

INTERDISCIPLINARY DESCRIPTION OF COMPLEX SYSTEMS

Scientific Journal

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LIST OF REFEREES

The following scholars, listed in alphabetic order, refereed manuscripts for the journal INDECS in period from November 2013 to October 2014:

Istvan Biro	Marija Meštrović
Damir Ciglar	Danijela Milošević
Boris Čulina	Irena Peharda
Jasminka Dobša	Mirjana Pejić Bach
Nikša Dubreta	Biserka Runje
Josipa Sanja Gruden Pokupec	Ivan Strugar
Josip Kasać	Zvonimir Šikić
Rafael López Rangel	Vanja Šimičević
Marjana Merkač Skok	Toma Udiljak
Gyula Mester	Jovana Zoroja

Their contribution to the quality of the Journal's content is acknowledged.

Zagreb, 30th October 2014

Josip Stepanić

INDECS AWARD

Dear authors of articles published in Vol. 11 of the journal INDECS,

the contest for the INDECS award, INDECOSA 2014, choosing of the best article published in INDECS during 2014, i.e. in Vol. 12, is opened.

You, the authors of articles published in INDECS Vol. 11, i.e. in 2013, and the members of the INDECS' Editorial Board, are the voters. Each and every one of you contributes with one vote.

Propositions for the INDECOSA are available from the web site of INDECOSA, <http://indec.eu/index.php?s=indecosa>.

I would like to ask you to give your vote to the article which you consider to be the best among the articles published in the year 2014.

The votes will be collected till 10th January 2015 and the results will be presented in INDECS 13(1).

Cordially,

Zagreb, 30th October 2014

Josip Stepanić

NOTE

Dear readers,

according to tradition, this autumn issue of INDECS, the CogSci issue, is dedicated to the broad area of cognitive sciences. The main part of the issue consists of contributions by authors who presented the core of their ideas at the International Cognitive Conference, which was held in Ljubljana, Slovenia in October 2014.

We selected the best presentations and invited authors to contribute to the present issue of INDECS. As a result and with the agreement of the conference's program committee, the papers by the following authors are extended versions of their presentations at the conference: Borut Trpin, Jernej Sever, Toni Pustovrh, Bruna Pikš, Rado Gorjup and Niko Gorjup.

Cordially,

Ljubljana, 28th October 2014

Urban Kordeš

Olga Markič

Toma Strle



THE NEUROENHANCEMENT OF HEALTHY INDIVIDUALS USING tDCS: SOME ETHICAL, LEGAL AND SOCIETAL ASPECTS

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ABSTRACT

Over the past two decades there has been increasing scientific interest in Human Enhancement, that is, the possibilities of expanding and enhancing the capabilities of healthy individuals with direct technological interventions into the body. The (sub)field of neuroenhancement, which explores attempts to technologically increase attention, memory, perception, learning and other cognitive capabilities, as well as alter mood and emotions, has become especially prominent. Recently, transcranial Direct-Current Stimulation (tDCS) has emerged as a possible method for enhancing cognitive abilities in healthy individuals. The article provides a short overview of the concept of neuroenhancement and of the cognitive enhancement effects that tDCS has demonstrated in the scientific literature. It further focuses on the (neuro)ethical, legal and societal implications of such a practice, and points out issues and questions that especially require further research and investigation, both from a neuroscientific and from a social sciences and humanities perspective. tDCS could become another addition to the increasing set of Human Enhancement Technologies, but it requires further rigorous studies and trials in order to properly assess its potential risks and benefits.

KEY WORDS

tDCS, transcranial direct-current stimulation, neuroenhancement, cognitive enhancement, neuroethics

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INTRODUCTION

Human Enhancement, the idea that the physical and mental capabilities of healthy people can be expanded or increased through direct technological interventions into the body, especially the brain, has become a subject of increasing discussion and investigation in the scientific community over the course of the last twenty years [1, 2]. While there are still many conceptual and normative disagreements about the notion itself, Human Enhancement can be generally expressed as meaning “an intervention that improves the functioning of some subsystem of an organism beyond its reference state; or that creates an entirely new functioning or subsystem that the organism previously lacked” [3; p.179]. The reference state can be taken as the normal, healthy or average functioning of an individual’s specific ability or trait, or as referring to the species-typical or average range of an ability or trait. An entirely new functionality would be one that no member of the human species has previously possessed, for example infrared vision or controlling a machine with thoughts. In this way, enhancement can be seen as different from therapy, although the attempts to turn this differentiation into a normative one have proven unsuccessful, especially considering the changing nature of norms, values and medical goals in contemporary societies. There is a wide range of technologies and applications, some already in use, some still experimental, others only theoretical, that have been discussed as potential Human Enhancement Technologies. These range from prescription pharmaceuticals, such as methylphenidate (Ritalin) and steroids, through gene and stem cell therapies, to cybernetic implants and brain-computer interfaces. The application fields of Human Enhancement Technologies can be roughly separated into healthy lifespan extension/anti-aging therapies, the enhancement of physical capabilities, and neuroenhancement, although there is also considerable overlap between these fields, as the enhancement of some specific system can have simultaneous effects in more than one of them.

The field of neuroenhancement can be further divided into at least three subfields, namely Cognitive Enhancement [4], Mood and Affective Enhancement [5], and Moral Enhancement [6]. Cognitive enhancement is usually seen as aimed at improving the cognitive capabilities of healthy individuals, such as attention, memory, wakefulness and executive function [7], mood enhancement targets emotional processing and subjective emotional states, while moral enhancement is focused on improving altruistic, cooperative and virtuous behavior. The enhancement of such capabilities is most often explored through the use of prescription pharmaceutical and experimental psychopharmacological substances, and while Pharmaceutical Cognitive Enhancement (PCE) has been the main focus of research and debate in this field [8] over the last two decades, newer methods for potentially enhancing cognitive capabilities have opened new possibilities and new dilemmas in recent years.

These newer neuroenhancement methods are enabled by non-invasive brain stimulation (NIBS) devices, such as Transcranial Magnetic Stimulation (TMS) and Transcranial Current Stimulation (TCS), the latter most notably as transcranial Direct-Current Stimulation (tDCS) [9]. Such tools promise to be less invasive and without as many systemic side effects as the use of pharmacological substances, while still facilitating similar enhancement effects. For the time being, TMS remains costly and (relatively) complex due to its hardware requirements, while tDCS with its technically simple, readily available and cheap hardware has been rapidly adopted in scientific and medical research and clinical trials, and has also quickly spread among the amateur community of Do-It-Yourself (DIY) technology enthusiasts and neuroenhancement (self)experimenters [10, 11]. And although there are still many open and pressing technical (pharmacological), ethical, legal and societal issues connected with PCE [12, 13],

some of which are shared by tDCS use, the latter brings with it its own issues and challenges, as well as opportunities.

The primary focus of this article will be on the potential use of tDCS as a method for enhancing the cognitive capabilities of healthy adults and on presenting some of the (neuro)ethical, legal and societal implications of such a practice. The article will also briefly touch on some possibilities and aspects of using tDCS in the other two neuroenhancement subfields, namely mood enhancement and moral enhancement.

COGNITIVE ENHANCEMENT AND tDCS

Cognitive Enhancement in the context of Human Enhancement usually refers to attempts to increase human cognitive abilities or functions that are already considered to be in the normal or healthy range, through the use of technological means that directly target the underlying neurophysiological mechanisms. In this way, the Nuffield Council on Bioethics defines cognitive enhancement as “the use of interventions to improve cognitive functioning and performance, where these are not impaired in clinically significant ways ... such as attention, understanding, reasoning, learning, and memory ... loss of painful memories might equally be viewed as a functional improvement” [14; p.164], and Galert and colleagues as “improvements in cognitive performance, which are not intended to pursue therapeutic or preventative goals, and which employ pharmacological or neurotechnical means” [15; p.40]. The targeted cognitive abilities usually encompass perception, attention, memory, motor abilities, language skills, visual and spatial processing, and executive functions [7], although some definitions entail a broader scope of mental states and functions, including emotions, mood and non-ordinary states of consciousness.

For the purposes of this paper, the technological means of cognitive enhancement under scrutiny are tDCS devices. These are technically simple, composed of a battery-powered device, which delivers the electrical current, and of two electrodes (one positive and one negative) that are placed on specific areas of the head, whereupon a weak direct current is sent through the cortical brain matter for a short time. This leads to increases or decreases of neuronal excitability in the target area, and to changes in the functioning of the underlying mechanisms [9]. As influencing a specific ability or system requires a quite exact placing of the electrodes, an accurate mapping of sites on the scalp that correspond to individual cognitive functions is one of the requirements for further progress in this area. Although the precise functioning and structure of the mechanisms involved in various cognitive functions are not yet fully known, this is not necessary for eliciting enhancing effects, which can be gauged through experimentation. While the technique of transcranial electrical stimulation itself has a long history [16], with widespread unregulated commercial use between 1740 and 1930 in depressive patients and in various attempts to increase wellbeing and enhance performance in the healthy, tDCS has only been rediscovered as a research tool in neuroscientific investigation and a therapeutic method for various disorders and diseases in the last decade. Its applicability as a tool for cognitive enhancement has only come to be recognized over the past few years, with the discovery of enhancing effects in healthy individuals [17].

The cognitive enhancement effects from medical and neuroscientific research include improvements in attention [18], memory [19], facilitation of insight in problem solving [20], improvement of numerical abilities [21], enhanced learning of novel and challenging motor skill tasks [22], and of language acquisition skills [23]. In many instances, tDCS seems to increase the learning capability of the brain, and is especially effective when stimulation is combined with training and learning activities. Regarding mood, tDCS did improve (positive) emotional processing, but did not influence subjective emotional states in healthy people [24].

More precisely, this means that the subjects perceived the facial expressions of other people as more positive and friendly, while their internal mood or emotions did not become more positive than they already were. While the duration of such enhancing effects is usually short-lasting, they can be increased through greater time length and current intensity of the stimulation. It should also be noted that improvements in one capability or faculty often lead to diminishment in another [25], and that improvements in processing in one hemisphere often impair processing in the other [17], therefore the trade-off nature of such enhancements needs to be taken into account. Similar effects have been observed in PCE, where there was also a diminishment in general capabilities with increasing dosages. The latter has not yet been observed with increasing current intensity and duration of tDCS, although there are at least some (anecdotal) reports of short-lasting mental blackout caused by personal experimentation outside of established parameters.

Apart from use in the research and clinical setting, such devices are now commercially available for purchase over the internet [26, 27], and their potential enhancement use and benefits, in no small part driven by the DIY tDCS community, have become popular and often strongly magnified in the media [28]. In this way, the trend of amateur enhancement and experimentation use of tDCS can be predictably expected to continue and grow in the coming years.

ETHICAL, LEGAL AND SOCIETAL ASPECTS

There are numerous open ethical, legal and societal issues connected with the various aims and means of improving human performance in the context of Human Enhancement [29]. In the scope of tDCS used for cognitive enhancement purposes, as with other technologies, the primary considerations are safety and efficacy. The application of tDCS use is generally considered safe, having been conducted in thousands of subjects, usually with only mild, benign and transient side effects [30]. Thus it appears to be safe within established research protocols, although long-term and persistent use could have unwanted side-effects, especially when greater duration and intensity of stimulation is used, which is a salient concern in the DIY and amateur use of such devices. Also, enhancement uses should require a higher safety threshold than more clearly therapeutic uses, and tDCS seems to fulfill this requirement, in contrast to most current PCE substances. Thus it might prove to be a safer (and less expensive) alternative to at least some psychopharmaceuticals currently used (off-label) for cognitive enhancement by individuals in various demanding fields, including the military, medical research, academic and entrepreneurial spheres. Further safety concerns pertain to considerations of tDCS application on children and teenagers, as it might have completely unknown physiological and psychological effects on developing brains that were not present in healthy adults, and potential enhancement use opens many questions concerning the rights and obligations of parents [31]. This presents a special concern when such devices are commercially available to parents of children with actual or perceived neurophysiological developmental problems outside of any professional (medical) supervision and counseling.

The studies listed in the previous section show that the cognitive enhancement effects of tDCS, although transient, are tangible. Nevertheless, the outcomes are not always consistent, even when identical protocols are used. This variation seems to be due to anatomical differences between individuals, especially those with atypical brains [32], and would need to be considered in future research and application. Given that a firm and defensible normative distinction between therapy and enhancement uses remains elusive [12, 13], much of the debate about the ethical, legal and societal implications of tDCS enhancement use will revolve around its costs and benefits.

The potential positive implications for individuals and societies could for example entail societal savings from decreased numbers of accidents and errors at work and in personal life due to enhanced attention, decreased costs and losses due to better memory and increased social productivity due to enhanced cognitive capabilities [33]. Especially important might be decreases in costs due to the reduction of the time and resources needed for general learning, education and acquisition of skills and knowledge, as well as reduced personal costs and frustration involved in difficult and unsuccessful learning attempts.

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

Further important questions are concerned with the impact of tDCS use on personal identity, autonomy and authenticity. Enhancement through tDCS could result in changes in personal identity, and questions of whether these are ethically acceptable, especially if they foster a sense of wellbeing and autonomy [34] have been raised. In this regard, it would not be imprudent to assume that increases in wellbeing that also contribute to increased autonomy and engagement with the world can be regarded as personally positive and ethically acceptable. Authenticity has been often discussed in PCE, especially whether such means constitute a form of cheating, and there are good arguments that enhanced minds can be authentic [35]. Namely, if an individual uses tDCS to strengthen their abilities in attaining specific personally important goals, then it cannot be claimed that such a strengthened pursuit is inauthentic, no more than any technological shortcut makes any endeavor inauthentic. Furthermore, the use of tDCS does not mean that there is no longer any need to perform the learning or practice, only that these can be more effective with the application of tDCS, while an individual still needs to bring forth the effort required to engage in study or practice. The notion of cheating is closely tied to issues of distributive justice and access, which are, due to the inexpensiveness and simplicity of TDCS devices that can easily be assembled at home from inexpensive components, much less of a concern than in the case of expensive pharmaceuticals and other emerging neurotechnologies, which might exacerbate the capabilities gap between the rich and the poor. In case the benefits turn out to be large and the risks negligible, society might also opt to specifically promote such means, for example through subsidized access. Significant benefits to users and wide societal acceptance usually entail indirect coercion even of those who would otherwise not choose to use the technology, in order to stay competitive at the workplace or in school. The availability of proven and safe methods for cognitive enhancements also leads to considerations of expanding duties for specific professions where increased cognitive capabilities are important, such as pilots, surgeons, firemen, etc., leading to arguments that such professionals might have a duty to engage in cognitive enhancement [36]. Some authors have suggested that emerging neurotechnologies could also be used to promote virtuous behavior, increase happiness and suppress vice [37], thus enabling individuals to more easily attain desired personal characteristics or enable society to produce better citizens, which again opens many questions concerned with autonomy, authenticity and coercion. Further, tDCS might be used to elicit non-ordinary or mystical experiential states, including euphoric experiences. This raises questions of whether states elicited by tDCS are qualitatively comparable to "naturally" elicited ones and whether such shortcuts carry their own costs. They might also raise questions connected with drug policy, especially if the triggering of euphoric states has negative neurophysiological effects and changes comparable to those of illicit drugs, but also

about tolerated use if it proves to be less harmful. The ability of tDCS to trigger behavioral changes in individuals, such as reducing the propensity to punish unfair behavior [38] or influencing compliance with socially constituted sanctions [39], poses strong concerns regarding the abuse potential of triggering (nonconsensual) manipulative changes in individual behavior. Further concerns, as with practically any technology, are its military uses, for example in augmenting the perception, alertness and other cognitive capabilities of soldiers, as well as pilots and other combat operators, thus improving their performance on the battlefield. In this regard, the effectiveness of tDCS in reducing sniper marksmanship training time has already been demonstrated [40]. But the question of the (un)ethical (ab)uses of new technologies is ultimately a question of proper societal regulation, not of the technology itself being intrinsically either good or bad.

The primary implications for public policy in regard to tDCS use for cognitive enhancement entail considerations of whether access and use by healthy individuals should be supported and possibly encouraged for specific uses by specific populations, or even generally, whether governments might impose certain restrictions. Further considerations include how vulnerable groups and populations that would be unwilling to engage in such practices could be protected from harm. In this regard, the DIY or amateur self-experimentation use poses some pressing challenges for regulation, and some experts have called for regulatory frameworks that would regulate commercial tDCS devices as medical devices, ensuring quality and safety standards, and use by skilled operators, in order to prevent threats to public health and vulnerable populations [41]. Such considerations would of course need to be supported by expert and stakeholder opinions and by empirical research data in order to produce a well-informed and evidence-based policy. A good policy would ultimately engage regulators, scientists and the DIY community in crafting policy proposals that ensure public safety while still supporting (DIY) tDCS innovation [42].

CONCLUSION

Much of the debate concerning neuroenhancement has until now been focused on the off-label use of prescription pharmaceuticals, but the growing body of knowledge and experience with tDCS, as well as its DIY spread, is showing the need to discuss such issues with a focus on tDCS. A balanced policy promoting safety and innovation will need to consider both the requirement of ensuring public health and protection of vulnerable groups, and the fact that adults will employ such easily accessible neurotechnologies in pursuit of their own goals regardless of regulation. In this regard, DIY tDCS users might consider that the enhancement uses of tDCS could be employed strategically, to complement other techniques and approaches according to one's goals and needs at specific times, while following tested protocols and guidelines. They should also keep in mind the comparative cognitive enhancement effectiveness and additional benefits of more traditional and established non-invasive interventions, such as proper nutrition, exercise, sleep, rest, relaxation, mind-training, meditation, etc. [43], which can all contribute significantly to achieving an individual's optimum (biological) state. Furthermore, the DIY tDCS community represents a rich source of experimental information, which, although not rigorously controlled, can nonetheless provide valuable insights into personal experiments and experiences, both from a neuroscientific and a sociological viewpoint [44, 45]. Even if tDCS fails to provide consistent enhancement effects for the general population, it might still prove useful as a tactical tool for some individuals and for some occasions when one's ordinary capabilities are below average, for example due to (mental) exhaustion or lack of sleep. In this way it might prove to be another step in achieving rapidly flexible mental states that are demanded of us in today's increasingly high-speed and complex society. Of course, as has

been stressed before, safety considerations need to remain a priority where enhancement practices are concerned.

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NEUROPOJAČAVANJE ZDRAVIH INDIVIDUA PRISTUPOM TDCS: NEKI ETIČKI, ZAKONSKI I DRUŠTVENI ASPEKTI

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SAŽETAK

Tijekom zadnja dva desetljeća raste znanstveni interes za ljudsko pojačavanje, tj. za mogućnost proširenja i pojačavanja sposobnosti zdravih individua izravnom intervencijom u tijelo. Metode neuropojačavanja koje istražuju mogućnosti tehničkog povećavanja pažnje, pamćenja, percepcije, učenja i drugih kognitivnih sposobnosti, kao i mogućnosti utjecanja na volju i emocije, izrazito su istaknute. Metoda transkranijalne stimulacije istosmjernom strujom (tDCS) u novije vrijeme javlja se kao moguća metoda pojačavanja kognitivnih sposobnosti zdravih individua. Ovaj rad daje kraći pregled znanstvenih rezultata o konceptu neuropojačavanja i kognitivnog pojačavanja metodom tDCS. Nadalje, rad se fokusira na (neuro)etičke, zakonske i društvene posljedice takve prakse te ističe probleme i pitanja koja posebno zahtijevaju daljnja istraživanja s neuroznanstvenog stajališta i sa stajališta društvenih i humanističkih znanosti. Metoda tDCS može postati dodatak rastućem skupu tehnologija ljudskog pojačavanja, ali to zahtijeva daljnja rigorozna istraživanja i provjere zbog pravilnog izvrjednjavanja potencijalnih rizika i koristi.

KLJUČNE RIJEČI

tDCS, transkranijalna stimulacija istosmjernom strujom, neuropojačavanje, kognitivno pojačavanje, neuroetika

DESIGN PATTERN CANVAS: AN INTRODUCTION TO UNIFIED SERIOUS GAME DESIGN PATTERNS

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ABSTRACT

The aim of this article is to start a dialogue and search for a unified game design tool within the game design and research community. As a possible direction, presented paper outlines the practice and importance of design pattern use in serious game development and argues that design patterns can make serious game development more efficient by enabling knowledge exchange and better communication between different stakeholders. Furthermore, the use of design patterns provides a foundation for structured research and analysis of games. In order to help advance the state of game design the paper proposes a new method – the Serious Games Design Pattern Canvas or shorter Design Pattern Canvas (DPC). DPC is a design template for developing new or documenting existing (serious) game design patterns. It is a visual chart with elements describing a pattern's purpose, mechanic, audience, consequences, collected data, related research and ethical considerations. It assists game designer in aligning their activities by illustrating patterns characteristics and potential trade-offs. One of the goals of the DPC is to either help break larger game design problems into smaller pieces or assist in a bottom up approach of designing serious games. It is important to note, that the paper proposes the first step for co-creation of a game design tool and further research and validation of the DPC is needed.

KEY WORDS

design methodology, design patterns, serious games, co-creation

CLASSIFICATION

ACM: D.2.2, I.5.2, K.8

JEL: C92, O31

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INTRODUCTION

More and more research is focused on games that can be used for something more than just fun, for something good and change, besides the “time sinking” component. Apparently, games can make us smarter, games can make us healthier or even help us enhance brain functions [1]. These games are so called serious games, an oxymoron by the name. Still, as defined by Michael & Chen, serious games are “games that do not have entertainment, enjoyment or fun as their primary purpose” [2].

In such definition, however, could also hide a reason that serious games design is facing challenges of creating an engaging gameplay as it puts more focus on how to devise treatment, learning, etc. than on the design of the “game”. Experience shows that it is often a tall order to make learning an enjoyable, exciting, and enriching experience [3]. In this regard it is even becoming questionable if serious games are truly games in terms of player experience or just an attempt of “gamification”, where gamification refers to the use of game elements in non-game services and applications with the goal to improve user experience and user engagement [4]. Still, as traditional games are also motivated to be as much as possible engaging and fun, we can argue, that the presented challenge of serious games design is in its essence also one of the fundamental challenges of game design. Furthermore, by stating that the scope of serious games is beyond entertainment, we merely state that their main purpose is somewhere else than entertainment. In addition, a game cannot be dissociated from its player and the goal of successful game design is meaningful play [5]. Consequently, it can be argued that designing engaging serious games is also important for purpose outcome as perhaps the foremost reason to use serious games is their alleged motivational appeal while noting that a game with integrated game mechanics and serious game content can be more motivating compared to a game version where these components are not integrated [6]. In this regard, game design definitions also still apply; creating a truly meaningful game just becomes a harder task as a result of increased complexity of the “problem to solve”. Unfortunately, neither the player and its relation to the game, nor games fundamentals like gameplay, feedbacks, or goals are stressed in existing definitions of serious games [7].

Therefore, to address the issue of creating engaging serious games, game design best practices should be considered in the development of a serious games design tool. However, a major issue and limitation in game design is the lack of a shared design vocabulary and tool box containing both broad application solutions and solutions specific to certain genres of games [8]. It is considered by many researchers and designers that a shared and unified vocabulary can bring significant benefits to the area [9] and in the past several authors, as for example Costikyan and Church, pointed out the need for greater formalism on game design and a shared designer vocabulary [8]. Furthermore, various tools aimed at the improvement of the games creation process were proposed as researchers and professionals agree that such tools, whether conceptual or software, would positively influence knowledge transfer between generations of designers and bring industry and academia closer, contributing to build a universal knowledge base of game design [9]. Moreover, although dictionaries alone cannot become design tools, they are necessary complements to any method or conceptual tool and can be seen as a lower abstraction layer, serving as a foundation for other approaches [10].

One of these approaches which seems to be a promising field of research and a promising solution for people involved in serious game design is pattern design [3]. A game design pattern collection would provide a shared design vocabulary that allows experienced designers to communicate efficiently with each other, document their insights, organizing individual experience as written knowledge and analyze their own design as well as the

designs of others [11]. In addition, the usability and advantages of design patterns have also been recognized in the serious games community [3, 12]; where currently, each project is more a new challenge than the re-use of established and well-grounded procedures and lack of these procedures slows down serious game production and probably has a negative impact on the quality of the products [3]. Furthermore, because of added design complexity of serious games more stakeholders need to be involved in the design process, which calls for upgraded and unified communication and design tools encompassing more information as pattern templates used at the moment. Thus, such tool should be able to describe best practice design approaches of games, serious games, serious games with biofeedback, neurogames and not-yet-invented games with added and relevant information to the serious part of the game. At the same time it should reflect the relationship between design and player. Furthermore, it should give a possibility to look at a game and its building blocks from different viewpoints and levels. After all, a complex system cannot be understood fully by looking at just one level [13].

Therefore, this article is intended for all stakeholders involved in the process of creating and researching games with the goal to propose an expanded game design pattern tool “Design Pattern Canvas”¹ upon which later a framework for designing games could be build. Let’s play.

SERIOUS GAMES

WHAT SERIOUS GAMES ARE

Serious games are based on the idea of connecting a serious purpose to knowledge and technologies from the video game industry [14]. A more recent definition is that serious games are games that do not have entertainment as their primary purpose [2]. Serious games span over a wide range of fields such as education, therapy, advertising, defense, research, etc. and because there is no consensus on the domain boundaries of the serious games, a definition of serious games is still an open subject [15]. Some “domain-specific” definitions reflect these differences and are used to force a limited view of the nature of “serious games” [16]. Still, two common aspects that were identified in a review of new definitions which include all game genres and application fields are that 1) a serious game has a purpose beyond entertainment and that 2) an objective of a serious game is to use the attractive shapes of the game to serve the serious purpose [7]. For the purpose of this paper, we will assume that serious games are games that in addition to entertainment have another purpose. This way we leave it open if the “other purpose” is superimposed to entertainment or is rather parallel to it. Furthermore, this definition enables us to also include games used to perform “purpose-shifting”, that is games that are not designed with the primary purpose of “seriousness”, however their use-case can be the same as with serious games. Deeper explanation of “purpose-shifting” is out of scope of this paper and the reader is advised in case of additional interest to read upon it in Djaouti’s paper [15].

CLASSIFICATIONS OF SERIOUS GAMES

In general, classifications are a structured approach in defining games, use same set of criteria within the classification and can consequently provide more information while also at least hint in the direction of game design patterns used. Furthermore, as the scope of game design patterns in our case is expanded by the “serious” dimension, it is reasonable to review them and see how a game design pattern template could be linked to it as an explanation of game elements at a deeper level.

Considering numerous definitions of serious games and fields they address, it should come as no surprise that there are also many more or less successful classifications of serious games.

While the most common approach to classify video games is to categorize them into “genres”, serious games classifications can in addition be market-based, purpose-based or based on multiple criteria [15]. However, a major limitation is that none of these classifications classifies “serious games” as “games” and does not provide relevant information about the game structure of the games it classifies [15].

To address this issue with more precision Djaouti et. al proposed a Gameplay/Purpose/Scope model (G/P/S model) that combines the analysis of both “serious” and “game” dimensions [15]. The G/P/S model analyses games from aspects relevant also for documenting (serious) game design patterns, such as how the game is played, what is the designed purpose beside entertainment and who it is made or targeted for. However, as a classification model designed intentionally to provide a general overview, its limitation is that the model is not able to provide detailed information concerning a specific area of the serious games field [15]. While it provides information about which main game design pattern is used it does not inform of all game design patterns nor their mechanics. In this regard the (serious) game design pattern canvas proposed in this paper presents a complementing tool.

Nonetheless, as much as the G/P/S model provides common ground with which we can browse the whole field of serious games, another limitation is that it does not address motivational aspects of games. In the context of a serious game purpose (e.g. therapy or education) motivation is the most expected and desired effect of a game. This issue is largely addressed in the player/game/therapy model developed by Mader et al. [7]. While the player/game/therapy model is intended as a design tool for serious games in the field of health and therapy, we can expand it for our purposes of our analysis to the whole field of serious games i.e. the effect of the game element of educational games is also motivation. This understanding is crucial for the design of serious games as the function of a serious game or (serious) meaningful play emerges from the relation between the player and the game. In addition, the therapy/game/player model provides another, more user-centric perspective on the analysis of serious games in order to find their interesting features and constraints which help facilitate the game designer’s work during the design process [7]. In other words, it can help discover and suggest serious game design patterns to make the game more pleasurable and interesting. However, as much as it can add to analysis, it is limited to therapeutic purposes and still does not provide standardized description of the most granular part of game design that could also be used across different domains. In this regard, again, the later in the paper proposed serious games pattern canvas can be considered a complementary tool.

There are many other models and analyzing them all falls out of scope of this paper. Nonetheless, the process of creating a unified serious games design template should be guided by research done in all these fields.

GAME DESIGN PATTERNS FOR SERIOUS GAMES

WHAT ARE GAME DESIGN PATTERNS?

Alexander introduced the method of using design patterns in architecture: “Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of a solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice” [17]. Among other fields, this method was later applied also in software engineering, human-computer interaction and interaction design [18].

Kreimeier defines design patterns as conventions for describing and documenting recurring design decisions within a given context [11]. Thus, a design pattern is often defined as a

general reusable solution to a commonly occurring problem after it is repeatedly applied in specific context as a response to a specific design problem [12]. The pattern description itself is just a summary of cause and effect, describing one way to reach a given objective [11]. It is important to note that unlike earlier uses of patterns, Bjork et al argue that not all aspects of design can or should be seen as solving problems, especially in a creative activity such as game design [19].

Moreover, we should note that the use of game design patterns put forward by Björk et al. [19] is considered an evolution over the Formal Abstract Design Tools (FADT) suggested by Church and currently presents the most significant attempt to set up a database of design concepts [8].

WHY USE PATTERNS FOR SERIOUS GAMES DESIGN?

Even though it is not clear yet which approach to take, there is a wide consensus in the game design community that semi-formal or even formal game design methods must be developed as we must advance the way we discuss game design details [18]. Game design patterns seem to be a promising choice as they provide a means of capturing existing successful design practices, expand knowledge about game design and provide a shared design vocabulary for communication between researchers, game designers, and developers [12]. Furthermore, Björk et al. stress that game design patterns are beneficial to multidisciplinary groups as they ease communication by being neutral definitions based on the interaction in games and are not based on any research field or professional jargon [19]. In summary, the benefits of game design patterns are suitable for problem-solving during development, idea generation, creative design tool and communicating with peers and with other professions [18]. In addition, analysis, categorization of games and support for exploration of new mediums and platforms are listed [19].

For the domain of serious games, we can argue that some of these advantages are even more beneficial. As mentioned before, teams developing serious games face a major and recurrent problem which consists in combining or blending game and serious parts like learning or therapy within the same application [3, 7]. Patterns help to better understand features that make play engaging and motivating, thus, this helps in maximizing patient's intrinsic motivation and smooth out the medical aspect of therapeutic games consequently making a serious game more effective for treatment or therapy [7]. Moreover, we can argue that these benefits can be applied to other domains of serious games.

Furthermore, analysis and insights into games and design problems that come from using design patterns are especially important in what can be called experimental game design where the goal is to push the limits of existing games and genres [18]. As using patterns for the design of the actual game play can make the transferal between different parts of a project group easier [18], interdisciplinary teams can be more efficient. In addition, the documentation of design guidelines can assist in the knowledge transfer between generations of professionals [8] and different communities to a greater extent than before [18] which is a key factor for structured research built upon best and proven practices. For example, Dormann et al. proposed using game patterns as a conceptual tool to initiate discussions about the role of affect in games and to support the design of games situated in the affective domain [12]. In their research, they used game patterns to “bridge the gap between theories and high-level affective principles to their representation or actualization through games” [12]. Thus, developing a collection of game patterns helped gaining insights into the design of affective learning in games and raised a number of issues to take into consideration [12].

As patterns are a formal means of documentation [11] we can argue that they open doors to structured research in the serious game domain. Moreover, documentation of game design

patterns can be expanded with the “scientific part” as for example ethical concerns, serious purpose, data gathered, etc. – an example of such relevant and reusable information would be a research done in 2009 which demonstrated that the popular game Tetris is a visuospatial task that can reduce PTSD flashbacks if played after a traumatic event [20]. Moreover, such re-use of established procedures is in accordance with the claim presented already in the introduction that currently, each project is more a new challenge and Serious Game development is therefore less efficient [3].

Based on evidence presented we can come to the conclusion that game design patterns need to become broader and expanded beyond game mechanics with purpose, scope, appropriate media channels, ethics and related research references to fit the context of serious games. However, in order to start this process of documenting research, a standardized and unified template or canvas needs to be developed.

CRITICISM OF PATTERNS

Most of the criticism of design patterns such as that patterns are a fad and either too formal or not formal enough comes from other fields, however it can be also applied to game design patterns [18]. It is important to note that game design patterns are only useful as long they can be used and applied with reasonable effort to support development of a game or solve particular design problems [18]. In this regard Almeida & Silva criticize game design patterns proposed by Björk et al. as not being enough documented, having contradictory documentation on patterns with disagreements between title, definition and usage examples while also lacking graphical models which together results in less intuitive use [8].

However, these objections do not really criticize the notion of patterns but rather the quality of their current conceptualization, use and unspecified level of analysis they address. Furthermore, it can be argued that with standardized design language and taxonomy the quality and usability of game design patterns could be improved. Nonetheless, as we can consider the game design patterns method still in its beginning, critiques like this should be addressed in future development of serious game design patterns. In addition, game design patterns need to be validated or it has to be at least specified in which development phase they are. As there is not much research on game design patterns validation, this can be considered as a major limitation and future research should also address this question.

DESIGN PATTERN CANVAS: A PROPOSAL OF GAME DESIGN PATTERNS TEMPLATE FOR SERIOUS GAMES

RELATED WORK

The following proposal draws, among others, inspiration upon previous work of researchers presented until now [7, 15, 19]. Furthermore, as design patterns are used in several other fields, we should not shy away from looking for best practices outside of game design. In this regard, a very successful tool is the so called Business Model Canvas (BMC) created by Alexander Osterwalder [21]. While the BMC serves as a strategic tool providing insights into business models on the highest level, its design and form could be applied to proposed game design patterns template in this paper. Furthermore, the BMC proved to be useful for practical and academic purposes, efficiently connecting both spheres and driving a dialogue of innovation. In addition, the BMC could be viewed as one of the “One Page Design” schemes proposed by Librande [22] who also emphasizes that visual models are more synthetic, naturally communicative and scale better.

CONSIDERATIONS

In general, designers want standardized tools and techniques that 1) do not sacrifice the freedom and creativity inherent to their craft and 2) allow them to build experimental prototypes directly from the definition of a set of game characteristics [8]. Furthermore, such a tool would have a positive influence on productivity as it would enable iterative process of design and testing of gameplay, instant proofs of concepts and help creating the design documentation [8]. To summarize, in order to be useful for game designers and other stakeholder, the canvas should be:

- intuitive and familiar,
- easy to update and enable iterations,
- not time consuming to create,
- short, one page preferable,
- using shared design language,
- facilitating knowledge sharing and transfer,
- a tool that would allow them to build experimental prototypes directly from the definition of a set of game characteristics,
- standardized,
- considering perspective of the designer and the player.

SERIOUS GAMES DESIGN PATTERN CANVAS – ALPHA PROPOSAL

The serious games Design Pattern Canvas or shorter Design Pattern Canvas (DPC) is a design template for developing new or documenting existing (serious) game design patterns. It is a visual chart with elements describing a pattern's purpose, mechanic, audience, consequences, collected data, related research and ethical considerations. It assists game designer in aligning their activities by illustrating patterns characteristics and potential trade-offs. One of the goals of the DPC is to either help break larger game design problems into smaller pieces or assist in a bottom up approach of designing serious games.

As “patterns, like any semi-formal method, are only useful as long as reasonable efforts to memorize and apply them suffice” [18], DPC is not designed with the intent to hold all necessary information. Thus, it is complemented with 1) underlying detailed description and 2) visual representation. Thus, a complete pattern description should consist of tag description (DPC), detailed description and visual (diagram) representation.

The higher abstract level is the mentioned visual chart which is tag based in order to provide a quick overview and understanding. At the same time, tags simplify search and navigation among different patterns. The chart can be looked at from the center, where the left side is aimed at design questions and the right side is dedicated to interaction design. In this regard, the left side can be considered for the design of the “serious” part while the right side of the visual chart is the “game” part.

The second level is a detailed description of tags within sections that is looked upon when necessary and serves as a reference. Eventually, the designer does not need to check upon specifics of the pattern and can use only the canvas view of the pattern. This is important to reduce the information presented in order to better streamline the design process and conduct meta-analyses. In addition, the visual representation of the design pattern helps better memorize and understand mechanics of the pattern. Moreover, visual representation could serve as a foundation for software implementation.

Serious Game Design Pattern Canvas				
Name				
Releated Research, References <i>Has the pattern been used in any previous research or serious game? Has the pattern been evaluated and validated? A section dedicated to validation according to the scientific method.</i>	Using the Pattern, Related Patterns <i>When is it appropriate to use the pattern? How does the pattern fit the bigger picture?</i>	Purpose <i>Why should we use the pattern? For serious games purpose can be defined as message-broadcasting, training or data exchange [15] - should be more specific for patterns.</i>	Mechanics, Task, Gameplay, Rules <i>Rules, input methods, Space/Time/Drama-related setup. Challenge and variability should be also considered.</i>	Scope, Users, Stakeholders <i>Who is our user? What are they like? What are their motivations? The typical use of personas can be implemented here.</i>
	Key Data <i>What data do we gather? Do players generate research data?</i>		Media, Biofeedback, Channels <i>What channels does the pattern use? Which device? Is there any biofeedback?</i>	
Ethics <i>Are there any ethical concerns? Are there any negative effects in particular for serious game scenarios? How is privacy handled?</i>		Desired Outcomes, Consequences <i>This section should give emphasis on interaction results as initially proposed in the game design pattern template by Björk et al. [19].</i>		

Figure 1. Serious Games Design Pattern Canvas (alpha proposal), inspired by the Business Model Canvas [21].

In order to address as many considerations and requirements, the proposed pattern template might be considered bloated. It certainly is including information, which might not be relevant for all stakeholders, nonetheless it is necessary. For this reason and to improve the usability and experience of using the tool, ideally the DPC would be used for full functionality on a tablet computer. The advantage of this is a better overview, user can select information needed and at the same time contribute to common design language as the tool should be connected to a central database and suggest expressions. Furthermore, a much desired upgrade of such an application would also be the main view where patterns could be arranged or connected with another application for game design, diagrams or game design document creation.

Design Pattern Canvas (DPC) – Visual Chart

Information provided by the DPC is divided in two parts, which is 1) Information about the game design pattern and 2) meta information pertaining to status of the pattern. It is important to note, that the current proposal reflects just the initial version (alpha) with the purpose to start a dialogue and search for a unified game design tool within the game design and research community. Because of this, some section names and content are not set yet but more proposal are given. The exact “layout” and game design pattern form should be the subject of future research and scientific consensus.

Main Section

Purpose

Djaouti et al. proposed purpose classification to fall into message-broadcasting, training or data exchange [15]. While this classification can be suitable for classifying games, pattern purpose should be more specific.

Mechanics / Task / Gameplay / Rules

Understanding and defining gameplay is a tricky issue. From the various definitions available, we will refer to the one proposed by Portugal, a Serious Game designer, who defines “gameplay” as the combination of five components: *Rules*, *Input methods*, *Space-related setup*, *Time-related setup*, *Drama-related setup* [15]. This is also in line with the proposal of Mader et al. regarding the gameplay analysis of therapeutic games [7]. Furthermore, challenge, variability and input/output elements systems should be considered [7], however these can be partially addressed in the section “Channels”.

Scope / Users / Stakeholders

Who is our user? What are they like? What are their motivations? Understanding the player is an important aspect of game design as the game designer has to understand what the target audience is able to do [7]. The typical use of personas can be implemented here. Additionally, Djaouti et al. suggest also determining the “type” which for classification purpose is simply differentiated between *General Public*, which refers to anybody, *Professionals* which represents workers from the targeted market, and *Students* which groups the people who are studying to join the professionals [15].

Media / Biofeedback / Channels

What channels does the pattern use? Which device? Is there any biofeedback? These are the questions that should be addressed here.

Desired Outcomes, Consequences

This section should give an emphasis on interaction results as initially proposed in the game design pattern template by Björk et al. [19].

Using The Pattern / Related patterns

When is it appropriate to use the pattern? How does the pattern fit the bigger picture?

Key Data

What data do we gather? Do users of the game contribute to the body of knowledge of that particular domain where the pattern can be applied?

Ethics

Are there any ethical concerns? For example, in the consumer space the adjective “addictive” for a game is seen as a compliment while this certainly can have negative effects in particular serious game scenarios.

Related research / References

A section dedicated to validation according to the principles of science.

Meta information

Name

Like rules, pattern names typically name the solution, not the problem [18].

Domain / Scope

Is it an educational game? Game for health? Entertainment game?

Level of design

Patterns can be applied at different levels and some patterns can be even applied at more levels. Specifying the level of game design adds to the formal aspect of documenting patterns while also sets the detail of description.

Genre

Genre information can be helpful in accelerating game development and knowledge transfer. At the same time it can provide one view of pattern categorization.

Version / Status

Version should reflect the phase of design and if the pattern has been properly validated and recognized by the scientific community. Evaluation is a major issue and needs to be addressed. Serious games have serious purposes and evaluation and validation should be done with the scientific method. However, in order to not exclude, game design patterns, which are still in development, this section should reflect the current version or status.

Author

Who created or introduced the pattern. This should follow standard authorship conventions of the scientific community.

DISCUSSION

The proposed DPC is in its initial stage and many questions need to be addressed which should be done throughout development of the DPC and the underlying tools. Nonetheless, we can argue that benefits of such a framework are worth pursuing and necessary. Games design is growing in complexity and research in this field is scattered. Furthermore, we need a shared design vocabulary, knowledge exchange between domains with means to also validate patterns and research.

CO-CREATION

As mentioned already in the description of the DPC, a very good study-case from a different domain is the development of the Business Model Canvas. The development of the canvas took 9 years and there are 470 co-authors. It is by no surprise, that in a very short time, the BMC has become a standard tool within the business development community (ranging from biggest corporations to startups) – an effective tool to foster innovation in these fields, enabling communication between entrepreneurs, potential investors and other stakeholders. It is the firm belief of the author of this paper, that a similar tool for game design can be only developed with a similar approach, that is co-creation.

VALIDATION

A major quality of a co-creational process is also validation, be that the validation of the DPC or design patterns (and their serious purpose). Validating DPC can be best done by repeated use and applying feedback from it. On the other side, while validating design patterns is not a much researched question in the domain of game design, there are two main ways to do it, that is either by expert review or by testing patterns through repeated use [12]. With this in mind DPC is designed and can be further developed to assist in this process. Furthermore, DPC could be used as part of the serious game analysis process to validate the design coherency. For therapeutic games, design coherency can be examined by evaluating the relation between each aspects of a therapeutic game as the player, the game, and the therapy [7], aspects covered in DPC. Empirical evidence of serious games efficacy is for example still a key scientific and methodological challenge within the domain of serious games in psychotherapy [23].

DEVELOPMENT OF TOOLS

Kreimeier argues that, unless there are editing and search facilities that support and enforce the format, defining a standard format for game design documents is of limited use [11]. It

has been already mentioned in the description of DPC that ideal use of the DPC would be on a tablet pc or similar in order to increase motivation and game designer's user experience through a more intuitive use with better organization of different views and data. At the same time, such an application would enable data collection for better meta-analysis of patterns and their external validation the need for which has been often outlined [3, 7]. Furthermore, such implementation could help in the formation of a shared design vocabulary.

These are just few of the open questions that have to be tackled. Through development of DPC or a similar tool, maybe we could also get deeper insights into what makes a successful and meaningful game. On a side note, maybe in the future we could also replace the word serious with meaningful and give games a purpose not beyond but in addition to entertainment.

CONCLUSION

Presented paper has outlined the practice and importance of design pattern use in serious game development. Design patterns can make development more efficient; enable knowledge exchange and better communication between different stakeholders. Furthermore, the use of design patterns provides a foundation for structured research and analysis of games in order to help advance the state of game design by having in mind that the possibilities of games are always expanding from rather simple kicking of the ball to complex dialogue with our bodies. Thus, we have started our own hero's journey for which we hope more people are going to join, as this is a necessary part of development a design tool that could also provide a shared design vocabulary. It is a long walk until the ring is going to be thrown into the Mount Doom and it is definitely not a one man's walk. So, let's get serious or let's not play.

REMARK

¹Design Pattern Canvas was in the form of a poster for the first time introduced by the same authors at Sixth International Conference on Virtual Worlds and Games for Serious Applications: VS-Games 2014 that was held in Malta, September 2014.

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PODLOGA OBRASCA DIZAJNA: UVOD U OBJEDINJENE OBRASCE DIZAJNA OZBILJNIH IGARA

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SAŽETAK

Cilj ovog rada je započeti dijalog i potragu za alatom dizajniranja igara objedinjenim za potrebe dizajna igara i istraživačke zajednice. Kao mogući smjer, rad izdvaja praksu i značaj upotrebe obrazaca dizajna u razvoju ozbiljnih igara. U radu se diskutira o tome kako obrasci dizajna mogu učiniti razvoj ozbiljnih igara učinkovitijom pomoću omogućavanja izmjene znanja i bolje komunikacije između različitih dionika. Nadalje, korištenje obrazaca dizajna stvara temelje strukturiranih istraživanja i analize igara. Kako bi se doprinijelo unaprijeđenju stanja dizajna igara u radu se predlaže nova metoda – Podloga za obrasce dizajna ozbiljnih igara ili kraće Podloga obrazaca dizajna (eng. DPC). DPC je okvir dizajniranja za razvoj novih ili dokumentiranje postojećih obrazaca dizajna (ozbiljnih) igara. To je grafikon s elementima koji opisuju namjenu obrasca, mehaniku, publiku, posljedice, prikupljene podatke, vezana istraživanja i etičke razmatranja. On pomaže dizajnerima igara u usklađivanju njihovih aktivnosti pomoću ilustriranja karakteristika obrazaca i potencijalnih kompromisa. Jedan od ciljeva metode DPC je ili pomaganje u razlaganju dizajna veće igre na manje dijelove ili pomoć u pristupu dizajniranja ozbiljnih igara „odozdo nagore“. Važno je zaključiti kako rad predlaže prvi korak u kokreaciji alata dizajniranja igara kao i potrebna daljnja istraživanja i validaciju metode DPC.

KLJUČNE RIJEČI

metodologija dizajniranja, obrasci dizajniranja, ozbiljne igre, kokreacija

INTERPLAY OF COGNITIVE EFFICIENCY, COGNITIVE ABILITY AND MOTIVATION

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ABSTRACT

The current body of research often focuses on the problem of cognitive decline through ageing. People adapt to these changes of cognitive resources by using brain reserve. An overview of results of different studies on how cognitive abilities of older adults decline highlights high variability of conclusions and sometimes contradiction but it has been shown older adults can be as good as or even better than younger participants in specific domains. Among others, personal meaningfulness of a situation and closeness to the researcher can be strong factors when assessing cognitive abilities and the aim of this paper was to research how these effect cognitive efficiency.

In the pilot study we eliminated the factor of laboratory setting and checked how cognitive efficiency and abilities change in relation to motivation. Forty-eight participants, divided into two age groups, were asked to pass a proverb interpretation test. The results showed that participant's subjective view on the researcher, perceived closeness, correlated with the adequacy in proverb interpretation. Both groups scored higher on adequacy of interpretation when they perceived to be close to the researcher. The younger adults outperformed the older but those in the older adults' group, who felt to be close to the researcher scored as well as younger adults who didn't perceived to be close to the researcher. This motivational reserve might play a role in assessing cognitive abilities and pathologies that affect the outcome of neuropsychological tests.

KEY WORDS

cognitive ability, cognitive decline, motivational reserve, closeness, proverb interpretation task

CLASSIFICATION

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INTRODUCTION

Cognitive decline often accompanies normal ageing, however not all cognitive functions seem to decline at the same rate nor simultaneously [1]. On one hand, increasing impairments through ageing are seen in fluid intelligence (perception, processing accuracy, speed of processing, reaction time, the encoding of new memories into episodic memory, the ability to learn new things, the recall information from long term memory, the capacity of working memory, executive control, selective attention, and inhibition of distracting information) which is mostly biologically and genetically determined. On the other hand, crystalline intelligence (verbal knowledge, comprehension, autobiographical memories, emotional processes, strategies of processing, learned skills, occupational skills) can not only stay stable with age but may even improve. Since this knowledge is able to compensate for decline in the cognitive pragmatics, cognitive decline has little impact on everyday life. However, still differences in performance between young and elderly increase with task complexity [2], especially in laboratory and academic settings.

Many developmental research show that basic cognitive abilities decline with age, however, there are inconsistent results. On one side, studies on theory of mind (TOM) show superiority of older adults in their ability to attribute mental states to self and others as well as in predicting and explaining behavior. In first study of TOM in normal ageing [3] they suggested that despite decrease in performance on tasks with nonmental content the performance in TOM tasks (understanding double bluffs, mistakes, persuasions, and white lies) remains intact or may even improve with coming of age. In their experiment elderly group outperformed the younger on TOM stories task. However, these results were not replicated by Maylor, Moulson, Muncer, and Taylor [4] who found age-related decline in mental state based inferences. Another research [5] revealed age-related changes in older adult's performance on cognitive TOM stories task while their results in affective TOM task show that older adults performed nearly the same as the young adults. Many other research show an age-related decline of TOM [6-8]. Contradicting results might be explained by various factors, one of such being unclear differentiation of the subcomponents of TOM, differences in memory load that TOM tasks require, or different definitions of "old-age" [5].

Stability and increase in efficiency is often found in social cognitive functioning. Everyday problem solving was shown to increase with age, with older adults outperforming the younger [9]. In ecologically relevant contexts age-related declines in cognitive performance may no longer be observed [10]. Older adults were also reported to endorse more effective problem solving in comparison to middle-aged and younger adults [11]. Marsiske and Willis [12] supported the idea of multidimensionality of everyday problem solving. Based on older adults' reporting about having difficulties with tasks of cognition in a laboratory setting while feeling apparent efficacy managing everyday lives, Marsiske and Willis pointed out "an intuitive paradox". Later it was suggested, this paradox might exist because of motivation [13]. Since cognitive decline exhibited by adults in most of their cognitive abilities contradicts their sociomotivational increase in perspective taking in older age, they presumed it might be so because elderly are more motivated to perform better in certain perspective-taking tasks.

COGNITIVE AGEING

Theories in general prefer to explain cognitive decline by biological factors. First hypothesis is based on a correlation between age-related changes in cognition and speed of processing is

a *general slowing hypothesis* [14]. It holds that at least some of the age-related effects on cognition are a consequence of decreased speed of processing.

Second is *inhibitory deficit theory* [15] which presumes that age differences in cognition arise from reduced working memory capacity. According to this hypothesis decrements in cognition that are tested by tasks typically referred to as frontal lobe tasks are related to inability to ignore irrelevant information in the environment while subjects are focusing on the desired goal [16]. *Frontal lobe hypothesis* with a localizationist approach claims that a prefrontal deterioration in ageing drives cognitive decline [17, 18]. It predicts a selective decline of functions which depend on frontal regions and presumes also that other functions independent from frontal lobe are spared [19]. Cognitive processes subserved by the frontal lobe are one of the first to exhibit a decline with increasing age [20].

The third is the *sensory deficit hypothesis* of ageing which argues that changes in sensation are responsible for the changes in cognitive efficiency [21]. Sensory deficit is supposed to impair performance of subjects performing a task related to general intelligence. However, there were opposing reports to this theory where they found middle-aged adults performing even better in cognitive tests in low acuity condition [22]. Conflicting findings may be a result of different cognitive resource adjustments elicited by different methods.

ADAPTIVE ASPECTS OF BEHAVIOR

One of components of adaptive functioning within the context of social cognitive functioning is selectivity in allocation of cognitive resources [23]. Baltes [24] gave an example of a general theory of life span development. Metatheory *Selective optimization with compensation* (SOC) [24] represents a general model of effective adaptation to biological, psychological and socioeconomic changes in life. Adaptation of an individual depends on sociocultural context, individual resources, and personal preferences. In advanced age this adaptation and balance between gains and losses could be achieved by the three component processes: selection of domains important to an individual, optimization of resources and aids that facilitate success in those domains, compensation of the losses in those domains. However, despite contribution to successful ageing it becomes difficult for older adults to engage in SOC strategies due to resource decline [25].

Another theory is *Selective engagement hypothesis* [23] which argues that there is more selectivity in older adults' engagement of cognitive resources. Selectivity is determined by personal relevance, meaningfulness of a situation – that is, older adults would allocate more cognitive resources into tasks with more personal meaning. Hess, Rosenberg and Walters [26] used impression formation task to examine ageing-related selectivity. By varying personal relevance of two motivational variables; the context and behavioral information, they influenced the recall of consistent and inconsistent behaviors of older adults. Elderly were better in recalling inconsistent over consistent behaviors when they were expected to be held accountable for their impression. In experiment of impression formation, in situation where message relevance was high, older adults' attitude toward a lawmaker was independent of his likability. Hess et. al. [26] concluded that older adults' thinking reflected a type of heuristic processing which reflects selective engagement in the task and not necessarily reduction in resources and skills. They have also shown that inconsistency effect in recall of older adults is associated with their resource-consuming elaborative processing of behaviors incongruent with expectations.

REDUCTIONS IN COGNITIVE RESOURCES, SELECTIVITY IN COGNITIVE RESOURCES ENGAGEMENT AND MOTIVATIONAL RESERVE

Hess [23] highlighted the studying of cognitive functioning from a social cognitive perspective. He presumed energy consumption affects/mediates older adults' engaging in effortful processing. Resource-demanding social judgment processes depend on shifting goals of the resources and are not a mere consequence of variations of these cognitive resources. Changes in personal resources influence intrinsic motivational factors that are associated with everyday behavior and higher personal need for structure [27]. In other words, elderly show a greater need for structure if they are in poor health, in low ability, etc. which lead to a diminished engagement in cognitive and social activities [28]. In their research they found the need for structure only influencing older adult's performance in a high relevance condition which suggests that in adults who are in low need for structure the selectivity effect would be most evident. Similarly, in another research at low levels of motivation age differences were visible in the nature of processing [29]. Experiment was designed to make judgments based on scenarios containing informations that were either easily to process and superficial or complex and resource-demanding. Consistent with selective engagement hypothesis, older adults reported less interest in a scenario where their processing was less likely to be influenced by difficult-to-process information and exhibited behavior suggestive of more analytic processing when they reported higher level of engagement.

Decrease in the use of SOC by the elderly has been reported in empirical studies [30-32]. Approaching very old age might operate as a constraint on the use of SOC-related behaviors by limitation of internal or external resources restricting the range of possible alternative goals and domains of functioning of elderly people [31]. Their research showed a negative correlation between chronological age and self-reported SOC. In a longitudinal study [32] a linear decrease in the availability and efficiency of action resources was observed over the age range studied while compensatory efforts only started to decline at the age of 70 after previous constant increase.

It was repeatedly observed that the degree of brain pathology is not directly related to the clinical manifestation of that damage which gave rise to the idea brain reserve [33]. Brain reserve is also used by healthy individuals who cope with demanding tasks.

A type of brain reserve is motivational reserve which reflects motivational abilities that enable an individual to surpass neuropathological damage to some extent [34] in order the subject to function as before the damage. They include variables important for the implementation of personal goals [35] such as action planning and goal orientation [34]. It has been assumed that due to the motivational abilities the number of synaptic connections increases and thus strengthens pathways that compensate for the disrupted brain networks.

PROVERB INTERPRETATION TASK

Age-related decline is seen in cognitive abilities such as executive functions (EF) [20], abstract reasoning being one of its subcomponents [36]. A recognized instrument to evaluate abstract reasoning is the test of proverbs which we used in our pilot study.

In human speech we use non-literal expressions and the ability to interpret their meaning is essential if one wants to engage in successful interactive social communication. Direct literal interpretation would lead to misunderstanding. To test understanding of the non-literal expressions proverbs are used in a clinical test where subjects are asked to interpret the meaning of the proverb. Goldstein characterized this abstract attitude where "we transgress the immediately given specific aspect or sense impression; we abstract from particular properties. We detach ourselves from the given impression, and the individual thing represents to us an accidental or representative of a category." [21]. Non-literal understanding

of figurative expression might demand a suppression of the literal interpretation [37] which demands more engagement and motivation to achieve.

METHODS

PARTICIPANTS

Participants were not aware of the real subject of the study however they agreed to participate in a test of proverb interpretation, pretext under which the test was presented. Participants were assigned to two age groups: younger adults (YA) and older adults (OA). Exclusion criteria for OA – retired participants, was incapability of living independently. Only retired adults who live on their own, outside retirement homes, were included in the research. In group YA, only those who were employed at the time of testing were included in the research.

The mean number of years of education for group YA was 14,8 (range 12 to 21 years). This group consisted of 24 subjects (10 men and 14 women) aged 26 to 67 years (mean 46,5 years and standard deviation 10,18 years).

The mean number of years of education for group OA was 13,4 (range 8 to 21 years). This group consisted of 24 subjects (2 men and 22 women) aged 57 to 77 years (mean 64,2 years and standard deviation 5,50 years).

PROCEDURE

Testing was carried out in environment they found comfortable and familiar with. First group of OA was tested in a center of activities for retired adults, where they regularly visit different daily activities. The testing was carried out during the time they usually have sporting activities on schedule. They were tested in groups of 9-13 individuals at the same time, with some short breaks when they could drink water. Testing lasted from 45min to 1 hour. They knew each other and were well familiar also with the room. Second group YA was tested at home.

All subjects were presented a test with different short tasks printed on. Subjects first had to complete the odd number sequence. Second task was added to check heuristic thinking and as the third proverb interpretation task followed.

STIMULUS SELECTION

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

PROVERB INTERPRETATION TASK

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

The second part of the task assessed familiarity and agreement ratings for each proverb. For this purpose ranging in a shape of a five point-response scale ranging from 1 – “I have never read or heard this proverb before” to 5 – “I have frequently read or heard this proverb and I use it in my everyday life” was used. For agreement rating the same scale was used, five-point response scale rating marked 1 – “I cannot connect to the proverb’s message and I do not agree with it” to 5 – “I completely agree with the proverb and I can find connections to my life”.

SCORING SYSTEM FOR PROVERB INTERPRETATION

When assessing proverb interpretations the choices of proverbs and methods for analyzing are non-standardized and arbitrary [38]. Measuring proverb interpretations is sometimes based on their abstractness and concreteness [21]. On the other side investigators suggest literalness as the variable that should be measured [39]. They concluded that intelligence and the ability to respond abstractly do not affect literalness of proverb interpretation and that concreteness depends too much on intelligence.

A categorical system for scoring similar to Hertler, Chapman and Chapman [39] was created to assess the quality of interpretations of the proverbs in this pilot study. Scoring principles for literalness in responses ranged from 0 to 2 points for a proverb correctly explained.

The proverb interpretation was attributed 0 points in the following cases:

1. The answer was “I don’t know” or there was no response.
2. There was only a reference to the subject’s personal experience.
3. There was no relationship to the literal meaning or the interpretation.
4. There was only a repetition of the proverb or a part of the proverb.
5. The answer was a single word that did not have any relationship to the proverb or its interpretation.

The proverb interpretation was attributed 1 point if:

1. The answer did include at least a synonym for a symbol in the proverb.
2. The answer gave an abstract repetition of at least a part of the proverb.

The proverb interpretation was attributed 2 points when:

1. The answer gave an abstract meaning of the proverb with semantic associates for the symbols from the proverb.

RESULTS

NUMBER SEQUENCE AND HEURISTIC THINKING

All subjects in the group YA filled in the number sequence correctly, and the mean adequacy score for the OA group was 0,79 (standard deviation 0,415). The analysis found that group OA had statistically significantly lower level of success in completing the number sequence ($t(23) = 2,46, p = 0.022$).

Both groups A and OA scored the same number of correct answers ($N = 2$ in YA and $N = 2$ in OA group) in heuristic’s thinking task.

PROVERB COMPREHENSION, FAMILIARITY AND AGREEMENT

Proverbs were graded form 0 to 2 points, therefore 40 was the highest score possible. In group YA the mean score for all the proverbs was 17,4 (standard deviation 8,61) and the mean score for the group OA was 11,7 (standard deviation 7,11). The t-test comparing the scores of YA and OA group was significant ($t = 2,488, p = 0,017$), suggesting that the YA group produced more adequate responses than the OA group.

Familiarity with the proverbs was graded on a five-point-rate scale and thus the total amount of points was 100. Analysis of the ranging of the familiarity of the proverbs found the mean score of the group YA was 44.46 (standard deviation 9,95) while for the group OA it was 51.04 (standard deviation 12,56). The t-test comparing the scores was significant ($t = -2,013$, $p = 0,05$), implying that the OA group was more familiar with the proverbs than the group A.

Agreement with the proverbs was graded on a five-point-rate scale with the total amount of possible points being 100. For the group A the mean score was 57,46 and standard deviation 13,89 while for the group OA the mean score was 64,21 and standard deviation 13,06. The t-test showed a significant difference in agreement scale between the two groups ($t = -1,734$, $p = 0,09$), suggesting that the OA group agrees significantly more with the proverbs than the group A.

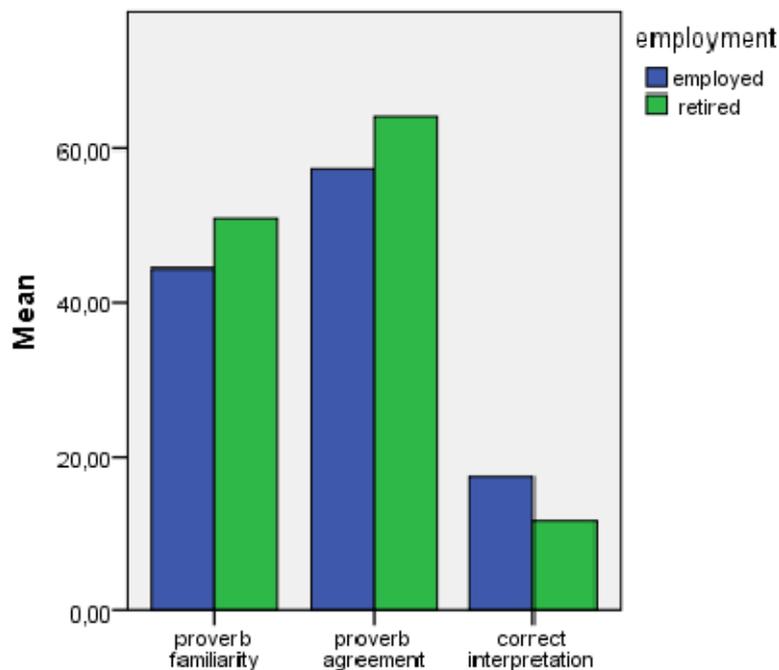


Figure 1. Proverb familiarity, agreement and comprehension comparison between two age groups.

CLOSENESS TO THE RESEARCHER

Considering ratings of relationship of the experimenter to the subject there were no statistically significant differences. In group A (employed subjects) the analysis showed that 11 subject rated the experimenter close to them, being friendly and approachable, while other 13 participants in this group stated experimenter rather professional and not close to them or felt indifferent. In OA (retired subjects) group the same number of participants rated the researcher rather close to them ($N = 11$) and distant and professional ($N = 13$). None of the variables (age, sex, education, employment) had an effect to closeness.

Participants' subjective opinion about the closeness to the researcher correlated with the adequacy of proverb interpretation. From Figure 1, which shows two independent variables (employment and preception of closeness) and one dependent (score in the test), it is seen that employed younger participants scored more points in the proverb interpretation task in comparison to the older retired participants. A univariate analysis of variance tested the effects of perceived closeness to the score. Results indicate that the perception of Closeness significantly effected score in the proverb interpretation task ($F(1,48) = 4,485$, $p = 0,040$). A

significant difference was found between the two age groups when comparing their score. Employment therefore had a significant effect ($F(1,48) = 6,691, p=0,013$). On the other side, interaction Closeness \times Employment was not significant ($F(1,48) = 0,194, p = 0,662$), indicating the two groups are not responding significantly different in test when the closeness condition is taken into account.

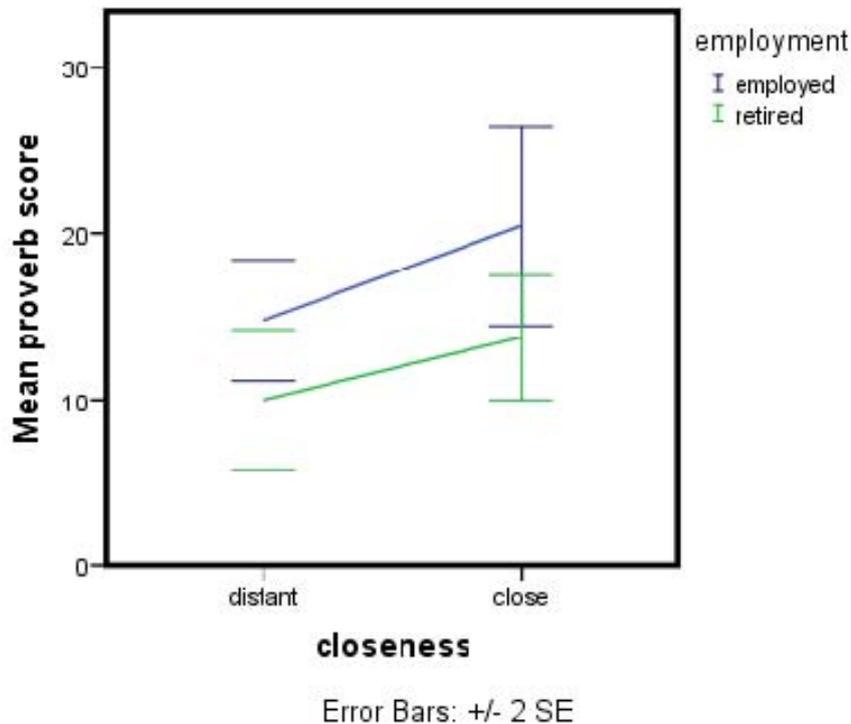


Figure 2. Adequacy of proverb interpretation (mean proverb score) of the two groups of participants in relation to their closeness to the researcher.

For further research the difference between subjects within the two groups would be interesting – retired subjects who perceived to be close to the researcher ($N = 11$) vs. the employed subjects who did not perceive to be close to the researcher ($N = 13$). Oneway ANOVA analysis showed no significant difference in score in proverb interpretation task ($t(22) = 0,398, p = 0,694$). The latter came as a nice surprise and would be worthwhile of further investigation.

DISCUSSION

The present study aimed to assess different effects on proverb comprehension with potential contributions of closeness to the researcher. The scoring system used in this study appears to be a useful tool however there might be some disadvantages. In cases when subjects failed to provide an abstract interpretation, it was difficult to interpret what they were doing. The problem with the proverb test is also its complexity and it involves hypothesized cognitive processes [38]. Providing inadequate interpretation of proverbs may happen due to various reasons. Subjects may not have recognized the proverb or had speech production problems. Familiarity in some cases did not play a role in successful interpretation; it occurred that subjects rated high familiarity with the proverb and failed to provide an adequate interpretation and vice versa. It is necessary to stress again that the proverb test was designed especially for the purpose of this pilot study and it was not a previously established test. Therefore a lot of improvements are possible in this area.

The present pilot study confirmed past research indicating that cognitive abilities decline with age however some stay unchanged or may even improve. Closeness was not manipulated but was still monitored and it proved that participants who felt closer to the researcher, finding her approachable and open to connect, performed better in the proverb interpretation task. On the other side, participants who were indifferent or found the researcher rather distant and not close to them, scored lower in the test. On average, younger subjects outperformed the older, but it came as a surprise that older participants who perceived to be close to the researcher did not score significantly lower on the test in comparison to the younger adults who did not perceive to be close to the researcher. If closeness increases motivation of older adults to a comparable level as younger participants, that they become more cognitively efficient, ways of manipulation could be developed in future in order to enhance older adults' cognitive abilities. By understanding cognitive networks in the background not only enhancing abilities but also preserving them into older age might become possible. For the time being, this knowledge might be worthwhile taking into account in neuropsychological assessment for ecologically more valid results. Other interpretations are possible. One might be that participants who did well in the test felt it and this could have boosted their confidence. This then made them more open to connecting to new people in this case, the researcher.

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VEZANOST KOGNITIVNE UČINKOVITOSTI, KOGNITIVNE SPOSOBNOSTI I MOTIVACIJE

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SAŽETAK

Suvremena istraživanja često se fokusiraju na problem smanjivanja kognitivnih sposobnosti uslijed starenja. Ljudi se prilagođavaju promjenama kognitivnih resursa korištenjem rezervi u mozgu. U radu je dan pregled rezultata različitih istraživanja o smanjivanju kognitivnih sposobnosti starijih osoba, uz istaknutu znatnu varijabilnost a katkad i kontradiktornost zaključaka. No, također se pokazuje kako stariji mogu biti jednako dobri ili i bolji od mlađih sudionika u specifičnim domenama. Između ostalog, osobni smisao neke situacije i bliskost s istraživačem mogu biti važni faktori pri procjenjivanju kognitivnih sposobnosti. Cilj ovog rada je istražiti kako ti faktori utječu na kognitivnu učinkovitost.

U pilot istraživanju eliminirani su faktori laboratorijskog postava te je provjereno kako se kognitivna učinkovitost i sposobnosti mijenjaju u odnosu na motivaciju. 48 sudionika, podijeljenih u dvije dobne skupine, prolazili su test interpretacije poslovice. Rezultati su pokazali kako su ispitanikov subjektivni doživljaj istraživača i doživljena bliskost, u korelaciji s prikladnošću interpretacije poslovice. Obje skupine postizale su bolje rezultate u prikladnosti interpretacija kad su se smatrale bliskijima istraživaču. Mlađa skupina nadmašivala je stariju. Ali oni u starijoj skupini, koji su se smatrali bliskima istraživaču, postizali su rezultate kao i oni u mlađoj skupini koji se nisu smatrali bliskima istraživaču. Ova motivacijska rezerva može biti značajna u procjenjivanju kognitivnih sposobnosti i patologija koje utječu na rezultat neuropsiholoških testova.

KLJUČNE RIJEČI

kognitivna sposobnost, kognitivni pad, rezerva motivacije, bliskost, zadatak interpretiranja poslovice

MODULATION OF MOTORIC PROCESSES ON THE BASIS OF TAIJIQUAN MOVEMENT PRINCIPLES

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ABSTRACT

Taijiquan (TJQ) is a Chinese martial art, in the West known primarily as a stand-alone version of moving meditation, which was developed mainly on the experience of martial art. The main goal of TJQ as a martial art is to control the opponent's balance with as little force as possible and can be described with the well-known metaphor that "4 ounce can defeat 1000 ounce." This metaphor usually stands for a special effect in TJQ, called fajing. To understand the basic movement principles of TJQ we have to analyse the experience itself. On the basis of first- person analysis, we designed a number of pilot and one extensive study. In this article we will present an intervention method that uses TJQ movement principles to modulate motoric (MM) process and produces the fajing effect – which usually takes years of proper exercise – in just 15 to 20 minutes. A pilot study was designed to measure the influence of MM method on our movement. The participants had to use each arm to work on a different task. They used one arm to move the computer mouse and the cursor on the computer screen trying to catch the marker on the screen as fast and as accurately as possible. The other arm was interfered with constant steady movement forward-backward in the lateral direction. We measured the accuracy and speed of movement before and after the intervention. It turned out that the participants were more accurate in performing their task after the MM intervention than before it. Before the intervention the accuracy was $0,443 \pm 0,058$ and after the intervention it improved to $0,498 \pm 0,053$, $p < 0,01$. The participants could follow the disturbances much more easily after the MM intervention, they could concentrate more on their task and they were better in using their arms separately.

KEY WORDS

taijiquan, motoric processes, embodiment, intervention, learning

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INTRODUCTION: ANALYSING COMPLEX EXPERIENCE OF TJQ

Taijiquan (TJQ) is a Chinese martial art, in the West known primarily as a stand-alone version of moving meditation, which includes slow and controlled movements, usually practised through defined exercise sequence, known as a TJQ form. TJQ uses a special kind of movement principles, which are different from every-day movement. The step in TJQ compared with ordinary slow step provides a longer stand on one leg, an increased range of motion leg joints, longer operation times and co-activation of isometric muscles [1]. Different research papers have shown that TJQ gait can be effective in improving flexibility, and can contribute to better static balance [2]. The TJQ exercise can reduce fear and the possibility of falling in older people [3]. Although quite some research papers deal with some of the consequences of the TJQ exercise, they are usually not concentrated on understanding the basic principles of TJQ.

The stand-alone version of TJQ was developed primarily on the experience of martial art. The main goal of TJQ as martial art was to control our own and the opponent's balance and is trained through exercise in pairs. The basis of the exercise in pairs is keeping constant contact with the fighting partner. By pushing, pulling and reflecting the participant tries to manipulate the relationship between the centre of mass (COM) and the base of support (BOS) of his or her fighting partner [4]. The ideal of effectiveness in TJQ is to control the opponent's balance with as little force as possible and can be described with the well-known metaphor that "4 ounce can defeat 1000 ounce" [5, 6]. This metaphor usually stands for a special effect in TJQ called *fajing*. We talk about *fajing* effect when we prepare our partner to lose balance, or to bounce to maintain their balance, with very little force on our part. To achieve the *fajing* effect all the basic principles of TJQ should be fulfilled.

When we try to understand complex experiences as TJQ, we encounter several problems because descriptions of these are limited by the linguistic and symbolic nature of the language as such. Complex experiences are usually described with abstract and metaphorical meanings, which can be formed in different cultural contexts and which allow many different interpretations. To understand TJQ principles properly we have to analyse the experience itself. Experiences appear on the basis of physical and mental processes. Embodied cognition offers a useful model which can help us deal with complex interweaving processes that produce complex experiences. Cognitive philosophy highlights the importance of understanding the cognition in connection with the body and its embedment in a given environment [7]. We can understand the concept of embodiment and the embedment primarily in terms of bridging the gap between body, brain and environment. Based on the interactions between these levels and the combination of a variety of mechanisms, our behaviour, perception and thinking are shaped [8]. TJQ experience represents one of the above-mentioned interactions. Such a model allows at least two different methodological approaches: the phenomenological analysis of experience and the possibility of quantitative research of various systems and components of these systems. We have tried to determine how physical and mental levels of experience are connected, and to what neurophysiologic processes metaphorical and abstract concepts, traditionally used to describe the experience, relate. Based on this analysis, we studied some of the neurophysiologic conditions that can produce *fajing* effect. Understanding the mechanisms that can produce a *fajing* effect can help us comprehend the basic principles of TJQ.

PHENOMENOLOGICAL RESEARCH OF TJQ AND FORMING THE EXPERIMENTS

To design proper experiments we had to understand the TJQ experience on the level of the first person. We used phenomenological approach [9]. The method we used in describing the TJQ experience is similar to *descriptive experience sampling* method, which was introduced by Hurlburt and Heavey [10]. In this method, the participant must, at random intervals, freeze current experience and write down a brief description of experiences into a notebook. By analyzing TJQ, freezing occurs based on the perception of muscle tension or stiffness of the body that happens in the process of interaction between fighting partners. Because we focused mainly on sensoric awareness and interaction with the partner, we called this type of research *first-person situational analysis*.



Figure 1. First person analysis in TJQ.

Based on the first-person analysis, we designed a number of pilot studies and an extensive one. We used an innovative method for measuring the stability after the sudden release of horizontal forces, which enabled us to observe physical reactions in a controlled environment. Loading and sudden release of the load produced similar situation that we face in contact with a partner. We have developed a special method to modulate the motoric processes (MM method). A pilot study on the effects of MM method, also called a JMV method [8], will be presented in this paper. On the basis of this method we have managed to produce the *fajing effect* in 15 to 20 minutes.

TJQ PRINCIPLES OF BODY STABILITY

We have developed a method for measuring stability, which allows us to observe our body reactions in a controlled environment, similar to those happening in contact with a partner. A pilot [11] and extensive study was made on this topic. By horizontal loading of various parts of the body and a sudden release of the load we achieved a similar situation as in pushing and releasing when working with a partner in TJQ sparring. We selected the parts of the body that are associated with sparring, namely the hips, shoulders and the arms at shoulder height. We monitored the movement of COP, the ground reaction forces in vertical (F_z) and horizontal direction (F_y), and the movement of knees, hips, shoulders and hands after a sudden release. We monitored the reactions after the sudden release of load on two groups, TJQ group (TJQ-G) and control group (CO-G). On the basis of the results we concluded that TJQ-G had better postural control after sudden release of the load. The TJQ-G produced smaller F_z amplitudes and shifted the whole body simultaneously forward after the release. The CO-G, on the contrary, locked the knee, therefore leaned forward with upper body and produced higher F_z

amplitudes [8]. We can conclude that TJQ-G used a different movement strategy and consequently produced lower forces on the ground. Less intensive response can also mean that the TJQ-G can regain conscious control over the movement faster than the CO-G. The TJQ-G reacted according to the basic TJQ principles.

DISTAL MOBILITY AND MODELLING OF MOTORIC PROCESS

At the level of proximal stability the results revealed yet another important difference. There is a big difference in the ratio of intensity of Fz response in the case of arms and shoulders release. TJQ-G group had a much better relationship between the response at the level of shoulders and arms than the CO-G. Fz amplitude for arms release amounts just 70 % of the shoulder release amplitude. For the CO-G the figure is 92% [8]. Based on these differences we can conclude that the CO-G had almost the same response after the shoulder and arms release. The participants from CO-G were not able to use additional joints in the case of arm loading to compensate the sudden release. TJQ-G therefore proved to have better mobility of the distal joints.

These results indicate another basic principle of TJQ movement. When we move, we have to keep our body straight, to produce less intensive reactions after disturbances, and we have to keep our arms as free as possible to move. In TJQ classical literature we can find many descriptions and metaphors that deal with the relationships between the arms and the torso. This is one of them:

“Drape the shoulders and sink the elbows;
Rise the back and relax the chest” [6; p.50]

To master TJQ principles TJQ students usually need years of proper exercise. But because of the complexity of movement principles and different interpretations it is quite possible that they will miss the described goal. On the basis of the first- person analysis of TJQ experience we expected that we could design a new method which would at least temporarily produce the desired effects. MM method uses TJQ learning principles and movements and brings them into controlled environment, where the participant has constant feedback. With manipulation of muscle coordination, muscle stiffness and muscle synergies we try to achieve a state described with the metaphor “drape the shoulders and sink the elbows”. Following this goal the MM method produced *fajing* effect in just 20 minutes. The effect was temporal and was usually lost after some trials. That means that participants have not learned a new way of movement, they just got the right experience. On the basis of this experience the learning process can be more efficient and faster. The MM method can give us new experience of movement and can help in learning processes. To understand the influence of MM method on our motoric patterns, we designed a pilot study.

THE PILOT STUDY: HOW DOES MM METHOD INFLUENCE OUR MOTORIC PATTERNS

EXPERIMENT SETUP

In the pilot study we focused on MM method intervention at the level of the shoulders, to produce better distal mobility of arms and to achieve TJQ ideal “drape your shoulders and sink the elbows”. We measured the accuracy and speed of movement before and after the MM intervention. We used a freeware “TheraWii”, programmed by the Drexel Computer Science University, to measure the mentioned parameters. The software can be used to determine effects of rehabilitation process. We can use a mouse or a balance board to perform different tasks on the computer screen. To measure the movement of the shoulders, we

installed a computer mouse in a moving plate and with elastic belts immobilize the arm from the elbow to the wrist (Figure 2.). The designed task was composed of thirty circles of three different sizes. We started with large circles, continued with smaller ones and concluded with the smallest circles. The circles occurred randomly on the screen. To complete the task, the participant had to move the mouse cursor inside the circle as fast and as accurately as possible, and he had to keep the cursor inside the circle for 3 second. Then another circle appeared. The participant finished the task when they hit all 30 circles.



Figure 2. Experiment design, first protocol (left), second protocol (middle), large circle task on computer screen (right).

The study consisted of two separate protocols. In the first protocol we tried to determine the effects of the MM method on the accuracy and speed of the cursor on the hand where we performed MM intervention. In the second task, we disturbed the hand where we performed intervention with a constant steady movement forward - backward in the lateral direction, and the participant performed the accuracy test with the opposite arm. The speed and the accuracy of movement was calculated with TheraWii program. In the pilot study, five participants – two women and three men – participated in both protocols. The tasks were done before and after the intervention.

THE INTERVENTION PROCESS – THE MOTORIC PROCESSES MODULATION METHOD

The basic components of the MM method are established on the basis of first person analysis of TJQ experience and on the basis of understanding the basic principles of TJQ movement. To achieve the desired goal “drape your shoulders” we included also other known approaches to MM method, especially Feldenkreis and PNF (proprioceptive neuromuscular facilitation stretching) approach. We can expose the main components of MM method in four main areas:

- 1) Partial local elimination of the need to resist gravity forces (in our case relaxing elbows on the vibration plate and keeping the participant’s torso straight),
- 2) Gentle vibration in the range between 2 and 7 Hz with a medium-sized amplitude (1 cm – 3 cm),
- 3) Using a vibration plate to move the relaxed part of the body, in our case the arm, in different directions, with smooth circular or linear movement. The movement can be done manually or mechanically,
- 4) Relax and extend principle. Extending one muscle or chains of muscles to slight stiffness, relaxing the muscle with self- awareness or with PNF method, and further extend the muscle or muscle chains.

In our case we used the technique to influence the motoric processes in the shoulder and in the arm. We extended the relaxed arm in three different directions (Figure 3.), sideways, forward and backward. In each direction the arm is relaxed on the vibration plate and extended until the participant feels slight tension in their arm. Then we ask the participant to tilt the head in opposite direction to achieve some further muscle tension, after a few seconds they return to normal position and their muscles relax. After the relaxation we extended the

arm further until the participant feels a new tension (Figure 3). We increased the distance for three to five times in each direction. The MM method can be done also with a computer regulated movement. In this case extension of muscle is carried out until the value on the force sensor exceeds the predetermined value. After the relaxation, the distance is increased automatically until the force sensor value is exceeded. The vibration process is a constant part of the MM method. In the last phase of intervention we performed a slow in smooth movement of the arm in different directions. In our case the intervention was carried out for 15 minutes.



Figure 3. Modulation of motoric process on the basis of MM method.

DATA ANALYSIS

The program TheraWii calculates different values that relate to the motion of the cursor before successfully completing the task. In our case, we focus on two figures: the average speed of movement (V), whose calculation is based on the distance and the time that the indicator needs to achieve the goal, and accuracy (U), which is calculated on the basis of the relationship between the calculated shortest path and actual travelled distance between cursor position and its targeted circle. We used the program to calculate the average value for each of ten tasks and for each size of the circle. On the basis of the calculated averages for each person and each size of the circle, we compared the values before and after the intervention. We calculated the standard deviation. The statistical significance was measured with the two-way t-test. In the results of the main comparison (Table 1) 300 measurements before and after the intervention were included. In addition, we calculated the correlation between speed and efficiency values before and after the MM method intervention. Because we were interested in the difference between the speed and efficiency of large and small circles, we calculated the average value for small and large circles and then compared them.

RESULTS

The calculated results showed that there was the biggest difference between accuracy of the movement before and after the intervention in the second protocol, where we disturbed the arm on which the MM intervention was performed and the participant used the other arm to complete the task. The participants were more accurate and efficient after the intervention. The values before are $0,443 \pm 0,058$ and after $0,498 \pm 0,053$, $p < 0.01$ (Table 1.). In the case of first protocol the rate of accuracy is slightly higher but it is not statistically significant. The differences between results before and after the intervention are $0,539 \pm 0,042$ and $0,548 \pm 0,04$, $p > 0,05$.

The accuracy of movement could also affect the speed, but it does not show a statistically significant difference between the speeds before and after the intervention (Table 1). In both protocols the speed remained fairly similar. When we compare the accuracy of movement for large and small circles we can see that the only difference that is near statistical significance $p = 0,058$, is in the case of second protocol before the MM intervention (Table 2). The movement is much less accurate in the case of small circle when the task is more difficult. On the other side there is almost no difference between accuracy at the level of big and small circles after the MM intervention, the values are $0,503 \pm 0,047$ and $0,492 \pm 0,058$, $p = 0,572$ (Table 2).

Table 1. Comparison of accuracy and speed before and after the MM intervention for both protocols.

	Protocol one		<i>p</i>	Protocol two		<i>p</i>
	before MM	after MM		before MM	after MM	
Accuracy	0,539 ± 0,042	0,548 ± 0,04	0,379	0,443 ± 0,058	0,498 ± 0,053	0,000
Speed	0,612 ± 0,077	0,615 ± 0,09	0,871	0,608 ± 0,091	0,604 ± 0,077	0,864

Table 2. Comparison of accuracy for large and small circles for both protocols.

	Protocol one		<i>p</i>	Protocol two		<i>p</i>
	before MM	after MM		before MM	after MM	
Large circle	0,540 ± 0,045	0,566 ± 0,031	0,072	0,471 ± 0,043	0,503 ± 0,047	0,184
Small circle	0,536 ± 0,041	0,544 ± 0,041	0,713	0,421 ± 0,068	0,492 ± 0,058	0,012
<i>p</i>	0,219	0,339		0,058	0,572	

CONCLUSION

It has been shown that the MM method does not affect accuracy of the movement of the arm where we performed the MM method intervention; at least the change was not statistically significant in our case. The difference before and after an intervention occurs in the second case, in which the task is done with the opposite hand, while the intervened arm is disturbed with constant steady movement forward-backward in the lateral direction. One of the reasons for the greater accuracy and effectiveness after the intervention could be smaller movement speed, but the average speed values do not support this option. Therefore we can conclude that in this case the speed of movement does not affect the performance. In the comparison between big and small circles accuracy we found out that there is a strong tendency towards a difference between the accuracy before the intervention in the second protocol. The participants were less accurate in the case of small circles, where the task is more difficult and the movement needs more attention. This result can indicate that in the second protocol where we have to use each arm on a different task, the participants have more difficulties to target small circles before the intervention. After the intervention there is almost no difference between accuracy in the case of large and small circles, so we can conclude that the participants could follow the disturbances much more easily after the MM intervention. This could be because they could concentrate better on the task and therefore achieve greater effectiveness and accuracy. We encounter a similar situation in TJQ exercise in pairs. TJQ classics say that in sparring you do not use “butting, insufficiency, separation and resistance in relation to the opponent, but rather use sticking, adhering, connecting, and following” [6; p.67]. This goal is achieved when we minimize the effect of external on our balance. MM method can produce a similar effect in very short time and can help us to understand some of the basic principles of TJQ. On the basis of pilot study we could design further experiments, which would include measurement of brain activity before and after the intervention, and we could use a robot arm to perform the interruptions.

With the pilot study we showed to some extent that MM method can temporarily change our motoric patterns, can produce a *fajing effect* in a very short time, and enables using both arms separately more easily. Because the effect of MM method is lost after some time, it cannot substitute the slow motoric learning process. To learn new motoric skills several proper repetitions are needed. The MM method can help us get the right experiences and include them in our learning. The method is not limited only to understanding the TJQ, but can also help us influence or change our every-day motoric patterns.

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MODULACIJA MOTORIČKIH PROCESA NA TEMELJU PRINCIPA POKRETA TAIJIQUAN

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SAŽETAK

Taijiquan (TJQ) je kineska borilačka vještina, na Zapadu poznata prvenstveno kao samostalna verzija pokretne meditacije koja je razvijena pretežno na iskustvu borilačkih vještina. Glavni cilj vještine TJQ kao borilačke vještine je kontroliranje protivnikove ravnoteže minimalnom potrebnom silom i metaforički se iskazuje kao „4 unce mogu pobijediti 1000 unci“. Ova metafora uobičajeno se odnosi na fajing, posebni efekt u metodi TJQ. Za razumijevanje osnovnih principa kretanja metode TJQ moramo posebno analizirati iskustvo. Temeljem analize prvog lica postavljeno je više pilot studija i jedna ekstenzivna studija. U ovom radu prikazujemo metodu intervencije koja koristi principe kretanja metode TJQ za moduliranje motoričkih procesa te generira efekt fajing unutar 15 do 20 minuta iako je za to uobičajeno potrebno višegodišnje pravilno vježbanje. Pilot studija dizajnirana je tako da mjeri utjecaj moduliranja motoričkih procesa na naše kretanje. Sudionici su trebali koristiti obje ruke za provođenje različitih zadataka. Koristili su jednu ruku za pomicanje računalnog miša a time i kurzora ne zaslonu računala kako bi uhvatili marker na ekranu što brže i točnije. Druga ruka je bila pod utjecajem stalnog i jednolikog, lateralnog gibanja naprijed-natrag. Mjerali smo točnost i brzinu pomaka prije i poslije utjecaja. Pokazalo se kako su sudionici bili točniji u obavljanju zadataka nakon intervencije moduliranjem motoričkih procesa nego prije njega. Prije intervencije točnost je iznosila $0,443 \pm 0,058$ a nakon intervencije porasla je na $0,498 \pm 0,053$, $p < 0,01$. Nakon intervencije moduliranjem motoričkih procesa sudionici su mogli znatno laganije pratiti utjecaje lateralnih pomaka, mogli su se bolje koncentrirati na zadatke i bolje koristiti pojedinu ruku.

KLJUČNE RIJEČI

taijiquan, motorički procesi, utjelovljenje, intervencija, učenje

LOOKING INTO SELF-EXPLORATION ATTITUDES AND WAYS OF CONSTRUCTING EXPERIENCE

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ABSTRACT

Empirical phenomenology – study of lived subjective experience is the latest addition to the interdisciplinary efforts aiming at understanding the human mind. We present the research, which was originally aimed at investigating the experiences of Holotropic Breathwork, however, results of the analysis convinced us to move the focus of our interest to differences between individual ways of constructing experience. We have identified three types of personal epistemologies (i.e. ways of constructing the subjective experience) and found the correlation with individual attitudes towards self-exploration. The paper aims at providing a novel model with regard to how experience is constructed and expands the understanding of the limitations of the phenomenological interview techniques.

KEY WORDS

empirical phenomenology, explicative interview, constructing experiences, personal epistemology

CLASSIFICATION

APA: 2260, 2340, 2630

JEL: D83, D84, Z19

INTRODUCTION

Last decade was marked by an apparent integration of experiential research as a valid methodology for investigating consciousness, and an active effort is made to build the ever-so-necessary bridge between the natural sciences and phenomenology. Third person research of cognition and consciousness seems to have reached an impasse, and the need for a different, rather novel perspective has become obvious to researchers from various disciplines, such as neuroscience, artificial intelligence and cognitive psychology; However, even after admitting that studying consciousness and inner experience by means of ‘classical’, third person methodologies has not brought much insight into the matter, and that a first person approach would be much better suited for such experiential research, phenomenology still remains the ‘helping cousin’ of quantitative research. Nonetheless, it appears that phenomenology is here to stay, claiming its rightful position among the cognitive sciences.

Observing inner processes and then reporting on them as accurately as possible involves not only great curiosity from the participants, but also patience and dedication to the cause. [In other words, looking into subjective experience in an objective way is challenging for both the researcher and the co-researcher (participant) for a number of reasons, which will become transparent in the following paragraphs.

We set out with great eagerness to investigate the experiential landscape emerging from a Holotropic Breathwork (HB) session, which has indeed brought much interesting insight into the experience of our co-researchers rising from this meditation technique; However, as it often happens when using a qualitative approach, another dimension has caught our attention, leading us to a whole new topic, which became the center of our research. We realized, upon close analysis of the experiential data, that the participants’ inner experience was closely linked to their personal models of connecting with the world (which we then named personal epistemologies), as well as to their attitudes toward self-investigation and being interviewed.

Our focus quickly turned toward investigating within the phenomenological discourse *how much* and *in what way* are participants interested in their own experience, *how* they construct their experiences and how these might be related.

METHOD AND PROCEDURE

The protocol of the HB workshop consisted of 2 days of sessions of accelerated breathing, loud evocative music and process-oriented body work, followed by expressive drawing and integration processes, all done in pairs and under the close supervision of two trained specialists [1]. This technique was developed by Stanislav Grof as an alternative to psychedelic psychotherapy (which was banned in the early 70s) and is now used worldwide as an autonomous psychotherapeutic practice due to its profound emotional release and physical relaxation [2].

The participants were previously familiarized with the explicative interviewing technique, and were selected on the base of their prior experience with to phenomenological interviews. Due to their active collaborative role in the investigation and their self-search oriented attitudes, they will, from this point on be regarded as co-researchers.

Three co-researchers have been recruited and further informed on the specifics of *phenomenological interviews*, more precisely previously briefly acquainted with Hurlburt’s Descriptive Experience Sampling method (DES) [3], after which each of them underwent two explicative interviews [4, 5]: one precisely after the HB session, and another a week later, to check if and how they have integrated the experience into their everyday lives.

The approach selected for the purpose of this qualitative research is the one of *empirical phenomenology*. In a nutshell, this approach postulates the idea of scientific explanations being “grounded in the first-order construction of the actors, [...] and then related to the second-order constructions of the scientist” [6]. It entails seven steps which guide the researcher to formulate her assumptions in such way that the readers would be able to see the philosophical roots of the scientific explanation derived from the first-order constructs [7].

The explicative interview, the used method of data acquisition, is a form of guided retrospective introspection [8], which supports the interviewee in accessing her passive, continuous, involuntary memory synthesis [9]. According to Husserl, much of the autobiographical memory is pre-reflective, meaning that it occurs without the person being aware of it. Within the course of the explication interview, this information becomes available to the interviewee, and pre-reflexive transitions into reflexive consciousness. This interviewing technique creates the special framework in which recalling lived experience becomes accessible to the interviewee. The markedly feature of the explication interview is that it seeks to *evoke a present relation* to the lived experience [10]. In this process it is crucial that the subject does not *think* of the lived experience in a reflective, recollective manner, for these two approaches being very different from one another [5].

Hereby we outline the procedure of the phenomenological inquiry:

1. As mentioned before, although prior knowledge about the phenomenological approach was an inclusion criteria of our participants, once they agreed to become co-researchers, they were introduced to the philosophical perspectives, attitudes and concepts behind the approach used in the experiential research.
2. The co-researchers were encouraged to ask questions before beginning the interviews to clarify any uncertainties they might have, either regarding the method or the tone in which the interview will take place.
3. The co-researchers were asked to attempt getting back in the moment of the experience about which they were going to report. They were instructed to focus on the experience itself, setting aside, as much as possible, explanations, contexts, knowledge, constructs and comparisons¹. They were instructed repeatedly to explicate how they think/feel in the most direct way possible, and try to present it in natural, free language “what goes on inside” [11]. These instructions have been given out separately to each co-researcher.
4. Each interview was audio-recorded, with the consent of each participant, while the researcher had been taking notes [12]. The recordings were stored on an iPad under suggestive names (see next paragraph). Each interview had an approximate duration of 60 minutes².
5. The data collected from the interviews was subsequently transcribed by the investigators, and the raw material was coded, analyzed and categorized, in accordance with qualitative text analysis methodology [13].

DEFINING RELEVANT CATEGORIES

Before setting out to present the categories that have emerged from the analysis of the interviews, it needs to be clarified that only those which were relevant for the discussion of our topic were selected and mentioned below. In order to prevent confusion and misapprehension, we ought to explicitly state that the aim of this paper is not to illustrate verbal case descriptions, neither is it to offer a detailed review of the analytical data obtained through the explicative interviews.

In the following paragraphs, we will shortly present the abbreviations used in the coding phase, without going into detail, for this would exceed the purpose of our current article.

What we are trying to do here is merely offer some clarifications, so that the reader would better comprehend the model which we propose in relation to our findings. This being said, we will further present three main groups of categories, each consisting of subcategories which we will attempt to explain and briefly exemplify where needed, but not before shortly presenting a few of our coding techniques³.

Our three Co-Researchers have been coded with CoR1, CoR2 and CoR3. Each interview was assigned the code I1 or I2, 1 referring to the first interview, and 2 referring to the follow-up interview. Also, to keep track of the location of the construct mentioned within the interview, the corresponding digits have been assigned in brackets. So, as an example, supposing a construct was identified in the first co-researcher's follow-up interview at the time of $t = 17 \text{ min } 49 \text{ s}$, the corresponding code's mark would be, intuitively, CoR1.I2.(t17.49). We introduce these codes just to offer a sense to the reader of how we kept track of our data, so that when revisiting the interviews we would know which construct belongs where.

As mentioned above, three relevant categories have been identified, and they are as follows:

- A. Ways of Constructing Experience (C.E.)
- B. Attitudes toward Self-Exploration (S.E.)
- C. Findings about Personal Epistemologies (P.E.)
 - A. Under the 'umbrella' term of C.E. we have included the following sub-categories
 - A1. Manner of Manifesting Thoughts (Inner Speech, Imagery, Sounds and Voices, (Un)Worded Thinking)
 - A2. Feelings (Fear, Joy, Sadness)
 - A3. Mental Processes (Competing thoughts, Conceptualizations, Attributions, Rationalizations, Censorship, Inhibitions, Time Perception)
 - A4. Bodily Sensations (Temperature, Vibrations, Pulsations, Pain)
 - A5. Disturbances (External Voices, Music, Light, Content, Thought Flow)
 - B. Amongst the attitudes of S.E. we count the sub-categories:
 - B1. Perceived Self-Image (self-confidence, contempt, misunderstood ?)
 - B2. Expectations (Comparison, Previous Experience, Assumptions, Contradictions)
 - B3. General manifested attitudes (Argumentative, Suggestible, Detached, Dismissive, Research-Oriented/Curious, Avoidance)
 - C. The findings about P.E. include
 - C1. Thinking styles ("Magical Thinking", "New Age Thinking", "Pragmatic Thinking")
 - C2. Interpretations

All of the above have been coded in such way to facilitate the investigators' keeping track of the data within the transcripts. A conclusive example shall be presented, for purely demonstrative purposes.

Within the first interview, the first co-researcher reported: "the boundaries between body and mind started to disappear, the perception of 'me' was unclear, [...] I was in an empty space, I visualized myself in a rough form of who I am, with a blurred body and felt a spiraling effect. Then I went into my inner space, and that inner space became the Universe, because it was all there is for me at that moment". These statements have been assigned the label consistent with the "New age thinking" category, and the code corresponding to the episode appears like this: C1:NewAgeThi – CoR1.I1.(t48.24 – t51.03). This particular code was encountered in other parts of the interview, as well as in the follow-up, and has consequently been used

throughout the transcripts. The overall moment was experienced as an Unworded Thought, with nuances of Curiosity and traces of Fear, in a generalized Avoidance attitude.

A great deal of the constructs identified throughout the explicative interviews have anchors in all three categories, which is why we took the liberty to propose a model of the lived experience of our co-researchers.

We thus continue with assessing and discussing whether these constructs have any relation with one another, and whether they can be clustered into a relational structure.

CLUSTERS OF INSIGHTS

CONSTRUCTED EXPERIENCES AND PERSONAL EPISTEMOLOGIES SHAPE ONE ANOTHER

Based on the processed data, there are multiple dimensions of constructed experience, beginning with how thoughts are manifested and processed, what sensations arise, are consciously perceived and then interrupted throughout the body, and culminating with how feelings intervene in the experiential scheme, Figure 1. It is suspected that these constructs are rooted into deeper experiences. Our findings suggest a co-dependent relation between the categories pointing to Constructed Experience (C.E.) and Personal Epistemologies (P.E.), namely the P.E. ‘dictate’ how the experience will be created, while the newly formed structures serve as reinforcement to the P.E.

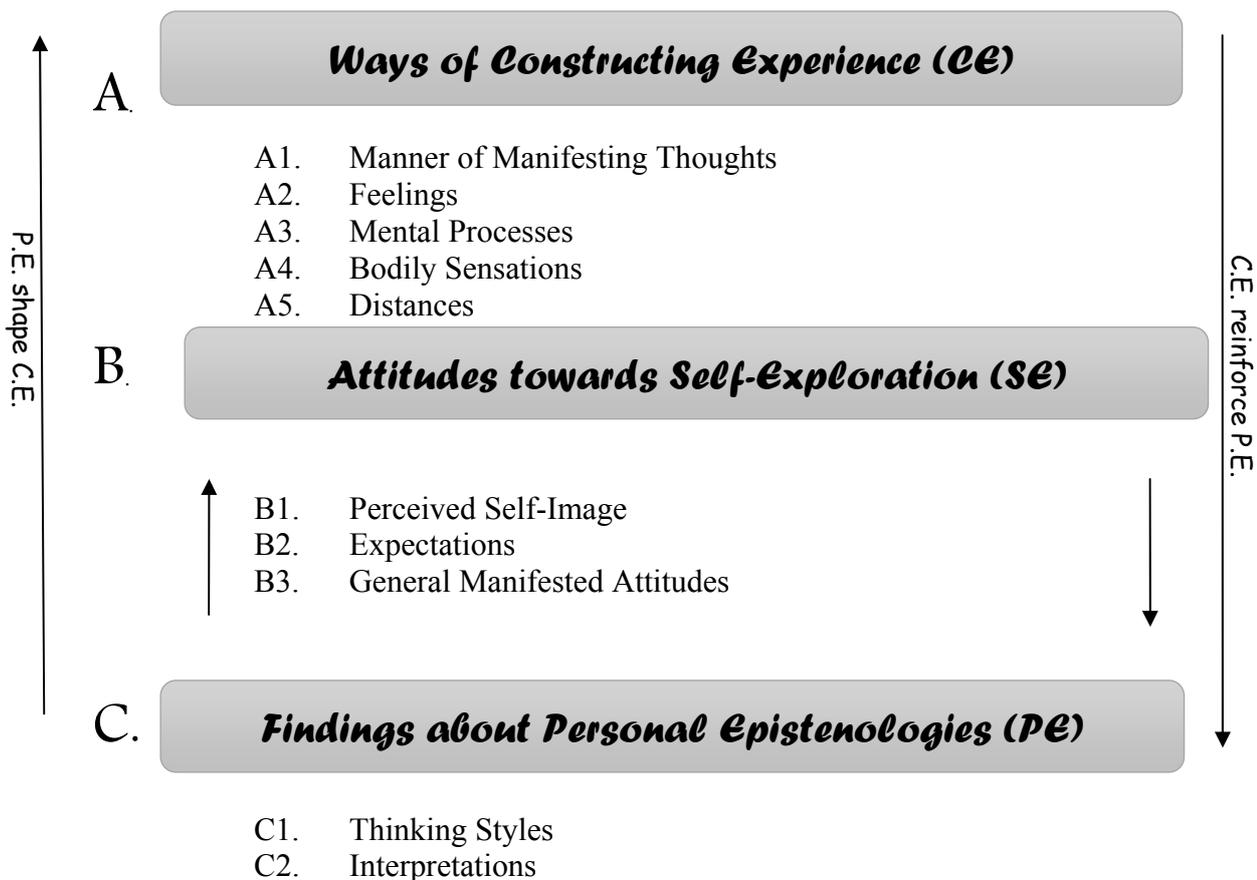


Figure 1. Dimensions of constructed experience.

ATTITUDES FOR SELF INVESTIGATION ARE CONSISTENT WITH CORRESPONDING PERSONAL EPISTEMOLOGIES. AND VICEVERSA

According to the findings of this research project, the level of interest co-researchers show varies greatly, revealing different attitudes and stands they have taken towards self-investigation. As our research shows, three participants revealed three completely distinct types of attitudes; on a first glance, it would appear that all three co-researchers were curious to look into their inner experience. However, upon closer inspection and through insisting in the narrative discourse, we observed anxious behaviour on behalf of one of the co-researchers (CoR2), which was triggered by fear of in-depth investigation. The participant refused to make an effort to verbalize the issue. Ultimately, he would defer questions and would repeat multiple times the same phrases, without truly investigating the actual core experience.

In contrast, another co-researcher (CoR1) presented explicit and implicit desire to find out about details and nuances of novel experiences, and would frequently get frustrated when not able to fully express the desired nuance of the phenomenon discussed. Some inconsistencies were however found even within the same individual, who at one point seemed to have briefly lost interest in investigating and reporting on a rather “overwhelming” experience over where he felt no control was possible.

CONCLUSIONS AND DISCUSSION

CONTRADICTIONARY STATEMENTS

The explicative interviews have brought to light surprising details about the co-researchers, who set out with a certain mind-frame, only to realize that they had misinterpreted or never even gave serious thought to alternatives. A pertinent example would be the case of one of the co-researchers in particular, who upon having repeatedly verbalized his desire to investigate novel sides of his experience quickly came to the limit of his self-directed interest. He was not bothered that his report was logically incoherent and became anxious, annoyed upon being asked to observe, explore, define and articulate his experience. He would then refuse to challenge his views, taking a step back and changing the subject when his beliefs came to be questioned and possibly defeated.

Such contradictory statements emerged with repeatedly during interviews, and have put on display the co-researchers’ rigidity towards going deeper into their constructs, and losing the control over a well-known conglomerate of convictions.

Put into the terms of our current research interests, this issue might hint that better reports might arise from interviewing more inquisitive individuals, and that not all personifications are adequate for conducting phenomenological interviews and studying experience.

A VARIETY OF EXPERIENCES

This, however, poses a serious question, namely: Does this mean that certain experiences can simply not be properly investigated? Can we perhaps not learn about some intimate realities due to phenomenologically undesired approaches? If some realities are indeed so unpleasant that none of the available co-researchers come through, would we not be able to gather reports and problematize it? Also, is it perhaps the case that exactly due to different ways of approaching an experience, the entire experience is perceived differently, thus changing the experience itself? Or the other way around, that would well imply that people might have just different attitudes when approaching a phenomenon and not a distinct, separate experience altogether.

We have worked alongside three different co-researchers concerning their attitude toward self-investigation. Further broader qualitative research would naturally be needed to confirm the typologies identified by our investigation.

If we were to offer a relevant example, two of the co-researchers reported having anxieties during their HB experience, CoR1 stating: “my upper half if the body started spinning, spiraling; it got overwhelming and I had to take a step back”, while the CoR2 reported: “My body is vibrating at a totally different frequency. The cramps were painful and I was feeling pressure on my chest. I wanted to stop”. While CoR2 would only return to the same description and reformulate the same idea without further questioning the experience, CoR1 went back to the moment and offered valuable additional details: “my attention was directed inward, towards my energetic body. I had a mental image of a rocket launching. And then I felt it. I felt the fear of the unknown”. Through this comparison of the two experiences, we come to wonder whether CoR2’s fear was so much more intense as to not want to observe and investigate it, or is it perhaps the case that the experience of CoR1 changed with his decision to observe it?

If enough co-researcher reports would be gathered and thoroughly analyzed, a topology of different experiences and different nuances might arise, case in which it would be very desirable to go even further and quantify the results, perhaps even build a map to compare and make sense of the co-researchers’ experiences.

LIMITATIONS OF THE CURRENT RESEARCH

While conducting the interviews, the very real challenge of setting aside our own expectations came forth, as trying not to bias or lead the co-researchers was highly important for the purpose of capturing the core experience.

While accessing the lived experience, the co-researchers had to rely on their memory in order to report, even though the first set of interviews was conducted immediately after the HB session. This poses a series of questions related to the role of memory, its biases and reliability. Such an example would be the fact that all of the co-researchers reported having trouble pin-pointing the exact time of their experience, and even reported struggling with remembering the sequence in which their experience occurred.

REMARKS

¹Husserl called the inquiry made from a researcher’s perspective “bracketing”. In this study, bracketing involved setting aside the co-researchers’ beliefs, feelings, prior experiences, expectations and convictions.

²Due to time-frame constraints, namely returning to the workshop after the first interview.

³The data analysis procedure is sketched in Figure 2.

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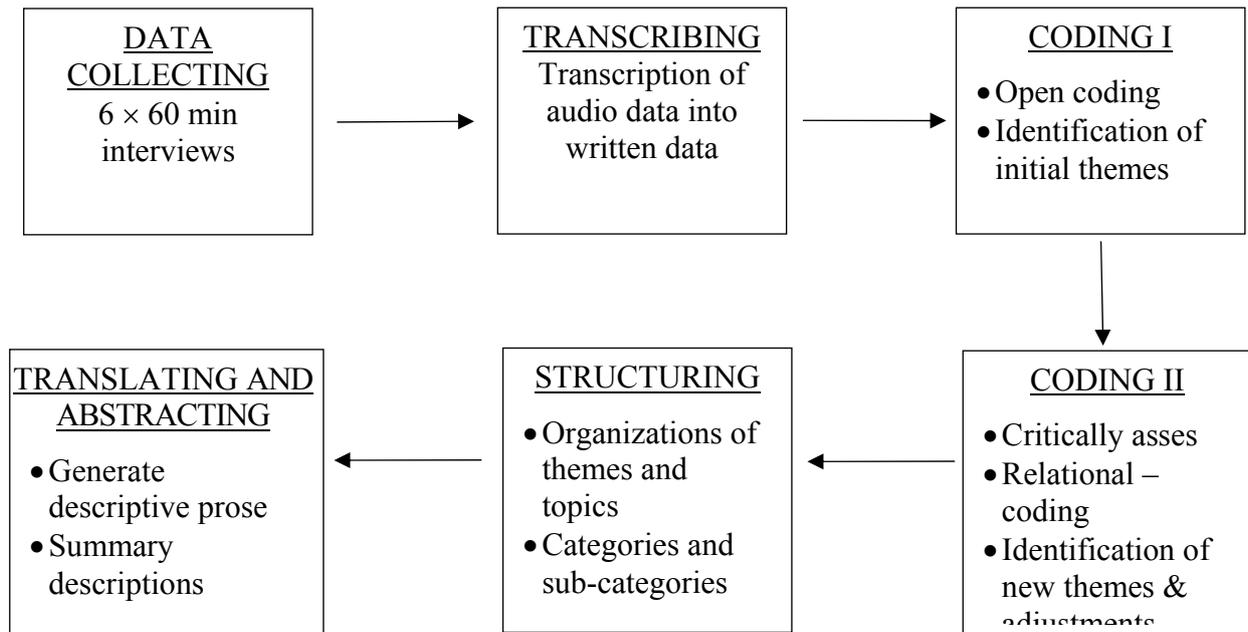


Figure 2. Data analysis procedure.

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POGLED U STAVOVE ISTRAŽIVANJA SEBE I U NAČINE KONSTRUKCIJE ISKUSTVA

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SAŽETAK

Empirijska fenomenologija – priučavanja proživljenih subjektivnih iskustava – zadnji je dodatak interdisciplinarnim nastojanjima razumijevanja ljudskog uma. Prikazujemo istraživanja koja su prvotno težila istraživanju iskustava holotropskog disanja, međutim rezultati kojih su upućivali na potrebu stavljanja fokusa naših interesa na razlike između individualnih načina konstrukcije iskustva. Izdvojili smo tri vrste osobnih epistemologija (tj. načina konstruiranja subjektivnog iskustva) i pronašli korelacije s individualnim stavovima o istraživanju sebe. Rad teži prikazati novi model konstruiranja iskustva te proširuje razumijevanje ograničenja tehnika fenomenoloških intervjua.

KLJUČNE RIJEČI

empirijska fenomenologija, objašnjavajući intervjua, konstruiranje iskustva, osobna epistemologija

WHY CREDENCES CANNOT BE IMPRECISE

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ABSTRACT

Beliefs formed under uncertainty come in different grades, which are called credences or degrees of belief. The most common way of measuring the strength of credences is by ascribing probabilities to them. What kind of probabilities may be used remains an open question and divides the researchers in two camps: the sharpeners who claim that credences can be measured by the standard single-valued precise probabilities. The non-sharpers, on the other hand, claim that credences are imprecise and can only be measured by imprecise probabilities. The latter view has recently gained in popularity. According to non-sharpers, credences must be imprecise when the evidence is essentially imprecise (ambiguous, vague, conflicting or scarce).

This view is, however, misleading. Imprecise credences can lead to irrational behaviour and do not make much sense after a closer examination. I provide a coherence-based principle which enables me to demonstrate that there is no need for imprecise credences. This principle is then applied to three special cases, which are *prima facie* best explained by use of imprecise credences: the jellyfish guy case, Ellsberg paradox and the Sleeping Beauty problem.

The jellyfish guy case deals with a strange situation, where the evidence is very ambiguous. Ellsberg Paradox demonstrates a problem that occurs when comparing precise and imprecise credences. The Sleeping Beauty problem demonstrates that imprecise credences are not useless, but rather misguided. They should be understood as sets of possible precise credences, of which only one can be selected at a given time.

KEY WORDS

beliefs, credences, imprecise probability, uncertainty, epistemology

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INTRODUCTION

The idea that beliefs come in degrees – called degrees of belief or *credences* – is widely accepted among epistemologists and is intuitively easily understood. It is also widely accepted that credences are measured by probabilities and this provides the base for the subjective interpretation of probability. But could these probability measures of credences be imprecise, i.e. could there be imprecise credences? This view has recently gained a lot of attention, but I will claim that it is misleading: credences (degrees of belief) can only be precise.

But let us first get to the underlying notion of credences. The world we live in is full of uncertainties: we cannot know for certain how much the price of gas will rise or drop in the next days, whether it will rain tomorrow, who will win the election and so on. Proponents of the degree-of-belief interpretation of probability, also known as Bayesians (after their founder Thomas Bayes), made an influential claim that uncertainty requires one of the basic epistemological concepts, beliefs, to be reduced into credences, with probabilism being the leading view on how to measure the strength of credences.

Different analyses of what credences as such are were provided and their exact nature remains an open question. Eriksson and Hájek hold a view that credences are primitive terms, but more importantly, their conclusion that “we can get by well enough without such an analysis” [1; p.212] allows us to focus on probabilities that are successfully used to measure credences.

It has thus become common to ascribe numerical values of probabilities (from 0 to 1) to credences (the higher the probability the stronger the credence). This idea is at the core of Bayesianism, which has demonstrated that an agent can only be rational if her credences follow the laws of probability (Kolmogorov’s axioms) [2]. While this interpretation has had a lot of success (and many problems), one specific question has recently caused a lot of debate amongst the researchers, namely, should the probabilities ascribed to credences be precise or imprecise?

The introduction of imprecise probabilities (families of probabilities instead of single probabilities) into analyses of beliefs has divided researchers in two camps: sharpeners (proponents of precise credences) and non-sharpeners (proponents of the imprecise approach). The main motivation for non-sharpeners is that precise credences are not strong enough: if an agent is confronted with imprecise (ambiguous, vague, conflicting or scarce) evidence, she ought to adopt imprecise credences (measured by imprecise probabilities).

Imprecise probabilities *prima facie* look very appealing, but as I will demonstrate, can lead to irrational behaviour and do not make much sense on a closer inspection. This means that the imprecise (non-sharp) evidence does not require imprecise probabilities (which is what motivates many non-sharpeners, e.g. [3-6]).

Does this mean I should pretend I am perfect (as the title question of Julia Staffel’s draft [7] asks) and pretend all I ever deal with are risks and not uncertainties (in Knight’s sense, [8])? My answer is short: No. While there certainly are special cases, which raise philosophical interest, precise probabilities remain the most powerful way to deal with them. I will argue that imprecise credences are based on a wrong assumption that imprecise evidence requires them. Exactly the opposite: imprecise evidence allows multiple possible precise credences, but not all at once (as imprecise credences suggest). I will develop my defence of the precise credences on three special cases, which seem to call for imprecision, and show why and how imprecise approach leads in wrong directions. These three cases are the jellyfish guy case, the Ellsberg paradox and the Sleeping Beauty problem.

THEORETICAL FRAMEWORK

Let me first introduce a few theoretical considerations on the nature of imprecise probabilities, imprecise credences and associated theoretical questions. Imprecise probabilities are a generalisation of precise probabilities, more particularly, they are sets of probability functions. They may be represented with intervals of probabilities, even though this is not the only possibility. It suffices to limit myself to interval-based imprecise probabilities in this paper as my defence depends on the fundamental idea that a single credence cannot have multiple values. My objections could also be applied to other representations of imprecise credences.

The interval-based imprecise credences are represented by intervals of precise probabilities with lower and upper probabilities as its endpoints. Formally: “A family P of probabilities on X induces lower and upper probabilities on sets A . Namely

$$\underline{P}(A) = \inf_{P \in \mathcal{P}} P(A), \quad \overline{P}(A) = \sup_{P \in \mathcal{P}} P(A).$$

We have [9; p.250]:

$$P_{\underline{P}-\overline{P}}(A) = \{P \mid \forall A < X \text{ measurable, } \underline{P}(A) < P(A) < \overline{P}(A)\}.$$

The idea to represent probabilities with intervals rather than singular numerical values is relatively old (one of the earlier proponents was the famous economist J. Keynes in 1920's [10]), but only gained wider recognition in the last decades. Imprecise probabilities were introduced for a variety of reasons. It seems very hard to pinpoint the exact probability of most events, so it is, according to the non-sharpers, more accurate if an interval-based estimate is given. Pinpointing a precise probability (based on, e.g. maximum entropy principle) could in some situations also mean that more information was introduced than evidence provides and this would lead to disastrous consequences (cf. van Fraassen's cube factory paradox [11]).

Another motivation for imprecise probabilities lies in their apparent similarity to psychological reality. Ascribing precise numerical values to credences strikes us as psychologically unconvincing. What does it mean to have, say, 0,563 credence that it will rain tomorrow? Even more, how could this particular number be more appropriate than 0,564? While historical accounts show that this was not the main motivation for early introductions of imprecise probabilities (the before-mentioned Keynes, for example, used the imprecise approach in his work on logical probabilities), it is exactly this subjective interpretation of probability that gained the strongest momentum when applying imprecise probabilities to imprecise credences¹.

An important theoretical difference between precise and imprecise credences lies in their conditionalization, i.e. updating prior credences when confronted with new evidence, one of the pillars of Bayesianism (according to [2]). Conditionalization is, at least theoretically, quite straight-forward for precise credences. The most basic proceeding is as follows: a rational agent has some prior credence $P_{\text{prior}}(H)$ and some conditional credence $P(H|E)$ (credence in H given E). When she learns E , her posterior credence changes to $P_{\text{posterior}}(H) = P(H|E)$. When confronted with imprecise credences, conditionalization basically works in the same way, but the whole process requires much more computation as every value in the interval (or, more generally, in the set of credences) is updated, conditional on the new evidence.

One of the main reasons that a rational agent should still prefer imprecise credences despite their computational complexity is, according to the non-sharpers, that imprecise credences provide higher accuracy. An imprecise credence of $[0,3, 0,4]$ (between 0,3 and 0,4) in some proposition P is more accurate than a credence 0,34 in the same proposition given that its objective chance is not 0,34 but rather 0,341. This strikes as unnatural as we are more

inclined to accept non-accurate but precise estimates than wider intervals, as Yaniv and Foster [12] have demonstrated in their psychological experiments. The higher accuracy is not hard to understand if the rain example is exaggerated: it is much more likely that the actual objective chance² of tomorrow's rain is included in my credence if my credence is $[0,1, 0,9]$ instead of $0,34$. But even though this wider interval is more accurate, it is a lot less informative and almost useless. Non-sharpers are not unprepared for such objections and wouldn't agree with such a definition of accuracy at all. They constrain arbitrary widening (or narrowing) of the intervals with an important rule: lower credence should be exactly as low as the evidence minimally allows, while the upper should be as high as it allows. If a rational agent is faced with completely ambiguous evidence, her credence should be $[0, 1]$. The credence of tomorrow's rain of $[0,1, 0,9]$ would be wrong as the evidence does not allow it (given that we are not in England). This restriction makes imprecise credences much more attractive, but still leaves an important open question: how exactly to determine the correct (and, after all, precise) lower and upper boundaries? How could the credence of $[0,3, 0,4]$ be acceptable, given some evidence, while $[0,29, 0,41]$ would be wrong? This is a major problem for the standard interval-based credences as the upper and lower boundaries remain sharp (and thus subject to the same criticism as sharp probabilities). It is possible to envision a response to this problem – boundaries could be non-sharp (a similar idea was suggested in [13]) so that the credence would look somewhat like this: $P(A) = {}_a[{}^b x, y {}^c]{}^d$; $0 \leq a \leq b \leq x \leq y \leq c \leq d \leq 1$ with boundaries $[a, b]$ and $[c, d]$ defined as intervals. But it is obvious that we could repeat this process infinitely as boundaries of any interval are essentially sharp. This flaw could be generalised from interval-based credences to most non-sharp probabilities: how to allow some singular credences and exclude some? One could argue that imprecise credences could be represented by a fuzzy set (where each member has a specific grade of membership) or by a statistical distribution, which would supposedly save the attack that imprecise credences essentially remain sharp. As I will argue, even this would still be suspect to the basic problem – a credence may only be singular (and, hence, precise).

But let us first look into the primary theoretical role of (prior) credences. Konek [14], discussing the related problem of the priors (i.e. prior probabilities/credences), listed a few of the most influential accounts:

1. Informational account: To accurately reflect the informational content of the agent's evidence.
2. Subjectivist account: To accurately represent the agent's opinions about the plausibility of hypotheses (or, more generally, propositions).
3. Practical account: To yield the most sensible decision-making policy under conditions of ignorance.
4. Instrumental account: To put us in a position to secure accurate, minimally luck-dependent posterior credences by updating on new data.

The practical account is problematic as the most sensible decision-making policy “depends on which epistemic perspective you evaluate it from” ([14; p.9]). Most non-sharpers adhere to informational and subjectivist accounts and both accounts depend on accuracy, which is in conflict with informativeness (the less precise credences are the less informative they are). The instrumental account (Konek's position) remains the most promising of those listed. It directly suggests that credences are theoretical constructs and that their role should be defined by their relationship between prior and posterior credences. It remains problematic, though, as it aims at accuracy (alethic correctness), which is sufficient, but not necessary for rational agents. I argue that the necessary principle should rather be coherence.

The problem with accuracy is that many researchers who aimed at it implicitly “derived deductive consistency as a coherence norm for full belief” [15]. Coherence, on the other

hand, is a weaker principle than consistency. It still requires the credences to respect the laws of probability, but they do not need to be completely deductively consistent.

The preface paradox, a problem related to the difference between consistency and coherence, has recently been raised and it roughly goes as follows:

Imagine that you wrote a book and have re-read every sentence many times checking for mistakes. Yet it is highly plausible that there may be some mistakes left, so you point out in your preface that you are aware of this and that all mistakes are unintended. The paradox arises because of two inconsistent claims, both supported by your evidence:

1. Your evidence (thorough reading) suggests that every sentence of the book is free of mistakes.
2. Your evidence (past experience) suggests that human mind is prone to error, so there must be at least one mistake in the book.

The paradox basically arises because of the demand for consistency, which is a classical way to reach accuracy. One suggested solution is to withhold both claims, but as Easwaran and Fitelson [15] have demonstrated this is not the correct solution for rational agents. Rather than withhold both beliefs, one should withhold the demand for full accuracy or as Fitelson and Easwaran have shown, one should aim for beliefs that avoid accuracy-dominance. It is fully rational to hold both of the claims (1) and (2), even though this might be inaccurate (and inconsistent). This occurs because accuracy is a too strong constraining requirement for perfectly rational agents, so one is not only able to, but also required to be perfectly rational with weaker constraints. To put it in simpler terms (departing from Easwaran and Fitelson's formally more detailed account, dealing with full beliefs): one should avoid accuracy-dominated credences for weaker, coherent (with regards to evidence) beliefs. This brings us to the coherence principle (CP): a set of credences is coherent, in the most simplified form, if there are no other sets of credences that are better supported by evidence, regardless of the situation we are in.

It is exactly this tension between consistency (accuracy) and coherence (best evidential support), which theoretically furthers the defence of precise credences. CP lets us recognize that the requirements of accuracy, one of the motivations behind imprecise credences, are too strong and that a weaker principle (CP), satisfiable by precise credences, is sufficient for a perfectly rational agent. Imprecise credences are also compatible with CP but unnecessary. What is more: a perfectly rational agent should avoid them as they unjustifiably lower the informative value of credences. This leads us to a novel account of the theoretical role of credences, the so-called coherence-based instrumental (C-B I) account.

C-B I account: The role of credences is to be defined by their prior-posterior relationship in regards to credence-updating. The role of prior credences is, thus, to put us in a position to secure coherent posterior credences that are best supported by evidence by updating on new evidence.

And this role of credences may only be rationally fulfilled if credences are precise.

THE JELLYFISH GUY CASE

Still, there are some special cases that supposedly justify the use of imprecise credences. I refer to one of the more bizarre mental experiments, pointing in this direction, as the jellyfish guy case. It was introduced by Adam Elga [16] and goes as follows:

“A stranger approaches you on the street and starts pulling out objects from a bag. The first three objects he pulls out are a regular-sized tube of toothpaste, a live jellyfish, and a travel-sized tube of toothpaste. To what degree should you believe that the next object he pulls out will be another tube of toothpaste?”

A natural response is that I cannot have a precise credence. The whole situation is clearly bizarre and very unique. I have no past experience with strangers, who walk around with a jellyfish in their bag, so any precise credence (e.g. 0,2, 0,94 or 0,53) could only be arbitrary. The only way out of it with precise credences seems to be to apply the maximum entropy principle and say that I should have 0,5 credence that the next object he pulls out will be a tube of toothpaste, but this answer is unacceptable – there are no reasons to justify one (maximum entropy) or another principle. It is not that I do not have enough computational skills to determine the correct credence. The problem is that the evidence on hand does not allow me to determine which principle could be applied in this situation. As Elga [16] pointed out, this case is clearly artificial, but realistic scenarios have also been proposed. E.g. what is your credence that “the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in [40 years]” [16]? Such scenarios seem to call for non-sharp answers: if your evidence is essentially non-sharp, so should be your credences and it seems perfectly rational to do so.

Let me now show, why and where such claims go into the wrong direction. Imagine that my credence about the next item the stranger takes out of his bag is non-sharp, for example [0,3, 0,9]. Such credence is consistent with the strange evidence and very wide (non-sharpers claim that in cases of complete ambiguity, the rational credence is spread out over the whole interval [0, 1]). The problem with such non-sharp credence is that it does not conform to the requirements of the C-B I account as I have listed it.

Exactly how could holding such prior credence secure coherent posterior credence, best represented by evidence, if we were to update it? It doesn't. If I were introduced to some new evidence (it would be on the news that there is a guy who walks around the town with a jellyfish, two tubes of toothpaste and a sock in his bag), my posterior credence would drop to [0, 0,3] (as I can still only be partially sure with such a bizarre guy). But this is not best supported by evidence: there is nothing in the evidence that demands a wide credence after all – it allows multiple (precise) possibilities, but not a single multiple-valued credence. It is only rational to have such multiple-valued credence in some rare cases like quantum physics scenarios.

A perfectly rational epistemological agent, confronted with the jellyfish guy case, should consider multiple possible credences (as the evidence is very vague) with all of them being precise as there are no evidential reasons for the opposite. Even more, how could one hold a multiple-valued credence in the next object the stranger pulls out? There is nothing in the evidence that demands a multiple-valued credence. But even if we pretend that it may make sense to hold multiple credences at the same time (what imprecise credences are in a nutshell), C-B I completely rules out imprecise credences when updating is called for. This may be more clear in our next case.

ELLSBERG PARADOX

The jellyfish guy case is very unrealistic and does not require updating in the standard version, so we should consider another more famous example that non-sharpers often refer to, the Ellsberg paradox (so named after Daniel Ellsberg, who first introduced it in [17]). The paradox can be presented in the following way:

There is a vase about which you know the following: there are 90 balls of three different colours inside. One third (30) of the balls are black and the other two thirds are either red or yellow. You are offered two exclusive choices:

- 1.A) You get 10€ if you draw a black ball, or
- 1.B) You get 10€ if you draw a red ball.

And another two choices:

- 2.A) You get 10€ if you draw either black or yellow ball, or
- 2.B) You get 10€ if you draw either yellow or red ball.

The paradox arises because most people choose answers 1.A and 2.B, which are inconsistent. If you choose answer 1.A, this would mean that you believe there are more black balls than red. This implies that you believe there are less or equal than 30 red balls ($B = 30 \geq R$), for example 29. Because you know that there are 60 yellow or red balls, this would also imply that you believe there are at least 30 yellow balls. In our case this would mean that if there are 29 red balls, then there are exactly 31 yellow balls. If you evaluate answers 2.A and 2.B on this basis, you conclude that the option 2.A can be fulfilled by at least 60 balls (61 in our example), and the option 2.B by at most 60 (59).

If you choose answer 1.A, it would only be rational to choose the answer 2.A. The same holds if you initially choose 1.B (you think there are more than 30 red balls). It would then only be rational to choose 2.B. The paradox arises because, as said, most people choose two inconsistent answers 1.A and 2.B. This is usually explained by ambiguity aversion. Both options 1.A and 2.B are clear; the first may be winning if one of 30 balls is picked and the other if one out of 60. Although the results may be explained (away) as a psychological bias, the use of imprecise credences also leads to irrational behaviour in this example.

Let us see why imprecise credences look appealing from the normative point of view and why they ultimately fail in comparison to precise credences. It is tempting to apply imprecise credences to cases like Ellsberg paradox. A rational credence about option 1.A would thus be $1/3$, while it would be $[0, 2/3]$ about 1.B. 2.A would be assigned a credence of $[1/3, 1]$ and 2.B a sharp $2/3$.

While such imprecise credences (1.B and 2.A) are accurate, they do not provide any rational guidance on selection. How may a perfectly rational make the first choice between 1.A and 1.B? She cannot, because there is no rational way of comparing which choice is better as one is precise and the other is imprecise. A correct set of choices (1.A, 2.A or 1.B, 2.B) would follow if this first choice was made, but there is no rational ground to make it. Our perfectly rational agent withholds her choice and gives up the possible prize, which is clearly irrational. This demonstrates another aspect of the possible violations of the C-B I principle. If the main argument against imprecise credences in the jellyfish guy case was based on the nature of evidence, Ellsberg paradox shows they may lead to irrational withholding of choices (and the updating from prior to posterior credences doesn't take place at all, which is a clear violation of C-B I).

This problem perishes if precise credences are used. Let's take a look at one of many evidentially possible sets of precise credences a perfectly rational agent may have:

1.A: $1/3$, 1.B: $1/6$; 2.A: $5/6$, 2.B: $2/3$. The rational choice would then directly follow: 1.A and 2.A. A formal proof that precise credences always lead to a set of coherent choices could be provided, but is not necessary for our means. It is more important to note that the imprecise approach is not useless - the intervals, provided as imprecise credences in Ellsberg paradox cases, could be understood as sets of possible precise credences. But to be able to update our credences, they should remain precise and only a single credence may be selected from the interval of possibilities. The main problem is then that imprecise credences should not be understood as credences, but rather as sets of evidentially possible precise credences.

THE SLEEPING BEAUTY PROBLEM

D.J. Singer titled his recently published paper *Sleeping beauty should be imprecise* [18]. He does not discuss how Sleeping Beauty should be imprecise to get the handsome prince's kiss

quicker. What Singer is really discussing is another paradoxical problem introduced by Adam Elga (the creator of the jellyfish guy thought experiment) with Sleeping Beauty in the main role. It was introduced in [19] and is paradoxical because it allows two distinct answers. The problem is: “Some researchers are going to put you to sleep. During the two days that your sleep will last, they will briefly wake you up either once or twice, depending on the toss of a fair coin (Heads: once; Tails: twice). After each waking, they will put you to back to sleep with a drug that makes you forget that waking. When you are first awakened, to what degree ought you believe that the outcome of the coin toss is Heads?” [19; p.143].

The two distinct answers are:

- 1.) $1/2$ - that is the answer put forward by David Lewis [20]. Sleeping Beauty knows that the coin is fair and when she is awoken it is only possible for her to keep the $1/2$ credence of heads. Coin is fair after all.
- 2.) $1/3$ - this is Elga’s position. He gets to this answer by imagining a series of repeated tosses. There are three possibilities:
 - a.) Heads is tossed - Sleeping beauty wakes up on Tuesday.
 - b.) Tails is tossed - she wakes up on Monday.
 - c.) Tails is tossed - she wakes up on Tuesday.

All three possibilities are equally likely as they depend on a toss of a fair coin. Beauty’s credence that heads was tossed should thus be $1/3$.

Many solutions were proposed, but none of them is able to reconcile the two distinct intuitions. Singer [18] claims that a solution could be provided if Sleeping Beauty was imprecise (i.e. her credences were imprecise). His detailed investigation leads him to the claim that Beauty’s credence should be imprecise and represented on a set of probability functions that assign for $x \in [0, 1/2]$ the credences as in Table 1.

Table 1. Singer’s analysis of the Sleeping Beauty problem.

	Monday	Tuesday
Heads	x	0
Tails	x	$1 - 2x$

Singer’s imprecise approach allows him to cover both traditional responses ($1/2$ and $1/3$) and even takes updating into consideration – but still fails at C-B I, because there is nothing in the evidence Sleeping Beauty that would demand a multiple-valued credence over precise responses. Does this mean that Singer’s finding are useless? This is not the case. If the range of possibilities (wrongly understood as imprecise credences) in Ellsberg paradox was easily determined, it takes a lot of effort to plot all possibilities Sleeping Beauty has on hand and Singer succeeded in providing them. His only problem is that he understands the sets of possibilities he provided as imprecise credences and concludes that Sleeping Beauty should be imprecise. His response to Elga’s original question would be: we cannot say precisely what credence is the most rational for Sleeping Beauty, but her credence can be represented with such and such interval.

The correct response would be to say that there are multiple possible precise credences (represented by Singer’s sets), but our Sleeping Beauty can only choose a single one of them – either $1/2$, $1/3$ or anything in his intervals. Singer’s intervals turn out to be very useful, but wrongly understood as credences instead of sets of precise credences. And this provides

another answer why credences cannot be imprecise - what they call imprecise credences are rather sets of possibilities in which one can find the correct precise credences.

CONCLUSION

More cases could be provided to show how imprecise probabilities may lead to disastrous consequences, but these three special cases should provide sufficient support for my defence of precise credences against imprecise ones. It should be clear by now that what is usually understood as imprecise credences are actually just sets of precise credences available given some (ambiguous, conflicting, scarce or vague) evidence.

After all, the existence of imprecise credences would mean that precise credences are just their special cases – like beliefs turn out to be special cases of credences above a certain threshold. But as Hájek and Erikssen [1] have shown, credences may be understood as primary concepts which cannot be further analysed. This does not prove that imprecise credences do not exist, but is in line with my defense of precise credences.

It is by now also clear why imprecise credences are so appealing at the first sight: they look like a good representation of our actual credences – human agents are often dealing with fuzzy evidence and the instinct is that our credences should also be fuzzy (imprecise). The main problem is in the misunderstanding of the precise credences, which allow multiple possibilities, but not all at once as imprecise credences call for. Imprecise evidence under uncertainty allows multiple rational responses, but it is irrational (and impossible except for the quantum physics scenarios) to have multiple responses at the same time.

Problems mainly arise because the theoretical role of credences is not discussed often enough and the interpretation one uses is often implicit or naive. We must be aware, though, that credences are either theoretical constructs and so they should play a role most suitable for our fundamental epistemological principles, or they are primary concepts which cannot be further reduced. It should be noted, though, that there are no real reasons credences couldn't also take part in the empirical reasoning of common people [21] and my conceptual clarification could well serve as a basis for further empirical research of credences.

I only pointed out problems that arise after using imprecise credences if they are confronted with my C-B I principle, but there are more problems for non-sharper, which I have not discussed. One of the most frequent attacks says that imprecise probabilities (which is how imprecise credences are measured) lead to probabilistic dilations which, roughly speaking, occur when a more precise estimate E changes to a less precise estimate E when new evidence F is learned (for a non-sharper's counterargument, c.f. [22]).

To conclude on a more positive note: imprecise probabilities are not defeated by my arguments. There are some great uses for them, for example in statistics, quantum physics, bioinformatic. But there is really no place for imprecise probabilities in analyses of credences. Imprecise credences just cannot exist.

REMARKS

¹It must be noted that imprecise probabilities are successfully used in some scientific fields, like statistics and quantum physics.

²The notion of objective chance is introduced as a measure of credence's accuracy, i.e. a credence is accurate if it is equal to the objective chance. It is unimportant for my point what, if anything at all, an objective chance could be.

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ZAŠTO UVJERENJA NE MOGU BITI NEPRECIZNA

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SAŽETAK

Vjerovanja formirana uz nesigurnost dolaze u različitim stupnjevima koje nazivamo uvjerenja ili stupnjevi vjerovanja. Najčešći način mjerenja snage uvjerenja je tako da im pripišemo vjerojatnosti. Koje vrste vjerojatnosti možemo koristiti ostaje otvoreno pitanje koje dijeli istraživače u dva tabora. Tabor oštrijih tvrdi kako se uvjerenja mjere uobičajenim preciznim vjerojatnostima jedinstvenog iznosa. S druge strane, tabor neoštrijih smatra kako su uvjerenja neprecizna te ih se mjeri nepreciznim vjerojatnostima. Ovaj zadnji pristup u novije je vrijeme dobio na popularnosti. Prema neoštrijima, uvjerenja moraju biti neprecizna kad su dokazi u biti neprecizni (višeznačni, magloviti, suprotstavljajući ili rijetki).

Ovaj pogled je, međutim, stranputica. Neprecizna uvjerenja mogu dovesti do iracionalnog ponašanja i nakon detaljnijeg propitivanja ne pokazuju puno smisla. U radu predstavljam princip temeljen na koherentnosti koji mi omogućuje demonstriranje kako nema potrebe za nepreciznim uvjerenjima. Princip je zatim primijenjen na tri posebna slučaja, koje je *prima facie* najbolje objasniti primjenom nepreciznih uvjerenja: slučaj čovjeka s meduzom, Ellsbergov paradoks i problem uspavane ljepotice.

Slučaj čovjeka s meduzom razmatra neuobičajenu situaciju u kojoj su dokazi višeznačni. Ellsbergov paradoks demonstrira problem koji se javlja pri usporedbi preciznih i nepreciznih uvjerenja. Problem uspavane ljepotice demonstrira kako uvjerenja nisu beskorisna nego više vode na stranputicu. Mora ih se razumjeti kao skup mogućih preciznih uvjerenja od kojih se samo neka može odabrati u određenom trenutku.

KLJUČNE RIJEČI

vjerovanja, uvjerenja, neprecizna vjerojatnost, nesigurnost, epistemologija

TOWARDS CONTEMPORARY NEUROETHICS: WHY DOES IT MAKE SENSE TO RE-DEFINE PLACEBO?

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ABSTRACT

The main message we are trying to get across throughout the article is that the placebo is not an inert entity but instead it has a potential of subjective interpretation, a healing potential of its own, over and above that of any healing potential of the medication per se. Such healing potential is greatly dependent on how strong the interpretation value in being healed is that is created by the doctor. In this regard, we are also arguing that there are myriads possibilities at work that can influence how strong this interpretation value can become. The crucial role of contemporary medicine should be to expand the use of these interpretation effects even more and use them to help reduce any negative mental states that could continue to suppress the immune system after the initial healing. In other words, medicine should use the power of interpretation effect not only to re-arouse the immune system temporarily but permanently. In order to achieve a complete process of permanent healing it is necessary to take advantage of making full use of the powerful interpretation value through psychosocial context. It is possible to do that beyond the usual “sugar pill” through evidence based approach – a science of compassionate care! By introducing the new operational placebo definitions, we clearly show that the human mind (unconscious and conscious) is an inevitable substance involved in the Healing Process. The terms “placebo”, “placebo effect”, and “placebo response” are re-defined into the new working definitions. We explain how there is no more distinction (duality) such as body / mind, specific / nonspecific or health / disease, which offers new insights for future directions in contemporary Neuroethics.

KEY WORDS

placebo, bioelectromagnetics, evidence-based medicine, compassionate care, neuroethics

CLASSIFICATION

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INTRODUCTION

More than 50 years ago a revolutionary book titled “Introduction to a Submolecular Biology” announced the crucial importance of quantum physics in biological systems [1]. Less than fifteen years later research in biophysics showed that electromagnetic frequencies as energetic signaling mechanisms are one hundred times more efficient and incredibly faster in transmitting information from the environment compared to the chemical signals such as hormones or neurotransmitters [2]. Energies like microwaves, radio frequencies, extremely low frequencies, sound frequencies, and scalar energy have shown to have a significant influence on each aspect of biological regulation. Indeed discovery that quantum physics but not Newtonian laws regulate molecule movements, which in addition generate life has offered further support of previous findings [3].

Despite the fact that many of pioneering scientific reports in the past sixty years have revealed the importance of those “invisible” forces of electromagnetic spectrum and were even published in peer reviews, these finding were somehow neglected [4-11]. Many professional and locally produced devices have been constructed for research purposes in order to manipulate experimental conditions by exposing the living organisms to different ranges and frequencies of electromagnetic fields [12]. In one experimental study, the germination and growth of Lemma Minor by exposure to square pulse and 16 Hz sinusoidal magnetic fields revealed statistically significant differences [13].

Back to the very beginning of the humankind, it is not that hard to understand that culture is deeply embedded into human biology because of perceptual and attentional processes [14, 15]. Speaking about old primitive societies, they had long healing ceremonies and very complex rituals that sometimes lasted even more than a week [14]. Such meaningful healing strategies in primitive cultures were extremely impressive and respected for they were capable to induce powerful psychological (symbolic) component of the healing process, nowadays known as psychosocial context or meaning response [15]. Rituals might trigger subjective expectations of different emotional states: joy, anxiety, relaxation, altered states of consciousness through biased attention. Attentional biases can influence what information people prefer to focus upon. Indeed subjects with chronic pain and emotional problems show increased attention to information regarding their concerns [16, 17]. This bias in attention accompanied by emotional states and perceived from the cognitive perspective corresponds to hypervigilance [18]. Cognitive self-evaluation about amount of reported failures in memory and attentional domains is a good predictor of vigilance performance in complex tasks [19].

Anxiety modulates attention [20], in particular trait anxiety modulates top down, executive control network [21] while, state anxiety is more responsible for bottom up, alerting/orienting attentional networks [22]. Furthermore, in a computer-based neurocognitive test using the ANTI-V paradigm individual differences in vigilance performance were measured. A step-wise multiple regression analysis showed that vigilance performance (Signal Detection Theory – SDT indices of Vigilance), were predicted by cognitive and somatic state anxiety, but not trait anxiety [23]. Under negative psychological states usually present in subjects with health problems, it is obvious that their hyper-vigilant attentional focus depends on the level of concerns in how to get well again. In this regard, psychosocial context through a compassionate care can become an important healing determinant.

Contemporary medicine (evidence-based) has on the other hand developed scientific methods and highly sophisticated technology, which enables it to be more successful in the pharmacological and physiological component of the healing process. In his doctoral dissertation, Getz highlights an interesting topic that fits well with the concerns of Heidegger

and Foucault about the sophisticated technology. He says: “Can it be that professionals as well as lay people are currently becoming increasingly distracted and desensitized, as a result of medical technology’s particular way of enframing the human condition, in such a way that we lose sight of the essence of what it means to be human, in sickness and in health?” [24; p.113].

For our discussion, it is important that the placebo/nocebo response is an integral component of every treatment, and can not be avoided in even the most modern, sophisticated evidence-based medical treatment. Both the modern medicine and the primitive treatments of our ancestors share the same integral component of the healing process: the “nonspecific” component of the treatment. If we accept that, the history of medicine was more or less the history of the placebo response [25] than we can assume that the modern medical treatment has evolved from the placebo treatment, or to put another way, the “specific” factors have evolved from the “nonspecific” ones. Furthermore, if the primitive - nonscientific healing of our ancestors had been so useless, or if “nonspecific” factors had not played an integral role in the healing process throughout history, it is very likely that humankind would not have survived those harmful “nocebo” treatments, and thus there would have been no modern evidence-based medicine [26, 27]. Taking into account above arguments, we can hypothesize that what we perceive and to what we narrow our focus of attention on, becomes important, meaningful and makes sense for our further understanding and interpretation.

In the present article we intentionally bypass the extensive overview of the Placebo literature. Instead, we introduce the brief history of Placebo definitions to better understand their metamorphosis and point out some contemporary concepts of this puzzling phenomena. In addition we re-define Placebo terms and propose three major premises as the future standards for Contemporary Neuroethics. In conclusions we discuss that the placebo phenomena is very real and natural, and that there is nothing supernatural in its process.

METAMORPHOSIS OF HISTORICAL PLACEBO DEFINITIONS

In Table 1 one can see how the term Placebo has changed from the late 18th century until the beginning of the third millennium [28].

It is important to note, that the definition from the 1785 was misquoted [25] and instead of “a common place method of medicine” the actual definition was “a common place method or medicine”. So the early definitions classify as placebo not only medicines or active drugs, but also other non-drug treatments and methods such as magic, psychotherapy, hypnosis ...

Early definitions did not define placebo as an inert substance until about 1950, when the double

Table 1. (Continued on p.337) Some dictionary definitions of Placebo.

Source	Year	Definition of Placebo
New Medical Dictionary	1785	A common place method of medicine
Hooper’s Medical Dictionary	1811	An epithet given to any medicine, adapted more to please than to benefit the patient.
Dunglison; Dictionary of Medical Science	1874	“I will please” (from placebo) – A medicine usually prescribed rather to satisfy the patient than with any expectation of its effecting a cure.
Medical Lexicon	1881	Name for a medicine given by a doctor to a patient simply to satisfy the patient’s mind; usually of a harmless nature, e.g. water colored with cochineal (dried insects used as dye).
Standard Dictionary of the English Language	1895	Any harmless substance as bread pills, given to soothe a patient’s anxiety rather than as a remedy.

Table 1. (Continuation from p.336) Some dictionary definitions of Placebo.

Century Dictionary	1900	A medicine adapted rather to pacify than to benefit the patient.
Chalmers Twentieth-Century Dictionary	1911	A medicine given more to humor or gratify a patient than to exercise any curative effect.
Pepper, O.H.P.	1948	The giving of a placebo... seems to be a function of the physician which, like certain functions of the body, is not to be mentioned in polite society.
Stedman's Medical Dictionary	1953	An indifferent substance in the form of a medicine, given for the moral or suggestive effect.
Oxford English Dictionary	1953	A medicine given to humor rather than to cure the patient.
American Pocket Medical Dictionary	1953	An inert substance given as a medication.
Britannica World Language	1960	Any harmless substance given to humor a patient or as a test in controlled experiments. Anything said to flatter or please.
Webster's 3rd New International Dictionary	1971	An inert medicament or preparation given for its psychological effect, esp. to satisfy a patient or act as a control in an experimental series.
Taber's medical Dictionary	1971	1. Inactive substance given to satisfy patient's demand for medicine. 2. Also used in the controlled studies of drugs. The placebo is given to a group of patients, and the drug being tested is given to a similar group; then the results obtained in the two groups are compared. Also, something tending to soothe or gratify.
Brewer's Dictionary of Phrase and Fable	1981	An innocuous medicine designed to humor a patient, and which may have a beneficial psychological and physical effect.
Collins Dictionary of Medicine	1992	1) A pharmacologically inactive substance made up in a form apparently identical to an active drug that is under trial. 2) A harmless preparation prescribed to satisfy a patient who does not require active medication.
Oxford Concise Medical Dictionary	1999	A medicine that is ineffective but may help relieve a condition because a patient has faith in its powers. New drugs are tested against placebos in clinical trials: the drug effect compared with the placebo response, which occurs even in the absence of any pharmacologically active substance in the placebo.
Dorland's Medical Dictionary, 29th edition	2001	Any dummy medical treatment; originally a medical preparation having no specific pharmacological activity against the patient's illness or complaint given solely for the psycho-physiological effects of the treatment. More recently, a dummy treatment administered to a control group in a controlled clinical trial in order that the specific and nonspecific effects of the experimental treatment can be distinguished – i.e. the experimental treatment must produce better results than the placebo in order to be considered effective. Active placebo, impure placebo: A substance having pharmacological properties that are not relevant to the condition being treated.

blind randomized clinical methodology appeared in the literature. To conclude, the metamorphosis of the term “Placebo” goes as follows: from the original definition placebo, which included not just medicines (substances) but also methods, later on the definitions of the term Placebo were limited only to medicines and further to inert substances.

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

Shapiro’s phenomenological definition

“A placebo is any therapy (or that component of any therapy) that is intentionally or knowingly used for its nonspecific, psychological, or psycho-physiological, therapeutic effect, or that is used for a presumed specific therapeutic effect on a patient, symptom, or illness, but is without specific activity for the condition being treated. A placebo, when used as a control in experimental studies, is a substance or procedure that is without specific activity for the condition being treated” [25; p.41]. Oddly enough, how can something causing an effect be non-specific?

CONTEMPORARY PLACEBO DEFINITIONS

If men define situations as real, they are real in their consequences, is a well-known Thomas theorem that was formulated in 1928 as a fundamental Law of Sociology [29]. Curiously how authors with their theorem, perhaps unknowingly at that time were coming close to many of the modern definitions of placebo. The definitions proposed by some of the contemporary researchers such as Barrios, Benedetti, Di Blassi, Kirsh, Moreman and others agreed that perhaps the term “placebo effect” and “nonspecific effect” have some negative connotations and should be replaced by some more proper terms. Barrios points out that the placebo response is based on the power of belief or expectation [30]. Benedetti shows that the classic concepts of “placebo effect” are too restrictive, that we need a broader term, namely the “medical context”. He argues that the context effect (meaningful induced expectations) can help to explain the placebo effect through the doctor-patient interaction [31]. Di Blassi and colleagues proposed that we should use “placebo effect” interchangeably with the term “context effect” [32].

One of the leading authorities in the field of Placebo research Irving Kirsch, also the author of the Response expectancy theory [33] noted that when a person expects something to happen that is inconsistent with the common predicted pharmacodynamic properties of a drug, the effect of subject's expectations can prevail that of the medication. He defines response expectancies as anticipations for the occurrence of non-volitional responses and believes that they are the most important mediator in the placebo effect. Furthermore, according to his immediacy hypothesis [34] he suggests that an expectation for a subjective experience leads directly to that subjective experience (expectation of anxiety directly causes anxiety). In an interesting research design Kirsch and Wiexel elegantly showed how different is clinical setting from the research setting [35]. Moerman explains how meaning interacts with the illness and the healing process. He proposes the term “meaning response” as the physiological or psychological effect of meaning [14].

THE NEED FOR THE NEW PLACEBO DEFINITIONS

So far, we recognized that there is no need any more for the use of the term placebo and placebo effect. Furthermore, there is no need even for using such terms as “nonspecific”,

“inert” or “inactive”. Therefore, we propose new working definitions of Placebo, Placebo treatment, Placebo effect and Placebo response to replace the previous ones [26, 27]:

- “Interpretation Potential” (IP) instead of “Placebo”,
- “Interpretation Value” (IV) instead of “Placebo Treatment and/or Therapeutic Treatment”,
- “Interpretation Effect” (IE) instead of “Therapeutic Effect” and/or “Placebo Effect” and
- “Interpretation Response” (IR) instead of the term “Placebo Response/Treatment Response.

According to our proposed definitions, contemporary Neuroethical standards should stand on the following three major premises [26, 27]:

- Interpretation Potential (IP) in relation with the psychosocial context and its interpretation effects (IE) is a powerful healing determinant, having an effect in every treatment,
- because of its “unpredictable” bidirectional nature and simultaneous interaction with the pharmaco-dynamic properties of a drug/treatment, this interpretation effect must be accompanied with the “Science of Compassionate Care” in every treatment,
- Interpretation Response (IR) in the form of a well controlled Interpretation Effect (IE) is more powerful and long lasting than Interpretation Value (IV) per se.

DISCUSSION AND CONCLUSIONS

Instead of thinking in dualities, such as body and mind, specific and nonspecific, active and inert, which were and still are the common concepts in defining the placebo and the placebo effects, we rather changed the working definitions in such a way that polarity was eliminated. Instead, we reorganized the terms into new concepts: interpretation potential (IP), interpretation value (IV), interpretation effect (IE), and interpretation response (IR). In this way, the importance was found to be crucial on the part of the doctor-patient relationship that distributed the healing power between the external factors and the internal locus of control through interpretation effects of individual understanding and meaning. In our opinion, the re-defined Placebo definitions as proposed above suggest that it seems wise to rethink of their possible impact on future directions in neuroethics.

There is ample evidence supported by strong arguments claiming that it would be unethical to avoid Placebo effects [15]. Avoiding placebo effects means that we are avoiding real improvements of human well-being. Dorland’s Medical Dictionary from 2001 [28] demonstrates in Table 1 another conceptual inconsistency of traditional medical paradigm. While all drugs have to show they are better than placebo in order to be approved, there is one exception. Cancer drugs are never compared with placebo but instead these experimental drugs are always compared among themselves [36]. In oncology, placebo effect is regarded as unethical, but alleviating the negative psychological states with empathy and compassion could certainly help to reduce the immunosuppression thus helping patients to get well again [30]. It is now or never. Mind body interactions indicate no differences between pharmaco-dynamic and psychosocial effects, or to put another way cognitive affective events induced in a psychosocial context can trigger similar mechanisms as those activated by drugs [37]. If medical society will recognize the opportunity to define placebo as proposed above, then the art of a healing compassion can become a science - A science of compassionate care [26, 27]. By doing so the non-specific effect will become specific and the treatment will have the added effect. This effect is “gratis” and should be regarded in the future as psychosocial evidence based interpretation effect. By contrast, if medical society will insist on old definitions of Placebo in terms of duality then others will continue to manipulate and take advantage of the Placebo phenomenon. Let us here conclude with the last sentence from the book “The Powerful Placebo: from ancient Priest to modern Physician”: “If the non-specificity

of the placebo effect can be rendered specific and its strength can be unleashed, the terms placebo and placebo effect can appropriately disappear into medical history.” [25; p.237].

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PREMA SUVREMENOJ NEUROETICI: ZAŠTO JE SMISLENO REDEFINIRATI PLACEBO?

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SAŽETAK

Glavna poruka koju želimo prenijeti ovim člankom je da placebo nije inertni entitet nego sadrži potencijal subjektivne interpretacije, vlastiti potencijal zalječivanja, bitno različit od potencijala liječenja *per se*. Zalječujući potencijal znatno ovisi o tome koliko jaku vrijednost interpretacije doktor stvori u liječenoj osobi. Pritom diskutiramo o postojanju mnoštva mogućnosti koje mogu utjecati na to koliko jaka vrijednost interpretacije može postati. Ključnu ulogu suvremene medicine vidimo u širenju uporabe učinaka interpretacije kao i u njihovom korištenju u smanjivanju bilo kojeg negativnog mentalnog stanja koje može nastaviti potiskivati djelovanje imuno-sustava nakon početnog zalječivanja. Drugim riječima, medicina bi trebala koristiti snagu učinaka interpretacije ne samo za privremeno nego i za trajno podizanje imuno-sustava. Za postizanje cjelokupnog procesa trajnog zalječivanja potrebno je iskoristiti prednosti uporabe vrijednosti interpretacije kroz psihosocijalni kontekst. To je moguće učiniti povrh uobičajene „pilule šećera“ pristupom temeljenim na dokazima – znanosti suosjećajne njege! Uvođenjem novih operativnih definicija placeba jasno pokazujemo kako je ljudski um (nesvjesni i svjesni) nezaobilazna cjelina u procesu zalječivanja. Pojmovi „placebo“, „placebo učinak“ i „placebo odziv“ su redefinirani. Objasnjavamo kako više nema distinkcije (dualnosti) poput tijelo / um, specifično / nespecifično ili zdravlje / bolest što nudi nove uvide za budući razvoj suvremene neuroetike.

KLJUČNE RIJEČI

placebo, bioelektromagnetizam, medicina temeljena na dokazima, suosjećajna njega, neuroetika

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