost in njen redukcionistično-mehanicistični pogled na človeško duševnost skratka kaže, da bo nevroznanost v bližnji prihodnosti najverjetneje postala bistven sestavni del prava in njegovih praks, njene razlage duševnosti in vedenja pa čedalje bolj sprejete kot tiste prave, objektivne, najboljše, itd. – znotraj in izven prava.

2. POGLED NEVROZNANOSTI NA ČLOVEŠKO NARAVO IN KROŽNOSTI NEVROPRAVA

Vse do sedaj povedano pa nakazuje, da nevroznanost ni le na poti k temu, da postane neločljivo povezana s pravom, ampak počasi spreminja – in bo najverjetneje v prihodnje še močneje – naše intuicije, poglede in prepričanja na to, kaj pomeni biti oseba, kaj je in kako poteka odločanje, naš pogled na svobodovoljno dejavnost in odgovornost – koncepti, ki so za pravo bistvenega pomena. Kot to lepo izrazi Farah (2012): "Nevroznanost ponuja alternativno perspektivo, iz katere lahko človeško vedenje razumemo tudi kot posledico fizičnih vzrokov. … [U]porabe nevroznanosti … bodo ponudile veliko opomnikov, da je naša duševnost v svojem izvoru in bistvu fizični mehanizem. S tem, ko nevroznanost ljudi postavlja v in kot del mehaničnega univerzuma, prevprašuje mnoge predpostavke o moralnosti in pojmu osebe. … Sicer ne trdimo, 'Ni imel izbire, saj so ga prisilili zakoni fizike'. A vendar bo deterministični pogled, glede na to, da nevroznanost osebnosti, odločanja in nadzora impulzov začenja ponujati bolj podrobne razlage fizičnih procesov, ki vodijo do neodgovornega ali kriminalnega vedenja, vseeno najverjetneje močneje prevzel naše intuicije" (str. 585–586).

In čeprav je nevroznanstvena skupnost *relativno* skeptična do *trenutne* uporabe nevroznanosti na sodiščih in do *trenutnega* dosega nevroznanosti (vendar ne prihodnjega; glej npr. Jones et al., 2014), v splošnem sprejema prepričanje, da bo nevroznanost v bližnji prihodnosti pojasnila "dejansko" delovanje človeške duševnosti na bolj ali manj mehanicističen in redukcionističen način ter da bo priskrbela najboljšo (če že ne popolno) razlago človeškega vedenja (glej na primer Gazzaniga, 2008; Greene in Cohen, 2004; Jones et al., 2013a; 2013b; 2014, za takšen implicitno ali eksplicitno izražen pogled; vendar glej Bennett in Hacker 2003; Morse 2006; 2015; Strle 2013 za kritiko).

Ker pa je bilo že veliko zapisanega na temo kritike objektivističnih in/ali redukcionističnih razlag in metodoloških usmeritev nevroznanosti, se bom v preostanku prispevka zadržal pri stvari, ki je izpuščena iz večine diskusij nevroprava in širše.

Trdil bom, da vedno bolj popularen in sprejet objektivističen in redukcionističen pogled nevroznanosti na človeka (in na pojave, kot so oseba, odločanje, samo-kontrola, odgovornost, ipd.), ki ima, če sploh, zelo malo vpliva na lastno mišljenje in vedenje, pravzaprav spreminja naša dejanja (na slednje nakazujejo tudi raziskave, ki jih bom predstavil v nadaljevanju), prepričanja in intuicije o naštetih pojavih in tako vpliva na same pojave, ki naj bi jih nevroznanost raziskovala objektivno, ločeno od naših prepričanj, teorij in intuicij o teh pojavih: nenavadna krožnost nevroznanosti, ki je izpuščena iz večine diskusij o vključevanju le te v pravne kontekste.

Slednje drži posebej, če vzamemo v zakup porast vedno bolj sistematične integracije nevroznanosti in njenih predstav o duševnosti v javno domeno kot je pravo, ki še nadalje utrjuje in krepi nevroznanstven pogled na človeško naravo ter s tem nadalje spreminja same pojave, ki jih nevroznanost raziskuje dozdevno objektivno, ločeno od naših prepričanj, teorij in intuicij o teh pojavih.

Naj sedaj na kratko predstavim nekaj študij, ki kažejo, kako spreminjanje človeških prepričanj o zadevah, povezanih s človeško dejavnostjo (angl.: *agency*), kot je na primer samo-kontrola, v smer deterministične, mehanicistične in/ali redukcionistične koncepcije le teh, vpliva na samo mišljenje, delovanje in možganske procese, povezane s temi pojavi.

Seminalna raziskava Vohsa in Schoolerja (2008) na primer razkriva, da zmanjšanje prepričanj v svobodo volje zmanjšuje moralnost dejanj: vodi v povečanje dejanskega goljufanja udeležencev. Podobne študije nadalje kažejo, da je zmanjšanje prepričanj v svodobo volje povezano z zmanjšanjem pripravljenosti pomagati sočloveku in s povečano agresivnostjo (Baumeister, Masicampo in DeWall 2009); s povečano nagnjenostjo k impulzivnosti in asocialnosti (Rigoni et al., 2012), kar avtorji interpretirajo kot zmanjšanje samo-kontrole; Rigoni et

[2] Seveda je v kontekstu nevroprava pomembno, a povsem nereflektirano vprašanje, kdo sploh naj bi bil Grady Nelson, oz., kdo sploh je ta »jaz« oz. dejavnik (angl.: *agent*), ki naj bi bila entiteta, odgovorna za (svoja?) dejanja. S tem pa področje nevroprava – predvsem tisti del, ki ni kritičen do nevroznanosti – bolj ali manj sprejema predpostavko, da so možgani pravzaprav tisti bistven (če že ne edini) dejavnik, ki »upravlja« dejanja človeka in nad katerimi le ta pravzaprav nima prav veliko zavestnega nadzora in tako ni, vsaj ne v veliki meri, odgovoren za (lastna?) dejanja.

[3] Številne študije prav tako kažejo, da nevroznanstveni dokazi in opisi dejanj na primer zmanjšujejo pripisovanje svobode volje in moralne odgovornosti (glej npr. Gurley in Marcus, 2008; Nahmias, Coates in Kvaran, 2007).

al. (2011) pa so celo pokazali, da zmanjšanje prepričanj v svobodo volje vpliva na možganske procese (zmanjšuje potencial pripravljenosti), ki so povezani s pripravo voljnih motoričnih dejanj. Implikacije takšnih in podobnih študij lepo izrazijo Rigoni et al. (2011): "Če povzamemo, … to nakazuje, da ima morda abstraktni sistem prepričanj veliko bolj fundamentalen učinek kot bi pričakovala večina ljudi" (str. 617).

Podobno kažejo raziskave t. i. učinka izčrpanosti ega (angl..: *ego-depletion effect*), ki so močno relevantne za nevropravo, saj poskušajo razumeti mehanizme samo-kontrole. Učinek izčrpanosti ega naj bi kazal, da je moč volje (angl.: *willpower*) oziroma zmožnost samo-kontrole omejena (glej na primer Baumeister, 2002) na primer na način, da uporaba samo-kontrole za opravljanje mentalnih nalog vodi v slabše reševanje nadaljnjih mentalnih nalog oz. zmanjšuje nadaljnjo zmožnost samo-kontrole. Po drugi strani novejše raziskave jasno kažejo, da sta učinek izčrpanosti ega in tako samo-kontrola močno odvisni od implicitnih in eksplicitnih prepričanj ljudi o njiju. Savani in Job (2017) sta na primer pokazala, da je učinek izčrpanosti ega močno odvisen od kulturnih prepričanj ljudi o uporabi in naravi samo-kontrole. V svoji raziskavi sta pokazala, da Indijci – ki so v nasprotju z Američani v splošnem prepričani, da naprezanje volje vodi v povečanje (mentalne) energije (to je bil prvi rezultat njune študije) – izkazujejo ravno nasproten učinek od učinka izčrpanosti ega. Namreč, uporaba samo-kontrole Indijcev je, v nasprotju z Američani, izboljšala njihovo nadaljnje reševanje nalog, ki so prav tako zahtevale mentalni napor (takšen učinek so izkazali tudi Američani, ki so imeli podobna prepričanja o naravi samo-kontrole kot Indijci).

Omenjene raziskave skratka kažejo, da pojavi, kot so samo-kontrola, volicija, odločanje, svobodovoljna dejavnost, itd., ki so bistveni sestavni del prava, nikakor niso zgolj biološke narave (oz. jih ni možno razložiti zgolj z biološkimi in/ali nevrološkimi mehanizmi), ampak so pojavi, ki so neločljivo povezani in odvisni od naših konceptualizacij, opisov in prepričanj o njih. So nadalje pojavi, ki so neločljivo povezani s socialnostjo, v katero smo umeščeni in jo so-konstituiramo. To pa pomeni, da posameznikova prepričanja in koncepcije o teh pojavih pravzaprav so-konstituirajo same pojave, ki naj bi jih nevroznanost preučevala objektivno, ločeno od kulturnih in individualnih prepričanj, intuicij in teorij o njih. Posledično nevroznanost s svojimi objektivističnimi in redukcionističnimi metodološkimi usmeritvami in ustrezajočim pogledom na človeško naravo – ki ga, predvsem preko porasta integracije nevroznanosti v javno domeno, kot je pravo, vedno bolj sprejema tudi javnost – pravzaprav spreminja pojave, ki jih preučuje in tako potencialno vpliva na lastne (prihodnje) empirične izsledke.

Če misel izrazimo v jeziku Hackinga (1995), omenjeni pojavi, ki jih preučuje nevroznanost, izsledke o njih pa vedno bolj zvesto uporablja pravo, niso *naravne vrste* (kar bi si želela in kar predpostavlja nevroznanost), ampak *človeške vrste*, ki so bistveno odvisne od klasifikacij, opisov in človeških dejanj, ki se jih tičejo, ter socialnosti, v katero so umeščene, in ki kot take "lahko vplivajo same nase" (po Brinkmann, 2005). Kot je to provokativno izrazil Alasdair MacIntyre (1985; iz Brinkmann 2005): "Vodi je vseeno, kako jo imenujemo, a za človeške vrste je to [bistvena] razlika. Konec koncev, … molekule ne berejo učbenikov kemije, med tem ko ljudje berejo knjige o psihologiji, ki vplivajo na njihovo samo-razumevanje" (Brinkmann 2005, str. 775) in treba je dodati, da tako tudi na njihove razmisleke in moralna dejanja.

V tem smislu ne moremo trditi, da so objektivistične in redukcionistične razlage človeške narave, ki jih podaja nevroznanost, ustrezne ali zadostne, tako v kontekstu prava in izven.

3. ZAKLJUČEK

Če povzamem. Tem bolj nevroznanost sprejema in spodbuja mehanicistično-redukcionističen pogled na človeško naravo in bolj in bolj je le ta sprejet s strani javnost in pravnih odločevalcev – in tako nevroznanost postaja vedno bolj sistematično integrirana v pravne prakse in sisteme —, čedalje bolj mišljenje, možganski procesi in dejanja ljudi odražajo takšno koncepcijo človeške narave. S tem pa, ko bo (bi) opisani proces krožno napredoval in se razvijal, se bo (bi) vedno bolj zdelo, da ima nevroznanost prav v trditvi, da imamo v "resnici" zelo malo (če sploh) vpliva na lastno mišljenje in dejanja (manj, kot bi ga lahko imeli, če bi imeli drugačna prepričanja o človeški naravi) in da smo tako veliko manj (manj kot v "resnici", če bi imeli drugačna prepričanja o človeški naravi) ali pa sploh ne(?) odgovorni za lastna kriminalna ali običajna dejanja.

Če se strinjamo z opisanimi krožnostmi nevroznanosti in nevroprava, nevroznanosti ne moremo (več) jemati kot tiste prave objektivne znanosti o človeški duševnosti in vedenju, ki bo pravu končno prinesla tako dolgo iskani nespremenljivi "temeljni kamen modrosti", na podlagi katerega bo končno lahko sklepala pravilne in nepristrane odločitve. Pri združevanju objektivistične in redukcionistično usmerjene nevroznanosti ter prava, ki temelji na vrednotah in odločitvah pravnih odločevalcev in javnosti, moramo biti tako bolj previdni, kot trenutno nakazuje prikazani trend integracije nevroznanosti v pravne kontekste.

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Zavest in samozavedanje: iluzija ali realnost

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POVZETEK

Razpravljam o pojmovanju zavesti in samozavedanja (jaza) v zahodni filozofiji in v kognitivni znanosti. Ugotavljam spor med realizmom in antirealizmom glede zavesti in jaza, ki se je okrepil v kognitivni filozofiji in razvijam tezo o realnosti zavesti in jaza: človeška zavest in jaz realna le tedaj, če ljudje participirajo na »objektivnem duhu« skupnih situacij, kjer se razvijajo ustrezna skupna pričakovanja.

Ključne besede

zavest, samozavedanje, zavest kot realnost, zavest kot iluzija, skupna pričakovanja

Razprave o zavesti v psihologiji, filozofiji in kognitivni znanosti se skoraj vedno zapletejo v težko razrešljiv vozel nasprotujočih, celo paradoksnih trditev in domnev o tem, ali in kako je možno samozavedanje, ali to implicira obstoj samozavednega sebstva, ki obstaja kot posebno duševno ali mentalno bitje itd. Zavedanje samega sebe je nujna sestavina samospoznanja, to pa je že od antičnih časov temelj vse modrosti, saj nam že Delfsko svetišče narekuje "Spoznaj samega sebe". V evropski filozofiji je bilo to včasih povezano z vprašanjem obstoja (nesmrtne) duhovne duše, ki transcendira človeško snovno (telesno) bivanje. Vendar tudi potem, ko so zaradi kritike religije v razsvetljenjstvu takšne domneve vsaj v znanostih in v velikem delu filozofije postale nerelevantne, ostaja vprašanje, ali in kako obstaja kako samoovedeno sebstvo še vedno odprto. V neevropski filozofiji, predvsem v indijski filozofiji je to vprašanje zlasti pereče v budizmu in hinduizmu, posebno v sankhiji, jogi in vedanti. Zanimivo, da tovrstno spraševanje nikoli ni bilo kaj dosti pereče v kitajski filozofiji, še celo v kitajskem budizmu, npr. chanu ne. Zdi se, kot da Kitajci lahko "shajajo" tudi brez domnev o samo-ovedeni zavesti ali sebstvu, saj ne poznajo niti prave ustreznice za "sebstvo" (self) ali "jaz", še najbližje temu bi bili izrazi "ziran"(samo po sebi), "hsin" (srce, um) ali tudi "zihsing" (lastna narava), vendar običajno nastopajo v povsem drugačnih miselnih povezavah kot v zahodni ali indijski tradiciji.

V zahodni filozofiji je vsaj od Aristotela dalje znana teza o božanskem umu (duhu), ki po svoji naravi "misli samega sebe" (in zgolj sebe), medtem ko je bilo v Antiki človekovo samozavedanje bolj vprašljivo. Platon je v dialogu Harmides celo podvomil o tem, da lahko z miselno dojamemo samega sebe, vsaj če to dojamemo kot vedenje o svojem vedenju [1]. Avguštin je kot krščanski mislec, ki je visoko cenil samospraševanje posameznika, razvijal tezo o človeškem umu kot najvišji plati človeške duše, ki je sposoben samospoznanja na podlagi tega, da se zaveda samega sebe. Ta um je nematerialen in lahko biva sam zase, brez telesa. Auguštin je tudi predhodnik Descartesovega *cogita* „Mislim, torej sem", torej da moje mišljenje implicira priznanje mojega obstoja [2]. Descartes in nato Locke sta temeljna avtorja glede miselnega samospoznanja v novoveški tradiciji. Za Descartesa je bilo preprosto evidentno nujno, da se zavedamo lastnega obstoja, če le kaj mislimo, tudi Locke je menil, da imamo nezmotljivo evidenco o lastnem obstoju, čim se česarkoli zavedamo ali o čem razmišljamo. To je povezano z njegovo tezo o tem, da preprosto neposredno zaznavamo lasten obstoj, tako kot neposredno zaznavamo čutne kvalitete zunanjih stvari ali lastna duševna stanja. Po tem pojmovanju je vsak jaz, ki se "kaže" človeku v njegovem samospoznanju, trden in samoidentičen čisto miselni subjekt in notranji opaovalec njegovih fizičnih in duševnih stanj. Strog kritik *cogita*, teze o nedvomnem zaznavanju lastnega sebe in o jazu kot subjektu doživljanja in mišljenja je David Hume. Za Huma sebstvo ni nič drugega kot sveženj medsebojno zvezanih različnih doživljajev oz. vtisov (zaznav in spominov na minule zaznave), vendar brez kakega "lastnika" te zbirke, tj. brez kakega trdnega in samoidentičnega jaza [3]. Zanimivo je, da je tudi Kant sprejel ta ergument, kajti tudi za Kanta nimamo nobene evidentne in nezmotljive zvesti o samem sebi in o svojem jazu. Svoje ideje o čistem jazu kot nujnem pogoju vsakega spoznanja je Kant dobil na podlagi zahtevnega sklepanja, ti. transcendentalne dedukcije o nujnih pogojih možnosti izkustva. Po tej "dedukciji" misel "jaz mislim" nujno spremlja vsako misel, pravzaprav vsako doživljanje posamične empirične zavesti, vendar ta kantovski kogito ni nobena miselna substanca, kot je bil za Descartesa, temveč zgolj "formalni" spremljevalec vseh vtisov in duševnih dogodkov, ki omogoča sintezo raznovrstnih predstav v enotnost empiričnega spoznanja (izkustva) [4].

Očitno gre za vprašanje odnosa med človekovo zmožnostjo za samozavedanje in posedovanjem predstave o samem sebi kot psihofizičnem akterju v snovnem in kulturnem svetu. Kasnejša filozofija, tako bolj idealistično spekulativna "nemška klasična filozofija" kot bolj empiristično naranana, fenomenološko ali eksistencialno ali analitično naravnana filozofija se je vsaka na svoj način lotevala tega problema. Na to so se navezovale nenehne raprave o naravi samozavedanja, npr. o tem, ali imamo neposredno ali intuitivno zavest o samih sebi, ki se je ne da zvesti na nič drugega, ali pa je nasprotno, vtis o tovrstni zavesti le nekakšna koristna iluzija, ki nam pomaga smiselno delovati v svetu kot enotni akterj in "igralci" v naših življenjskih igrah. (za kratek pregled teh razprav gl. [5] ali [6]).

Na podlagi teh razprav lahko sklepamo, da nam vsakdanje doživljanje samega sebe ponuja neko obliko samozavedanja, ki jo običajno miselno artikuliramo v prvo-osebnih mislih ali izjavah, kot je npr. »Sem tako in tako«, »Sem to in to«, »Sem ta in ta« itd. Vprašanje pa je, kaj to pomeni. Ena možnost je, da takšne misli in izjave morda merijo na neko zaznavanju podobno zavest o lastnem sebstvu, torej na sebstvo kot realni predmet doživljanja

(izkustva). Druga možnost je, da samozavedanje primarno ne vsebuje nobenega nanašanja na samega sebe kot predmet zavesti, temveč je predrefleksivna zavest, ki se sicer lahko, ne pa nujno izrazi v prvo-osebnih miselnih in govornih gestah. Tretja možnost je, da samozavedanje predstavlja posebno obliko občutka posedovanja, namreč občutke posedovanja določenih fizičnih ali duševnih stanj kot »svojih lastnih«.

V vseh treh možnostih gre za nepojmovno, nepropozicionalno, vendar nezmotno in nedvomno nanašanje posameznika na samega sebe. V vseh primerih gre za teze o realnosti zavesti. Tem možnostim stoji nasproti pravo morje nasprotnih tolmačenj nanašanj posameznika na samega sebe, ki vsaka na svoj način zavračajo realni obstoj zavesti in jaza. Humovo zavračanje *cogita* je npr. klasični primer tovrstnega tolmačenja samonanašanja, prav tako »klasična« sta npr. Parfittova teorija o sebstvu kot *domnevno enotnem* mentalnem središču zavedanja in delovanja, pri čemer ima to domnevanje neko evolucijsko in družbeno podprto koristno vlogo v človekovem življenju, čeprav je dejansko iluzija [7] in Wittgensteinova teza o prvo-osebnem zavedanju samega sebe kot o gramatični iluziji, ki je sicer nujna v jezikovnih igrah, ki jih poznamo ljudje [8]. V sodobni kognitivni filozofiji je znan Dennettov poskus vsaj okvirnega pristopa k zavestnemu doživljanjau, tudi izrecno prvo-osebnemu doživljanju s tretjeosebnega stališča, namreč s pomočjo množice mikrodogodkov v človeških možganih, ki ustvarjajo vtis o enotni zavesti posameznika [9]. Za Dennetta je zavest je torej neke vrste virtualni uporabniški vmesnik za človeško (evolucijsko in kulturno) smiselno rabo svojih možganov. Dennett zlasti vneto zavrača predstavo o ti. kartezijanskem teatru, po kateri naj bi v možganih obstajalo neko središče, od koder »motrijo« to, kar se dogaja v telesu in izven njega.

Podobno kot Dennett razmišljajo še nekateri drugi kognitivni teoretiki, ki bi jim lahko rekli »antirealisti glede zavesti« (npr. S. Blackmore, T. Metzinger in M. Siderits). Po njihovem mnenju sta človekova zavest in še zlasti zavest o lastnem jazu neke vrste življenjsko koristni iluziji, ki nam jo posredujejo naši možgani zato, da čim uspešnejše preživimo v kompleksnem človeškem svetu. Susan Blackmore meni, da je ugotovitev o iluzornosti jaza sicer edina razumna, čeprav jo »zelo težko pripustimo v svoje osebno življenje, saj s seboj prinese korenito drugačen pristop na naše doživljanje in od nas zahteva sprijaznenje z dejstvom, da ni nikogar, ki bi ta izkustva imel« [5, str. 97–98].

Strinjam se z ugotovitvijo, da je takšno predstavo o zavesti in samozavedanju težko sprejeti, nisem pa prepričan, da je edina razumna, še zlasti, ker obstaja cela vrsta alternativnih pogledov, ki so vsaj na pogled enako »razumni«, zlasti tu merim na ti. nevrofenomenologijo, tj. poskus sinteze med fenomenološko metodo (prvo-osebnim pristopom) in nevroznanostjo (tretje-osebnim pristopom). Za nevrofenomenologe zavest je realnost, ne iluzija, čeprav je ta realnost sintetični učinek delovanja nevronov (predvsem v možganih, a ne le teh) [10].

Sam ponujam nekoliko drugačno gledanje na zavest in samozavedanje, a se omejujem le na kratek oris, ker za kaj več tu ni prostora. Podajam ga v obliki nekaj temeljnih domnev, iz katerih izhajam v svojih razmišljanjih o zavesti.

Moja *prva domneva* je, da vsako, še tako elementarno zavestno doživljanje in delovanje, predpostavlja, da *dani organizem ali splošneje, kognicijski sistem, zavzame svoj določen »zorni kot«,* s katerega zaznava svoje okolje, ga »razumeva« in v njemu deluje. Temu pravim »zavzemanje doživljajske perspektive« in sem o tem že večkrat govoril in pisal (npr. [11], [12]). Te perspektive ne smemo izenačiti z zavestjo o svojem jazu, tudi ne z samozavedanjem ali kakim posebnim osebnim stališčem posameznika do svojega okolja, pač pa gre za to, da je specifični položaj, v katerem se nahaja kognicijski sistem, nekako pomenljiv za ta sistem in mu ta položaj nudi izhodišče za njegovo predelovanje informacij in njegovo delovanje v svojem okolju.

Moja *druga domneva* je, da so *tega sposobni tudi višje razviti živalski organizmi, v načelu pa tudi dovolj kompleksni umetni kognicijski sistemi,* npr. sistemi umetne inteligence. Vendar pa se strinjam z Nagelom, da način, kako se nek sistem znajde v svoji doživljajski perspektivi, ni docela opisljiv in dojemljiv s stališča brez tovrstne perspektive, npr. s povsem tretje-osebne perspektive naravoslovja.

Obenem privzemam še *tretjo domnevo*, namreč da je *možnost zavzemanja kake doživljajske perspektive temeljna sestavina narave same, pravim ji »dimenzija subjektivacije«*. S tem mislim na nečelno možnost zavzemanja neke doživljajske perspektive za vsako realno bitje, ki deluje relativno samostojno in se ohranja ob pomoči svoje avtopoetske organizacije in svojih interakcij z okoljem.

Moja *četrta domneva* je, da *čim so ta bitja dovolj razvita, da so občutljiva na razliko med svojim obstojem in neobstojem, se pri njih že lahko razvije doživljajska perspektiva*. Človeška zavest se mi s tega vidika kaže kot aktualizacija visoko razvitega potenciala za to, da se njegova občutljivost na svoj položaj (in način bivanja v njem) upodobi oz. izrazi v pomenljivih občutjih, mislih, hotenjih in dejanjih [13].

Važna se mi zdi še ena stvar, namreč prepletenost človekove zavesti in zlasti človekovega samozavedanja z intersubjektivno pomenljivim svetom med-človeškosti, namreč vpletenost ljudi v skupno deljene živkljenjske situacije. Šele tu namreč človeška zavest lahko izrabi in aktualizira svoje potenciale.

V nekaterih svojih prispevkih sem govoril o tem, da smo ljudje sposobni razumeti »objektivnega duha situacije«, pri čemer pod *objektivnim duhom situacije razumem celoto skupnih pričakovanj glede vseh tistih vsebin govora, mišljenja in delovanja, ki so morda relevantne za kompetentno ravnanje v dani situaciji* [14].

Moja *peta domneva* je, da v skupni situaciji tudi *vsak sodelujoči posameznik razvije posebno skupnostno in situacijsko obarvano doživljajsko perspektivo*, ki ni več le njegova, temveč se razširi v skupno doživljajsko perspektivo vseh sodelujočih v dani situaciji. Tedaj ne govorimo več le o sodelujočih jazih in o intersubjektivnosti, temveč o »nas« oz. o »mi«. V teh situacijah ljudje drug drugemu *potrjujemo* realnost lastnega doživljanja, mišljenja in stremljenja.

Moja *šesta* in *končna domneva* je, da se človeški jaz oz. sebstvo lahko *razvije in ohrani le tedaj*, če posameznik *prostovoljno in odgovorno sprejema ustrezne anticipacije in zadolžitve, ki izhajajo iz različnih skupnih situacij in iz splošnejših oblik objektivnega duha* (družbene institucije, narodi, kulture, države, danes morda tudi internetno globalizirane socialne mreže). Sklepam, da šele v tem primeru človekova zavest in človeški jaz *vsaj v splošnem* predstavljata neko *mentalno realnost* in ne le funkcionalno koristno iluzijo. Mentalna realnost pomeni dvoje: nedvomna prezentnost samega doživljaja za posameznika in takšna stopnja ustreznosti vsebine doživljaja objektivni (intersubjektivni in transubjektivni) realnosti, da se posameznik v svojem vsakdanjem in budnem ravnanju lahko zanese nanjo.

Mentalna realnost zavesti in jaza torej pomeni nedvomno prezentnost doživljanja neke predmetne danosti za posameznika oz. nedvomno prezentnost doživljanja samega sebe pri posamezniku ter relativno zanesljivo nanašanje na vsebino zavedanja in na vsebino tega, kar si predstavlja sam o sebi v objektivni realnosti. Dejal sem, da gre pri zavesti (in jazu) »v splošnem« za neko mentalno realnost, kar pomeni, da so možni tudi posebni primeri, kjer temu, kar se nam javlja kot zavest in našim vtisom o samem sebi, ne gre ravno za zaupati. Takšni primeri so npr. sanje, drogiranost, razne ektaze itd. Tu tudi ne bi dalje razpravljal o še globljem vprašanju, koliko je morda naše zavedanje objektivne realnosti in naše samozavedanje iluziorno v kakem višjem, recimo »duhovnem« smislu, kar nam sugerirajo določene filozofije in religije.

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