DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015)

Contents

DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015), pp. 3—12
DOI: 10.1515/sh-2015-0021

Finite Systems Handling Language (YAFOLL message 1)

Alex Shkotin

ACM
60-letiya Oktyabrya prospect 5/1-60
119334, Moscow, Russia

e-mail: ashkotin@acm.org

Abstract:
The concept a finite multi-carrier algebraic system (FMAS) as well as a language for handling systems such as YAFOLL (Yet Another First Order Logic Language) are introduced. The applicability of such systems to building a mathematical model of a part of reality, i.e. a mathematical structure that can be asked questions about the properties of subject domain objects and processes, is demonstrated.
Keywords: finite model, formal ontology, formal language, knowledge representation

1. Introduction

Algebraic system (AS) is a classical mathematical structure with a known procedure for specifying its properties and checking whether it possesses certain properties [1].

A YAFOLL language (abbreviated form: Y!L) fragment is described to create and use a certain type of AS. The processor that executes the YAFOLL language sentences is referred to as Yp. An AS is used in the form of a dialog with *Yp*: one or more sentences are fed to its input, and it returns an empty string or one or more messages. *No value* is one of important messages. Yp consists of two components: a syntax analyzer and an executor. The syntax analyzer passes the entire input text to output, and inserts messages in it in the form of xml elements in the event that errors are found, but its main function is to build a syntax tree. The executor receives the syntax tree of a group of sentences at its input, executes them, and presents a report on its operation as an xml document.

The Y!L sentences include the following commands: The !0! command zeroes the AS served by Yp, the !2! command outputs a text in Y!L where the AS contained in Yp is specified. The AS handling procedure on the whole is as follows: AS is uploaded from a file in Yp, processed, and downloaded from Yp by the !2! command. Thus, AS is contained in the text (*ontology*).

Basic definition

The classical AS definitions ([4], p.46, and [2], Vol I, p. 25) use the following algebraic system components: carriers, relations, operations (functions). Let us start with multiple sorts (see [3], p.71), limitations on the power of sets and partial functions. We will drop the relations immediately. In addition, let's call the carriers sorts for simplicity.

FMAS-0 **definition**

A finite multi-carrier algebraic system of the form 0 (FMAS-0) is a finite set of:

1. finite nonintersecting named sets (**sorts**) and probably some of their named elements (**constants**),

2. (also named) **functions** from a sort or a direct product of sorts into a sort. These functions are called primary functions.

end of definition

Note: An AS without relations is usually called *algebra*.

So, the function is conceived as a partial one (from-function), but prove to be full, and is even sometimes required to be so. There are many examples of unnamed functions in the λ-calculus.

Names

Let's use Flex syntax for regular expression (RE). Let an alphabet contain a set of letters (Lttr), a set of numbers (DIGIT), and letter '_' which we will call US. We will name FMAS and its components using the following RE: **Id** = {Lttr}({Lttr}|{DIGIT}|{US})*

i.e. a letter which can be followed by a chain of letters, digits and "_". For example, the following Y!L sentences:

Declaration sample sort. Declaration place sort.
introduce two sorts: sample and place.

Numbers and strings

The number are specified by the following RE:
Number = {MI}?{DIGIT}+({DOT}{DIGIT}+)?

where MI denotes '-', and DOT denotes '.', i.e. decimal rational numbers, but the '+' sign is implied and is not allowed.

Examples: 0, 10, -3.62.

The strings are specified by the following RE: **String** = {DQ}[^{DQ}]*{DQ} where DQ denotes a double quote mark ("), i.e. this is an arbitrary chain of letters except DQ framed by DQ. For example, "this is a string".

Sort elements

We will denote sort elements using letter strings of the following RE type **Ide** = {US}{Lttr}({Lttr}|{DIGIT}|{US})* i.e. strings beginning with "_" followed by Id. It is clear that the two sets of strings (Id and Ide) do not intersect. Let us introduce the following sort: Declaration TV sort. and specify its elements:

```
! _True TV !
! _False TV !
```

Let's e_m denotes "!" here and below in BNF rules. The Y!L language BNF rule
(fmca) Statement : e_m Ide Id e_m
assigns the Ide element to the Id sort.

The rule
(fmcd) Statement : e_m Ide e_m
removes the Ide element from the sort it belongs.

These two types of sentence (fmcd and fmca) enable introducing the composition and populating the sorts, i.e. adding elements to and deleting elements from a sort. Recall that sorts never intersect according to paragraph 1 of the FMAS-0 definition. The following Y!L sentences fill up the place and sample sorts:

```
! _PLC1809 place !
! _SAM32994 sample !
! _SAM32995 sample !
! _SAM32996 sample !
```

Result 1. Current example

Let's the !0! command (*forget all*) is sent to Yp, and then the Y!L commands previously encountered in the text are executed, then AS will contain three sorts populated as follows:

```
sample={_SAM32994 _SAM32995 _SAM32996}
place={_PLC1809}
TV={_True _False}
```

If now !2! is said to Yp, then we will obtain the AS text in the form of sentences for creation from scratch at the output:

```
!0!
! _True TV !
! _False TV !
! _PLC1809 place !
! _SAM32994 sample !
! _SAM32995 sample !
! _SAM32996 sample !
```

R and S sorts

The language has two built-in sorts R and S. R sort elements are numbers of the Number RE-type. S sort elements are letter strings of the String RE-type. Note: These sorts are denumerable, and do not take us beyond the FMAS is carefully used.

2. Finite System Elements

Function signature

The existence of multiple sorts results in the necessity of specifying not only the number of function arguments, but also the sort of each argument and function value sort. This leads to the notion of function signature (see [3], p.53 where the function signature is called *type*). Let COLON denote the ':' letter.

Signature is a syntactic structure (sig_f) specified by three BNF rules:

```
(sig_eI)          sig_e :   Id
(#sig_arg) sig_arg : sig_e+
(sig_f)   sig_f : sig_arg COLON sig_e
```

The sig_eI rule says that the sig_e non-terminal must be Id. A sort Id is *semantically* implied in this case. The #sig_arg rule says that the sig_arg non-terminal is a chain consisting of one or more sig_e. The sig_f rule says that signature is an argument signature followed by a colon (COLON letter) and a result signature. For examle, the sentence Declaration gathering_place sample : place prime. introduces the primary function gathering_place with a *sample : place* signature, i.e. the function is declared to be unary with an argument from the *sample* sort and a value from the *place* sort.

Truth-values and predicates

The existence of truth-values enables expressing relations of a classic AS through functions of a special type, predicates, with the TV range of values. See also *Relations and Predicates* [5] and [3], p.71. For example, let's declare

Declaration rhyolite sample : TV prime .

predicate that can assume the _True value on a *sample* sort element, which is natural to interpret as that this sample is rhyolite; _False value on a *sample* sort element, which is natural to interpret as that this sample is not rhyolite. In addition, since rhyolite is an originally partial function, there may be no value at all. Whether is it permissible for a predicate to be partial depends on the subject domain. So, if we have a rock sample and information about it in an AS, we may be unaware whether it is rhyolite or not at some time, and the lack of value can be interpreted as *unknown*.

For ex. studies may result that a particular sample represented as _SAM30697 in the AS proving to be really rhyolite. The predicate value should be specified as _True on _SAM30697, which is written as follows in Y!L:

```
!rhyolite ( _SAM30697 ):_True!
```

i.e. _True is assigned to the rhyolite function value on _SAM30697. Now, if we ask Yp ?rhyolite (_SAM30697)? it will answer _True.

Notion of term

The syntactic structure *term* is primarily used to obtain values from function application to arguments. For example, the NOT (_True) term typically has a _False value. We will also use the term to set values for primary functions. For example, the sentences

```
!NOT ( _False ):_True!
!NOT ( _True ):_False!
```

set values of the unary function NOT on TV sort elements.

Let's l_p denotes "(", r_p - ")", EXISTS - ∃, FOR_ANY - ∀, here and below while COLON denotes ':' as before. In a general case, we have syntax:

```
(trmi)   term : Id
(trmie)  term : Ide
(trmn)   term : Number
(trms)   term : String
(trmf)   term :   Id l_p TermList r_p
(trmp)   term :   l_p INFIX term r_p
(trmin)  term : l_p term INFIX term r_p
(trme)   term :   l_p EXISTS   Id COLON Id term r_p
(trma)   term :   l_p FOR_ANY Id COLON Id term r_p
(#trml)  TermList : term+
```

So, trmi says that the term can be Id, which is implied to be a constant and the term value to be the constant value. trmie says that the term can be Ide, and its value is the term itself. trmn says that the term can be Number, i.e. a decimal number, and its value is the term itself. trms says that the term can be String, i.e. a string enclosed in quotation marks, and its value is a string without quotation marks. trmf says that the term can be Id (functions being implied) applied to the list of terms (TermList), and term values are implied to give arguments for the Id function. For example, the NOT (_False) is a trmf rule term. trmp, trmin enable using special letters or key words (-trmp prefixes and -trmin infixes) to be assigned unary or binary functions. The prefixes and infixes are jointly called *fixes*. trme, trma say that quantifier structures are terms as well. Id-1 (the first Id) is implied to be an identifier of a variable bound by the quantifier, and Id-2 the sort of this variable. The term value is _True or _False. #trml says that TermList is a non-empty list of terms.

INFIX can assume the following values: ¬ ∧ ∨ → ≡ ≠ ≤ ≥ = neq leq geq < > + - * / not and or impl eqv

Let's consider an example. The term

(∀ x : sample (∃ y : place (gathering_place (x) = y)))

states that a place of collection exists/is specified for any sample. The value of this term can be true, false or result in a *No value* message on a particular AS. For example if we ask Yp

?(∀ x : sample (∃ y : place (gathering_place (x) = y)))?

No value. The term value is calculated in some language sentences that are easier to consider as commands to the Yp processor. If the term has no value, then command execution is stopped, and the processor outputs a *No value* message.

Definition of a *free identifier* in a term. This is an identifier that is not assigned to any constant, function or quantifier.

Definition of a *closed* term. A closed term satisfies the mandatory requirements and contains no free identifiers. The additional requirement is equivalent to trmi-4.

(trmi-4) If Id is not assigned to a constant or function in the term, then it is assigned to a quantifier.

Specifying primary functions

Many functions can be specified by maps: set of of n's such that the first n-1 values are function argument values, and the last value is function result value. So, the NOT function map consists of two n's: <_True _False> <_False _True>. On the other hand, values can be set for terms. For example, let _SAM30697 be an element of the *sample* sort, then a value can be set for the primary function *rhyolite* as follows:

! rhyolite (_SAM30697):_True!
In a general case, we have syntax:
(fmta) Statement : e_m term COLON term e_m
(fmtd) Statement : e_m term COLON e_m

The fmta rule sentence assigns the term-2 term value to the term-1 term, including a constant. If term-1 term already has a value, then it is replaced. The fmtd rule sentence deprives the term-2 term of the value, including a constant. There are big restrictions on the term structure. Let's start with definitions. term-1 called FSt (Finite System term), and term-2, FSv (Finite System value). The **FSt** must satisfy the following additional requirements: be a trmf term without quantifiers or fixes; its identifiers are only constants and functions, both being primary. It's follows from the definition that sort elements are permissible. **FSv** must be a string, number, sort element or Id of a primary function or constant. Note: The possibility of using the Id of a primary function or constants takes us beyond FMAS because the value is not an element of the sort already.

Requirements

(fmta-1) term-1 must be FSt.
(fmta-2) term-2 must be FSv.
(fmta_proc-1) Consistency of types. The term-1 value type must be equal to the term-2 a value type.
(fmtd-1) term must be FSt.
(fmtd-2) term must be in the FS, i.e. have a value. The desire to remove a non-existing value can be a mistake caused by a lack of understanding of the FS structure.

Specifying an FMAS

Height 1 terms suffice to specify an FMAS, i.e. terms of the type of function application to simple arguments, not other functions.

For example, the following sentences containing height 1 FSt

!OR (_False _False):_False! !OR (_False _True):_True!
!OR (_True _False):_True! !OR (_True _True):_True!
set OR primary function values.
The sentences
!NOT (_False):_True! !NOT (_True):_False!
specify the NOT primary function.
The sentence
Declaration authorial_number sample : S prime.
specifies a function assigning the author's number to the sample.
For example, !authorial_number (_SAM32994):"A"!
The sentences
Declaration latitude place : R prime. Declaration longitude place : R prime.
enable specifying the latitude and longitude for a place:
! latitude (_PLC1555):-7.93!
! longitude (PLC1555):-14.37!

Finite system (FS)

A totality of FSt, FSv pairs where all the FSt are different is called *Finite System* (FS). There are no restrictions on the FSt height, and the following expression can be written:

!NOT(NOT(True)):False!

In doing so, one only has to keep it in mind that Yp goes along the term from the bottom upwards when searching for the term value in a FS: it will try to find a value for NOT(True), and will only search for a value for NOT(NOT(True)) if there is no value for NOT(True). It's unclear whether such opportunity is required in the practice of ontologistics.

Identity relation

It is natural to assign a binary predicate of an identical relation to each sort, which is true then and only then when argument values are one and the same sort element. A function should be introduced, and an '=' infix assigned to it to do that. For example, let *sample* and *place* be two sorts. The following YAFOLL sentences introduce two primary functions (EQU_sample, EQU_place) and declare them computable using the fm_strcmp algorithm, which is part of the Yp processor. Each of these functions is assigned one and the same '=' infix.

Declaration EQU_sample sample sample : TV prime fm_strcmp. Add infix "=" to EQU_sample.
Declaration EQU_place place place : TV prime fm_strcmp.
Add infix "=" to EQU_place.

Term value request

Once values of primary function and constants, if required, i.e. FS, have been specified, we can calculate the values of terms on the FS. It can be sometimes regarded as a clarification of FS properties and sometimes as obtaining the value of interest. Note that first order predicate calculus formulas, including quantifier formulas, are terms. Let q_m denote "?". Having BNF-rule

(st-11) Statement : q_m term q_m

This sentence asks the term value from Yp. Since we are dealing with partial functions, not only a value, but also a message can be the Yp processor response: No value!

Requirements

(st-11-1) The st-11 rule term must be closed, i.e. meet trmi-4 in addition to general requirements.

A query to FS performs two fundamental functions by analogy to AS: It checks whether subject domain axioms are satisfied, It clarifies the subject domain properties. If all the axioms are satisfied, then the AS is considered a model of the system of axioms and subject domain itself.

For ex. ?(∀x:TV ((x∨x)=x))? responses _True.

3. Building an Ontology of the Subject Domain (PROBA DB)

Let's review the formalization of a small part of the petrology knowledge: accumulation of information about rock samples, i.e. place of collection, rock, concentration of chemical substances, article where the information is published, etc. We are talking about all the samples accumulated at all laboratories in the world. The information already accumulated in the Proba database is taken as a sample [6]. This is a 'world' of samples stored at laboratories, places on Earth where they were collected, and publications on sample properties.

Sorts

We will keep to the 'flat' idea about sorts during formalization: if entities of a species are of interest, then this such species can be considered to be a sort. We'll obtain three subject sorts at once: *sample* is a rock sample, *place* is sample collection place, *publication* is publication.

Populating sorts and basic attributes

The rock samples processed and stored at a laboratory can be identified using various methods. The Ide type identifier assigned to the sample can be arbitrary within a FMAS, provided that three requirements are satisfied:

(GUI) global unique identification: the identifiers of different samples must be different.

(I2SW) id to sample works: the sample can be found by the identifier and FMAS in the laboratory.

(S2IW) sample to id works: sample identifier in FMAS can be obtained by the sample at the laboratory.

A unique number of record on sample was taken from the Proba database and updated to the Ide to get GUI. For ex. DB record number 32994 obtains an Ide = _SAM32994.

References to reality functions, i.e. basic attributes of the element of each subject sort enabling finding the sample in reality by their values are introduced to execute I2SW in FMAS. For example, let's introduce the function Declaration authorial_number sample : S prime.

The authorial_number function supports the author's sample number, which is unique for the laboratory that stores the sample. This function must be full, i.e. we have an axiom: Axiom AN_full (∀x:sample(∃y:S(authorial_number(x)=y))).

A material algorithm is assumed to exist: how a sample can be found in the laboratory if its author's number and other basic attributes are known. A material algorithm that is 'reverse' in a certain sense is assumed to execute S2IW, i.e. to determine sample Ide in the FMAS while being one-on-ones with the sample in the laboratory: values of the basic attributes of the sample unambiguously characterizing it in FMAS are located somewhere in the laboratory. This unambiguity is supported by the axiom of uniqueness of the totality of basic attributes. Suppose for simplicity that already authorial_number is globally (for all laboratories) unique. Then the axiom of uniqueness will look as follows: Axiom AN_uni (∀x:sample (∀y:sample (authorial_number(x)=authorial_number(y))→(x=y))).

A set of basic attributes, material algorithms, and axioms of completeness and uniqueness of their basic attributes similarly exists for *publication* sort and *place* sort. In addition, the following formalization method is used for geographical names (for example, Iceland, Atlantic Ocean): they are used to form an Ide (_Iceland, _Atlantic_Ocean) and to assign it to the *place* sort:

!_Iceland place! !_Atlantic_Ocean place!

Additional attributes and relations

The attributes that are not basic attributes can be diverse and are found in big quantities in databases. The presence of numbers and strings in YAFOLL enables adding any DB attribute to FMAS. Also note that the functional relation between DB tables is simply a partial (or full) function in FMAS. It does not mean that each table should be assigned a sort when building an FMAS on the basis of a DB, but some tables will usually be sorts. The gathering_place function assigning the place of collection to the sample was already mentioned above. It has a completeness axiom of its own: Axiom GPfull (∀ x : sample (∃ y : place (gathering_place (x) = y))). And value assignment sentences

! gathering_place (_SAM30681):_PLC1555!
! gathering_place (_SAM30682):_PLC1555!
! gathering_place (_SAM30683):_PLC1555!

Example of a string attribute: Declaration title publication : S prime. And value assignment to it: !title (PUB5633):"A CONTRIBUTION TO THE GEOLOGY OF THE KERLINGARFJELL"!

Predicates of rocks and chemical substances

It is natural to present the term corresponding to a certain rock (for example, rhyolite) in FMAS by the predicate: Declaration rhyolite sample : TV prime. Assuming one of the truth-values on the sample: _True _False or it may have no value although this is prohibited by the axiom: Axiom full_rhyolite (∀ x : sample (∃ y : TV (rhyolite (x) = y))). This predicate is primary in this FMAS, and values may and

should be assigned to it by assigning samples to it, for example as follows, !rhyolite (_SAM30697):_True! !rhyolite (_SAM32994):_True!

Example of chemical substance predicate: Declaration SIO2 sample : TV prime. It will be true on a sample only if the sample is a silica.

4. Conclusion

A part of the YAFOLL language and its Yp processor potential enabling handling FMAS and ask 'first-order' questions about its properties is described.

Finite system. The finite nature of a system simulating a part of reality is a most important element of the approach. A part of reality is simulated exactly as a finite system of elements in most cases. The elements may prove to be very numerous (for direct calculations), of course, or a part of the elements may prove to be conceived as continuous, i.e. 'infinite'.

Comparison with RBD. It should be emphasized that FMAS regarded as a data model (DM) is no weaker than a relational DM. The RDB tables structure can be reproduced one-for-one in the FMAS, too. However, this does not mean that one should act so when building an ontology.

Several languages. In fact, at least 3 languages are combined in YAFOLL: Handling FMAS, Query to FMAS, Language of responses. The latter is quite primitive, but it will develop.

Direct calculations. The idea of direct calculations is fundamental and precedes the idea of logical deduction. The vast majority of engineering calculations are generally algorithmically direct calculations. One of the main objectives of the project as a whole is to find out what types of direct calculations are needed to simulate a subject domain. In doing so, it was natural to start with a first-order predicate calculus language (FOL). The area of direct calculations includes both formalized laws of the subject domain and properties of the subject domain entities. The former ones are accumulated as axioms, and the latter ones as query formulas.

If an entity is conceived as a system in science, technology or legislation, then it can be simulated by a finite system. The properties that such system and the languages used to handle it should possess is exactly the subject of this message and subsequent ones.

References

1. Algebraic structure: 2015. *https://en.wikipedia.org/wiki/Algebraic_structure*. Accessed: 2015-09- 18.
2. Barwise, J. 1982. Introduction to first order logic. In Reference Book on Mathematical Logic I, J. Barwise, Ed., Moscow, Nauka, 13-54.
3. Kolmogorov, A.N., Dragalin, A.G. Mathematical Logic. 3rd stereotypical edition. Moscow: KomKniga, 2006.
4. Maltsev, A.I., Algebraic Systems, Moscow, Nauka, 1970.
5. Finitary relation: 2015. *https://en.wikipedia.org/wiki/Finitary_relation*. Accessed: 2015- 09- 18.
6. Shkotin, A. and Ryakhovski, V. (2015). *Proba DB. Ontology of a relational database - Open science*. [online] Sites.google.com. Available at: https://sites.google.com/site/alex0shkotin/formalnaa-geologia/bd-proba-ontologia [Accessed 18 Sep. 2015].

DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015), pp. 13—22
DOI: 10.1515/sh-2015-0022

Poland: A Dark Side of Church Cultural Policy

Konrad Szocik

University of Information Technology and Management in Rzeszow, Poland

e-mail: kszocik@wsiz.rzeszow.pl

Aneta Szyja

Adam Mickiewicz University, The Department of Dutch and South African Studies, Poznań, Poland

e-mail: as21163@st.amu.edu.pl

Abstract:
The cultural policy of the Roman Catholic Church in Poland is incorporated into state-run cultural policies. The organs of public authority enforce the objectives of Church regardless of Church's actual ability to influence the society. It should be pointed out that the secularization of religion in Poland is frequently misinterpreted and usually equated with its deprivatization. It is worth mentioning that Catholicism is the dominant religion of the country and the Roman Catholic Church has hold a special position in Poland and play a major role in the country's social and political life. In practice, however, Polish society appears to be religiously indifferent. This paper proves that the official, state-run cultural policy in Poland is based on favoritism of the Roman Catholic Church, regardless of Church's actual ability to wield influence on society. Thus, there is a variety of implicit and explicit cultural policies implemented by the authorities to support Church. This work also aims at addressing the question of social attitudes to women, especially the one concerning the UN and EU law embracing women's rights, until recently still not implemented in Poland. This paper further explores some peculiarities of this topic as an example of a specific outcome of Church cultural policy and its impact on both the past and present-day society.
Keywords: The Church, Cultural Policy, Women, Gender, Democracy.

1. Introduction

The issues of secularization, post-secularization, privatization and deprivatization of religion and numerous implications on social, cultural, political or philosophical contexts have been widely discussed [19], [7], [5]. These analyses delineate the Western European cultures but do not allude to the Polish reality. We would like to touch upon certain elements that are peculiar to the contemporary Polish cultural policy concerning the special position of the Roman Catholic Church which, however, do not reflect its actual power to wield influence upon society. In a sense, the explicit cultural policy of Church, which has functioned as an authoritarian institution, is strongly advocated by the state authorities which oftentimes implicitly (occasionally also explicitly) function as an executor of Church cultural policy. What we mean here, is the term of implicit cultural policy

expounded by Jeremy Ahearne and extended by Oliver Bennett [5, p. 157]. It is, therefore, understood that Church, as an agent of cultural policy, aims at shaping and controlling consciousness of believers and is of paramount importance, especially in Poland [5, pp. 167-168]. Nevertheless, the Polish case remains difficult to categorize. The special emphasis should be put on the situation of Polish women [20], [13, pp. 431-435], [15]. There is a particularly strong opposition in Poland against the UN and EU laws protecting women, which stems from the present-day Church cultural policy and the outcomes of its social and mental influence in the past.

One of the most important reasons of the present-day increased cultural policy of Church in Poland is the absence of commonly shared ideas upon which the nation could base their national identity and through which this identity could be expressed. This lack of the commonly shared elements of identity and the absence of an idea of "cultural citizenship", which is fundamental when it comes to cultural policy [17, p. 34], may be one of the main reasons why Church in Poland inclines to impact the society both implicitly and explicitly, unlike other countries in the Western Europe. On the one hand, Polish national identity and cultural continuity had been disturbed due to numerous political changes that occurred in the past and which significantly influenced the society's perception of national identity. Therefore, the Polish are remarkably less inclined to identify themselves with the state, which in turn, explains the logic behind the perception of Church as an important part of Polish society. In fact, Church had been perceived as a sort of substitute of the state over the years. On the other hand, even such a significant event as the Fall of the Berlin Wall, which goes back to 1989, did not give rise to any new cultural and ideological rudiments which could serve as the foundation of national identity.

Nowadays, there is a range of mindsets which appears to be somewhat superficial and to which the majority of Polish society seems to be indifferent. However, at the very top of it, there is one distinctive lineament, that is: the Roman Catholic Church. The nature of this institution could be described as political authoritarianism. In Poland, the Church attempts to maintain its dominant position not only in the area of culture but, first and foremost, in politics, successfully perpetuating its influence especially through the medium of cultural policy. Church is aware of a significant role it played in a communist Poland. Some events during the communist period in Poland, such as: the Battle for a Church and the Nowa Huta Cross in Cracow or the sermons of Jerzy Popiełuszko, a Roman Catholic priest associated with the Solidarity union, murdered by the agents of the Polish communist Security Service of the Ministry of Internal Affairs can illustrate this point. What Church in Poland wishes to achieve is creating the Polish history and national identity on the basis of Church's strong historical function. Still, Church is treated by the majority of Polish society only instrumentally (as it is a case for some other institutions in Poland).

After the Fall of the Berlin Wall the Church in Poland tries to manipulate both the political authorities as well as society by sexual matters. One of the first topics was the case of couples without marriage. In recent 2-3 years the main topic was the question of "gender ideology" and „Convention on preventing and combating violence against women and domestic violence". We consider this case in our paper. Currently, we can observe another topic associated with the sexual matters: the case of "in vitro". The Church lost the ideological battle against convention because this document probably will be soon ratified despite the great opposition of the Church. This is why the Church immediately focuses on a new "gender" question, "in vitro". The better example for consideration is the case of the convention. This complete history shows what mechanisms and strategies the Church in Poland uses to hold its position. First of all, we can see how the question of woman is understood in the current Poland and how, in specific way, in the polish society are connected the following questions: European idea of equality and justice, idea of citizen society (implemented especially by European Union since 2004) and democratic approach on the one side, and religious tradition and historically strong position of the Church, superficial religiosity and practical atheism on the other hand. Consequently, we observe a chaos of ideas and a lack of dominant and meaningful social and cultural beliefs and ideas. Probably, this ideological "chaos" causes that the Church cultural policy which is against civil laws preventing women, is not only possible but is still so strong and influential. In our paper we are focus on an analysis of these

mentioned above questions from the phenomenological point of view and critical analysis. However, deep sociological surveys and research could be found in many works of Józef Baniak who underlined some negative social and moral results of inappropriate cultural policy of Church [2], [3].

2. The Church Implicit and Explicit Cultural Policy

When taking into consideration a global context, it can be noticed that the "strategic canonization", promoted especially by Pope John Paul II, was used by Church as one of the main tools of its cultural policy to shape the secular world [6]. This practice of creating saints on a massive scale, which can be viewed as the production of Church's "international celebrity saints" some of them being: Padre Pio and Mother Theresa, connotes the implicit cultural policy [6, pp. 441, 451]. When analyzing the Polish case there is a particular link between implicit and explicit cultural policy. This phenomenon was uncovered by Jan Woleński, a Polish logician and philosopher. He prepared an appeal to Polish organs of authority, published in *Gazeta wyborcza* 17 October 2014, in which he underlines the fact that the organs of authority do not respect the principle of neutrality incorporated in the constitution of 1997 [27]. This appeal was signed by fifteen Polish professors (6 psychologists, 4 lawyers, 2 philosophers, a Polish scholar, a historian and a sociologist). It has been signed online by another 24 341 people (as for 29 November 2014). Woleński's main thesis is of a key significance in view of a current cultural policy guided by the state and Church. He is primarily concerned with the impact of Church on the following aspects of politics: educational issues (religious education in public schools), financial issues (public financial support provided to Church) and ethical issues (domestic violence, nature of relationships). He states that it is quite natural for Church to pursue its particular aims. However, it is not usual for the secular state authorities to accept these demands and implement them against the constitution [27]. Also from the perspective appropriate for the biological evolution, this Church approach is natural, because every organization, human as well as animal populations want to take an advantage over other [23].

One of the most important issues is religious education in public schools. This is not a compulsory subject and pupils attend the classes of their own volition. Parents determine whether their children should attend religion classes or ethics classes or none of them. The classes, nevertheless, are scheduled only in the middle of a timetable on request of Church as it do not acquiesce to arrange it at the end of a timetable (risk of low attendance rate). A special kind of declaration requested by Ministry of Education has to be fill out by parents who do not wish their children to attend religious education. This request of Ministry of Education is, however, inconsistent with the Polish constitution. This is yet another example of how the Ministry consistently implements the suggestions made by the Church [28]. According to Woleński, the Church invades the public sphere by forcing religious worldviews into public debates and is strongly involved in political activity. Consequently, other important social and economic issues are marginalized. In some cases, the immense power of Church reverberates throughout the decisions made by the organs of authority in the area of social matters and oftentimes result in serious repercussions as it may be seen in case of domestic violence. *Council of Europe Convention on preventing and combating violence against women and domestic violence* (Istanbul, 11 May 2011) underlines that its main purpose is to "protect women against all forms of violence" and "the elimination of all forms of discrimination against women" [10]. It may be seem incredible for the Western societies that this convention has still not been ratified in Poland. It was rejected by two ruling parties and the largest opposition party on 21 October 2014 [13]. Every year, in Poland some 700 000 to 1 000 000 women become victims of some forms of violence (30 000 of which are rape victims). Each year, in Poland 150 women are killed as the result of domestic violence [1]. The main enemy of this European Convention is Church who claims that this regulation destroys a Catholic family. The homily given by Polish Bishop Kazimierz Ryczan on 20th September 2014 in Częstochowa casts light on this matter:

> Dear Members of Parliament! Polish law is in your hands. (…) Europe has no right to interfere in our families! Dear Mr President! You have a decisive voice. Your signature can solve this problem [22].

It can serve as an example of the effectiveness of Church activity since after the above-quoted appeal the Convention was refused to be passed in the first session of Parliament shortly before the final decision of President. This homily, however, was not an isolated element of the Church's cultural policy. Another step was undertaken in form of the overnight adoration together with a prayer devoted to the rejection of this bill, supported by the Polish Episcopate with Bishop Jan Wątroba (the chairman of the Council for the Family of the Polish Episcopate) [18].

3. The Church Policy is Based on the Sexual Matters

Among other currently important issues is the legal status of women in Poland. The Catholic Church in Poland strives against the movements for women rights. Church clearly opposes many of the proposals on women's rights and not only stands in their way to guarantee them equal rights but also is one of the greatest obstacle to respect women's freedom and the right to choose. These matters are connected with the implicit and explicit cultural policy of Church and state authorities. Firstly, the reasons behind such state of affairs should be investigated. It is quite understandable that absence of a more unifying understanding of national culture has significantly contributed to this situation. Due to this lack of basic social and cultural foundation, various forms of cultural policies are introduced and are not "automatically" blocked by a filter called "national identity".

Church employs an ideological strategy which is based on the interpretation of the current legal changes introduced by Poland's membership in EU and claims that they are the instances of threat posed to the values of great importance to the Polish nation. The gender ideology being a case in point. This concept is presently central to Church's cultural policy. In the pastoral letter of Polish Episcopal Conference of 29 December 2013 (The Feast of the Holy Family), it was said that due to the enormous interest generated by gender ideology, a special attention should be paid to the defense of a Christian family and any kind of public information campaign should be run to raise awareness of all the threats posed to Catholic families. One of the preliminary steps of Church's cultural policy is creating a relevant definition of "genderism". Church sees gender ideology as a result of a school of thought based on Marxism and neo-Marxism, feminist movements and the sexual revolution [16].

Polish society, especially the younger generation, attempts to imitate the Western mode of life – a trend which had been much more visible after Poland's accession to the European Union in 2004. As it is a well-known fact that the human brain throughout its development is shaped by the environment, it is not surprising that various cultural forces give rise to different patterns of behavior, perception and cognition. In Poland, a large set of social and cultural patterns of behavior was shaped by a conservative model of education. And Church played a major role in its development and further transmission. As a consequence of this practice, a range of dichotomies between moral thought and ethical behavior was created which demonstrates the conflict between social norms and what is in reality cultivated by people. In Poland, there is a visible clash between general social norms and actual types of behavior preferred by society. Those strict patterns of behavior have been shaped by the Church since around 17th century until the present day. Also, the historical background (wars with other countries, e.g. Sweden, Russia, Turkey) resulted in the situation in which social structures are created according to two models: family relations and close collegial ties of rather hermetic nature. This is why, all forms of teamwork tend to be difficult and oftentimes require the employment of some kinds of extrinsic motivation tools as a means of encouraging efficient accomplishment of the tasks.

The real impact of Church on society is mostly seen in the area of sexuality. Church persistently emphasizes the importance of marriage in one's life. In Poland, this element of cultural policy seems to be a dominant one and until now the concept of marriage have strongly permeated

the lives of members of society and stands a symbol of a morally appropriate model of a relationship between two sexes. This pattern is a consequence of Church implicit cultural policy. On the one hand, there is society's set of rules marked by Catholic education, but on the other hand, people try to lead their lives according to natural laws and their own intuition. The reason why in Poland all acts of violence against women are not treated as criminal cases may stem from the inferior role of women in society resulted from the influence of Church cultural policy.

This dominant position of Church in Poland, in a sense, regulates male – female relationships and has an impact on how some ethical issues concerning sexuality are treated. A case in point is the EU and UN law concerning women's rights being rejected even by female representatives in Polish Parliament and it presents the attitude of Polish society towards women. This generally held view may provide us with an explanation of Church's ease of pronouncing views which are not applicable in the rapidly-changing world. Church seems to realize that a large group of female representatives will support its postulates due to the fact that female society is internally divided. It seems that two ways of referring to the social position of women co-exist in Poland. One is borrowed from the Western lifestyles, the other arises from Catholic education. It is well-known that Church has affected social attitudes to women in significant ways and that women for decades have not taken over pastoral and administrative posts in priest duties. Even though a great number of women is active in the Catholic Church, only few of them have sanctioned titles (becoming a nun does not mean being given the boon of the sacrament of Holy Orders; only men are ordained). In secular environment, a few decades had to pass for women to be regarded as full, equal partners with their husbands. This social attitude formed by Church is reflected in the way both sexes view relationships – men are more inclined to play a dominant part in a relationship and women more often feel inferior and subordinate to the partners. In this cultural and social framework, Church insists that it fights with gender ideology and that it has to take extra measures to "prevent violence and achieve equality" [16].

4. The Church Affected the Refusal of Convention Which Combats Violence Against Women

Despite the fact that Poland is in the process of introducing "The National Action Plan for Equal Treatment 2013-2016" and "The National Broadcasting Regulatory Strategy 2014-2016" (which aims at preventing stereotypes of women social roles in the media), the UN criticizes Poland for some forms of discrimination of women. The last report on the women's situation in Poland prepared on 7 November 2014 by the United Nations Committee on the Elimination of Discrimination against Women (CEDAW) stresses that the Polish Parliament does not fulfill its legislative obligations [9][1]. These conclusions and Woleński's point of view overlap in that the Polish state authorities do not respect the aforementioned law. The Committee concludes that:

> the Act on Equal Treatment of 3 December 2010 does not provide protection from sex and gender-based discrimination in areas such as education, health care, and private and family life; and that it does not adequately protect women from multiple and intersecting forms of discrimination based on ethnicity, age, disability or other grounds, in the absence of a legal definition of such forms of discrimination [9, p. 3].

The report of the UN explains briefly the situation of women in Poland:

> However, it reiterates its concern about the persistence of deep-rooted gender stereotypes concerning the roles and responsibilities of women and men in the family and society, which continue to be present in the media, education materials, and are reflected by the traditional educational choices of women and their disadvantaged position in the labour market, as well as by widespread violence against women [9].

We tried to provide an explanation for this peculiar social status of Polish women caused by the historically dominant Church's position and which cultural policy in case of sexual issues was so effective that it contaminated secular social networks. The UN report highlights this negative role played by Church cultural policy not in the past but today: "The Committee is also concerned at the absence of measures to counter the campaign by the Polish Catholic Church against "gender ideology" and recommends that the government should "promote the equal rights of women and combat efforts made by any actors including the Catholic Church to downplay or degrade the pursuit of gender equality by labelling such measures as ideology" [9, p. 5]. However, it may be the case that this particular rejection of the Convention in Polish Parliament is caused not solely by Church but may be prompted by the specific kind of Polish mentality. There is yet another recommendation included in the UN report: "Encourage the media to project positive images of women and the equal status of women and men in private and public life" [9]. This statement confirms the motion that the dominant social approach reflects how society perceives both sexes only from the sexual point of view and that it may create difficulties in portraying women as someone above their corporality. Yet, this perception is fully compatible with Church's doctrine on how intercourse determines cultural and social roles. Very similar critical comments can be read in the previous UN report of 2007:

> The Committee is concerned about the persistence of deep-rooted prejudice and stereotypical attitudes regarding the traditional division of roles and responsibilities of women and men in the family and in society at large [9, p. 4].

It can be seen that within those 7 years nothing has changed in Poland. From our perspective, any alternations could not be introduced due to above-mentioned peculiarities of Polish mentality. In this case, Church cultural policy has two functions. Firstly, it blocks explicitly and officially the Convention on Preventing and Combating violence against women and domestic violence. This explicit cultural policy focuses on Church attitude to state authorities and not to society, but at the same time, it has its consequences in actual social and legal status of women. Secondly, even though Church does not have any important influence on social mentality in the present-day society, the result of its power in the past can be observed today.

5. The Polish Anticlericalism

It should be noted that mentality of Polish society is of very peculiar nature. This social attitude towards certain ethical issues was mostly shaped by Church cultural policy in the past. This is probably why some of the new legal modifications proposed by the UN and by the EU are not received in Poland. However, in other cases, it can be observed that state authorities support Church cultural policy regardless of that fact that Church is no longer of key importance to society. This attitude of Polish society can be categorized under practical atheism.

It is not only Polish scholars (e.g. Woleński et al.) that disagree with this joint cultural policy of the state and Church but also the significant part of the society feels that something should be changed. According to the recent poll conducted by Polish Public Opinion Research Centre (CBOS) titled "Religion and the Church in public sphere" published on 13 December 2013, there is an intriguing split in the Polish society. On the one hand, Poles do accept such things as crosses hung in public places (schools and offices) (88% answered "not offend", 10% "oppose"), religious education in schools (82% "not offend", 15% "oppose"), priest participating in the public TV (74% "not offend", 22% "oppose). On the other hand, Poles strongly oppose direct interference of Church into secular affairs, both of private nature as those connected to politics. They disagree especially with the Church activity when it comes to acts of parliament (39% "not offend", 55% "oppose") and when priests try to instruct them how to vote in the elections (15% "not offend", 82% "oppose") [21, p. 6]. It can be concluded that there has been some form of general anticlericalism among Polish society from around 16 century.

6. Dichotomy Between Public Policy of the Church and the Social Resonance

There is a certain type of dichotomy in Poland when it comes to some tendencies present in the society, such as the process of naming the streets, buildings, public schools, bridges and other public structures. In Poland, at the top of the list with the names proposed for naming places in Poland is John Paul II. There is a significant number of structures of all types in public sphere that are named after Pope and other figures important from a religious point of view. The interesting fact is that the use of the names of saints seems more natural than the adaption of the names of historical figures.

This tendency may be interpreted as a way of strengthening the position of Church in public sphere [6] by the government, however, irrespective of the general preference of the society. One of the recent online referenda held to vote on the new names for six traffic circles in one of the districts in Warsaw illustrates this tendency. For all six roundabouts, secular names were chosen (including the name of a Polish heart surgeon and an atheist Zbigniew Religa) [24] and none of the religious names was favored. Nevertheless, state authorities when deciding on the names invariably opt for religious ones.

It is worth remembering that the Enlightenment, which stretched from around 1650s to about 1780s, significantly altered ideas concerning religion, reason, nature and man. This intellectual movement put stronger emphasis on reason, analysis and individualism and fuelled heated debates and criticism of religion and provided ground for the development of novel religious ideas, such as Deism and atheism. Much of the revolutionary ideas in Europe were provided by scholars and philosophers. However, this was not the case in Poland where the main figures of this movement were priests (e.g. Hugo Kołłątaj, Franciszek Bohomolec, Bishop Ignacy Krasicki). Maybe the fact that this movement in Poland was so strongly marked with religious influence and not with the scholar trains of thought was one of the reasons why the Polish Church cultural policy is nowadays of chief importance, at least for state authorities. This, in turn, results in a lack of debates on secularization and privatization of religion which are held in other Western countries. This may also be a binder that connects cultural policy of the state with Church policy so strongly that it is not so openly criticized and questioned by the society.

7. Conclusion

Two forms of dichotomy can be observed in Poland. The first one is visible in the division between state and Church cultural policies and the religiously indifferent Polish society. The cultural policy in Poland is, in most cases, guided by the demands of Church and effectively enforced by state authorities despite the fact that it is not consistent with the Polish constitution (e.g. religious education) or *Council of Europe Convention on preventing and combating violence against women and domestic violence*, rejected by Church and until recently by state authorities. Another instance of dichotomy can be seen in the sphere of social attitudes towards the teaching of Church. This attitude can be categorized as practical atheism or indifferentism connected with anticlericalism. It may be the case that the opposition to clerks causes indifferentism or it might be the other way round – anticlericalism stems from indifferentism of the society which demonstrates in this way its desire of self-direction in the moral issues.

The Church in Poland attempts to wield influence on society through both implicit and explicit policy executed by state authorities to regulate matters such as sexuality. From a historical point of view, it is one of the oldest and most basic tools of Church cultural policy [12, p. 475] which in a present-day Poland is in opposition to practical atheism and indifferentism of Polish society.

Cognitive science of religion's researchers identified a distinction between intuitive and reflective beliefs; they also proposed a hypothesis concerning theological incorrectness (difference between official religious beliefs and the interpretations of it by believers) [4]. Still, regardless of

this natural human tendency and secularizing process, church make use of his obsolete strategy to strengthen its presence in secular culture. In Poland, this process is of distinct nature when compared to "global" Church as it was described by Bennett [6]. The "global" Church strategy is based on implicit policy implemented by means of the media (e.g. strategic canonization or public life of Pope Francis), whereas Polish Church combines two strategies of cultural policy: implicit cooperation with successive state authorities (after 1989, regardless of their official political affiliations) and explicit impact on moral life of believers. In some cases, it is difficult to distinguish Church attempts to achieve its goals through the government from the strategy of politicians who seem only to take into consideration Church's demands as to, for instance, win the elections (even if the polls demonstrate that Poles do not wish priests to tell them how to vote).

The Church has specific moral background which is deeply rooted in the idea of the existence of another parallel reality. Christian background evokes ideas and behavioral patterns associated with the patterns of poverty and service. Above-mentioned historical context in Poland has connected the Church with the low level of identity of society with the state. However, this rather historical than moral and ideological correlation is insufficient in the current polish society which from 1989 is opened for all secular ideas and processes. These processes which have been working much earlier in the Western countries have affected institutional secularization and the great change of the Church attitude towards society and the state. It seems that good example of appropriate church policy in secularized societies is, on the lower level, public policy of John Paul II. This pope has tried to find balance between orthodox and secularization and he has excluded sometimes from his public teaching some normative, doctrinal claims which could block unity and social peace [23]. We can find a difference between the Church in Poland and the Church in the western countries which seem to be more affected by this ideologically neutral public teaching of John Paul II. When we look from a historical point of view we can find that the best solution for religious institutions in the time of secularization is to avoid strong political engagement and to focus on moral activity which is in line with democratic rules of the ideologically plural society.

References

1. *Apel o ratyfikację Konwencji o zwalczaniu i zapobieganiu przemocy wobec kobiet i przemocy domowej* [Appeal for Ratification of Convention on preventing and combating violence against women and domestic violence] [online]. Available from: https://www.change.org/p/rafa%C5%82-grupi%C5%84ski-apel-o-ratyfikacj%C4%99-konwencji-o-zwalczaniu-i-zapobieganiu-przemocy-wobec-kobiet-i-przemocy-domowej [accessed 16 November 2014].
2. Baniak, J. *Religia katolicka i Kościół rzymskokatolicki w opiniach polskiej młodzieży: od akceptacji do kontestacji* [The catholic religion and the catholic Church in the opinions of the polish youth: from an acceptance to contestation]. Kraków: Zakład wydawniczy Nomos, 2015.
3. Baniak, J. *Portret księdza w wyobrażeniach i ocenach polskiej młodzieży: studium socjologiczne* [The image of priest in imaginations and opinions of the polish youth: a sociological study]. Kraków: Zakład wydawniczy Nomos, 2015.
4. Barrett, J. L. *The Naturalness of religious Concepts. An emerging Cognitive Science of Religion*, in Antes, P., Geertz, A. W., Warne, R. W., *New Approaches to the Study of Religion*, vol. 2. Berlin: Walter de Gruyter, 2004.
5. Bennett, O. On religion and cultural policy: notes on the Roman Catholic Church, *International Journal of Cultural Policy*, Vol. 15, No. 2, May, 2009.
6. Bennett, O. Strategic canonisation: sanctity, popular culture and the Catholic Church, *International Journal of Cultural Policy*, Vol. 17, No. 4, September, 2011.
7. Casanova, J. *Public Religions in the Modern World*. The University of Chicago Press, 1994.
8. Committee on the Elimination of Discrimination against Women. 2007. *Concluding comments of the Committee on the Elimination of Discrimination against Women: Poland,* 2

February 2007 [online]. Available from: http://www.refworld.org/publisher,CEDAW,CONCOBSERVATIONS,POL,45f6d0a66,0.html [accessed 29 November 2014].
9. Committee on the Elimination of Discrimination against Women. 2014. *Concluding observations on the combined seventh and eighth periodic reports of Poland*, 7 November 2014 [online]. Available from: http://tbinternet.ohchr.org/_layouts/treatybodyexternal/Download.aspx?symbolno=CEDAW%2fC%2fPOL%2fCO%2f7-8&Lang=en [accessed 29 November 2014].
10. *Council of Europe Convention on preventing and combating violence against women and domestic violence* [online]. Available from: http://conventions.coe.int/Treaty/EN/Treaties/html/210.htm [accessed 16 November 2014].
11. Dziwisz, S. *Kraków miastem wyuzdania - pisze w liście do wiernych kard. Stanisław Dziwisz* [Cracow the City of Licentiousness – Cardinal Stanislaw Dziwisz writes in the Letter to the Believers] [online]. Available from: http://www.radiokrakow.pl/wiadomosci/krakow/krakow-miastem-wyuzdania-pisze-w-liscie-do-wiernych-kard-stanislaw-dziwisz/ [accessed 16 November 2014].
12. Gaydos, L. M., Smith, A., Hogue, C. J. R., Blevin, J. An Emerging Field in Religion and Reproductive Health, *Journal of Religion and Health*, Vol. 49, No. 4, December 2010.
13. Graff, A. Report from the gender trenches: War against 'genderism' in Poland, *European Journal of Women's Studies*, November 21, 2014.
14. *Konwencja antyprzemocowa znowu zablokowana. 'Tak Platforma pomaga PiS-owi'* [Anti – Violence Convention blocked again] [online]. Available from: http://m.wiadomosci.gazeta.pl/wiadomosci/1,117915,16842331,Konwencja_antyprzemocowa_znowu_zablokowana_Tak_Platforma.html [accessed 16 November 2014].
15. Lipien, T. *Wojtyła a kobiety. Jak zmienia się Kościół* [Wojtyła and the Women. How the Church changes], transl. J. Kabat, Warszawa, 2010.
16. List pasterski na Niedzielę Świętej Rodziny 2013 roku. [Pastoral letter of the Bishops' Conference of Poland to be used on the Sunday of the Holy Family 2013] [online]. Available from: http://episkopat.pl/dokumenty/5545.1,List_pasterski_na_Niedziele_Swietej_Rodziny_2013_roku.html [accessed 11 November 2014].
17. Mcguigan, J. *Rethinking cultural Policy*. Open university Press, 2004.
18. *Modlitewna ofensywa za życiem* [Prayer Offensive for Life] [online]. Available from: http://naszdziennik.pl/wiara-kosciol-w-polsce/98383,modlitewna-ofensywa-za-zyciem.html [accessed 16 November 2014].
19. Norris P., Inglehart R. *Sacred and Secular. Religion and Politics Worldwide*. Cambridge university Press, 2012.
20. Radkowska-Walkowicz, M. Frozen children and despairing embryos in the 'new' post-communist state: The debate on IVF in the context of Poland's transition, *European Journal of Women's Studies*, November 21, 2014, pp. 399-414.
21. *Religia i Kościół w przestrzeni publicznej* [Religion and the Church in the public sphere], *CBOS* [online]. Available from: http://www.cbos.pl/SPISKOM.POL/2013/K_170_13.PDF [accessed 16 November 2014].
22. Ryczan, K. *Bp Ryczan na Jasnej Górze: „Europa nie ma prawa dotykać laickimi rękami naszej rodziny!"* [Bishop Ryczan in Jasna Gora: „Europe can not touch his secular Hands our Family!"] [online]. Available from: http://www.diecezja.kielce.pl/bp-ryczan-na-jasnej-gorze-europa-nie-ma-prawa-dotykac-laickimi-rekami-naszej-rodziny [accessed 16 November 2014].
23. Szocik, K., *Jana Pawła II idee filozoficzne. Między ortodoksją a sekularyzacją* [Philosophical ideas of John Paul II. Between orthodox and secularization], Warszawa: Wydawnictwa Uniwersytetu Warszawskiego 2015.

24. Szocik, K. *Roots of self-domestication*, Science, 28 November, Vol 346, Issue 6213, 2014, p. 1067.
25. *Konkurs na wyłonienie nazw dla 6 bezimiennych rond na Ursynowie rozstrzygnięty!* [online]. Available from: http://ursynow.pl/2014/11/konkurs-na-wylonienie-nazw-dla-6-bezimiennych-rond-na-ursynowie-rozstrzygniety/ [accessed 29 November 2014].
26. Woleński, J. *Discussion*, in. Leszczyński, D. (ed.), *Wiara, wiedza, uzasadnienie* [Faith, Knowledge, Justification]. Wrocław: Atla 2, 2008.
27. Woleński, J. *Apel do władz Rzeczypospolitej Polskiej w sprawie klerykalizacji kraju* [Appeal to the Authorities of the Republic of Poland in case of Clericalization of the Country] [online]. Available from: http://wyborcza.pl/1,75968,16817936,Apel_do_wladz_Rzeczypospolitej_Polskiej_w_sprawie.html [accessed 16 November 2014].
28. Woleński, J. *Kolejne postulaty Kościoła psują nasze państwo* [Next the Church demands damage our state] [online]. Available from: http://m.wyborcza.pl/wyborcza/1,105402,16848629.html?i=0 [accessed 16 November 2014].

Notices

[1]The Polish Parliament has been accepted „Convention on preventing and combating violence against women and domestic violence" on 6th February 2015. Despite this delayed acceptance of this document, we can observe specific political and cultural game between three actors in Poland: the state authority, the Church and society. Now, the leading concepts in this game or, better, in this battle, are "gender" and "women".

DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015), pp. 23—38
DOI: 10.1515/sh-2015-0023

Neurobiology of Consciousness: Current Research and Perspectives

Beata Płonka

Department of Biophysics
Faculty of Biochemistry, Biophysics and Biotechnology
Jagiellonian University, Kraków

e-mail: beata.plonka@uj.edu.pl

Abstract:
Scientific, objective approach to consciousness has allowed to obtain some experimental data concerning brain activity, ignoring, however, the long-standing philosophical tradition. Spectacular development of neuroscience which has been observed recently made this dissonance particularly noticeable. The paper addresses the main problems of discrepancy between neurobiological research and philosophical perspective. Current opinions concerning neural correlates and models of consciousness are discussed, as well as the problems of working memory, attention, self, and disorders of consciousness. A new neurobiological approach to describe brain function in terms of brain connectivity (so-called connectome) is also presented. Finally, the need to introduce at least some aspects of philosophical approach directly into neurobiological research of consciousness is postulated.
Keywords: consciousness, attention, self, working memory, brain networks, disorders of consciousness, neural correlates of consciousness.

1. Introduction

In this paper I will try to present current findings and views in the main areas of neurobiological research concerning consciousness. I will endeavor to find some consistency among the vast number of papers with various topics and methodology that can be found in scientific databases every year. I will also discuss some shortcomings of the scientific approach to consciousness, the general lack of understanding of these problems by neurobiologists and the need to incorporate philosophical perspective into their studies.

Consciousness is a complex and ambiguous concept enjoying a long tradition of analyses that still eludes our understanding and lacks any universal definition. It is impossible to be certain that all neurobiologists use the same definition of consciousness because many of them do not define the subject of their research. However, one can assume that most authors apply the definition similar to the one used by G.M. Edelman, J.A. Gally and J. Baars, who define consciousness as "a dynamic, integrated, multimodal mental process entailed by physical events occurring in the forebrain" [42]. They also add that

> conscious processes arise spontaneously and display intentionality, i. e., for the most part, each is about something […] consciousness is necessarily subjective and internal […] but its contents can often be inferred from animal behavior or verbal report [42].

However, all attempts to match empirical data obtained by neurobiology with philosophical concepts of subjectivity or consciousness lead to major problems. There is a large rift between empirical sciences and philosophy, resulting from different approaches and methods as well as from progressing specialization (especially in life science). The precise meaning of such categories as consciousness or subjectivity is of minor importance for many neurobiologists. Neurobiological research is usually focused on proper application of various advanced techniques (such as methods of physiology and genetics, neuroimaging and computational methods) and interpretation of data in order to identify brain areas involved in psychical functions. Much attention is also paid to selecting psychological tests appropriate for analysis of the psychic state under study. There are many terms like awareness, consciousness, self, working memory or representation, that are frequently used in scientific papers without explaining their precise meaning. Limitations of techniques used in research as well as the great complexity of human brain lead to a huge number of data, but there is no model of consciousness universally accepted among neurobiologists.

2. Scientific Approach and its Weaknesses

We should not expect to fully explain the phenomenon of consciousness merely by accumulating neurobiological data, even the ones obtained using such advanced techniques like fMRI (functional magnetic resonance imaging) or PET (positron emission tomography). To achieve this goal we need to find a common ground to share ideas between neurobiology and humanities. This important problem is well described by Thomas Metzinger, who states:

> in the now flowering interdisciplinary field of research on consciousness there are two rather extreme ways of avoiding the problem. One is the attempt to proceed in a highly pragmatic way, simply generating empirical data without ever getting clear about what the explanandum of such an enterprise actually is […] What are the actual entities between which an explanatory relationship is to be established? Especially when pressed by the humanities, hard scientists should at least be able to state clearly what it is they want to know, what the target of their research is, an what, from their perspective, would count as a successful explanation. The other extreme is something that is frequently found in philosophy, particularly in the best philosophy of mind. I call it "analytical scholasticism". It consists in an equally dangerous tendency toward arrogant armchair theorizing, at the same time ignoring first-person phenomenological as well as third-person empirical constraints in the formation of one's basic conceptual tools [81, pp. 17-18].

Most researchers concentrate on obtaining experimental data even without defining the analyzed phenomenon. Therefore, it is extremely rare for researchers to provide a reader with the description of their philosophical assumptions. Bernard J. Baars is one of the authors who are aware (more or less) of the main problem of different perspectives in the analyses of consciousness. He is strongly convinced that first-person perspective can be linked with the scientific third-person perspective.

> We can only study something if we can treat it as a variable, comparing its presence to its absence […] Consciousness has seemed to be different from all other scientific concepts; it has been extraordinarily difficult to treat it as a variable. The persistent

> pattern over centuries has been to see our own experience as the only psychological domain that can be conceived, one that has no kinship to any conceivable comparison condition […] It is actually quite possible to compare conscious events that people can report accurately to unconscious ones that can be inferred and studied indirectly […] We can call this method contrastive phenomenology, to emphasize the involvement of private experience. Phenomenology is the study of consciousness based on subjective reports; in scientific practice we always supplement subjective reports with objectively verifiable methods [10, pp. 11-12].

Unfortunately, this awareness of the problem is often accompanied by total disregard of philosophical perspective, as presented by Edelman, Gally and Baars who declare:

> we believe, that such a biological approach can address and even dispose of several concerns articulated by philosophers of mind and others. We propose that a biological account of consciousness does not require metaphysical proposals, mathematical reduction, or "strange physics". We also maintain that previously argued categories such as selfhood and phenomenal experience can be explained biologically in terms of patterns of neural activity [42].

3. Models of Consciousness

This kind of approach is common among neurobiologists who apply advanced techniques (as mentioned earlier) in search of brain areas that are believed to give rise to consciousness. This means, in fact, monitoring of brain activity during conscious processes and attributing the increased activity to the generation of consciousness. Current research based on this assumption revealed involvement of various cortical areas (especially frontal, parietal and cingulate cortex), thalamus and reticular formation as well as some areas corresponding to episodic and semantic memory [36]. There are still controversies concerning the extent of the brain specialization, but there are brain regions identified that are specialized in analysis of faces, bodies, places, visually presented words and even thinking about another person's thoughts [58]. Such specialization substantially limits brain capacity to process multiple items simultaneously, but the extent of limitation depends on the category of objects [27]. Some data obtained by various techniques support the hypothesis that cortical areas contributing to consciousness exhibit enhanced synchrony in the gamma frequency band that may give rise to the global workspace (according to the global workspace theory consciousness results from integration of activity of many neurons in various brain areas) [42]. For many years main debates concerning models of consciousness have occurred between supporters of two main opposite theories – the global workspace theory [42] and Ned Block theory of phenomenal consciousness (P-consciousness) and access consciousness (A- consciousness). The Block's distinction of two kinds of consciousness was at first purely theoretical [21], but it has also been supported by empirical data [22], [23], [59], [67], [68], [91], [118], [121]. Both theories has been united in another model suggested by A. Raffone and M. Pantani [104].

Expansion of experimental data accompanied by occurrence of new techniques and approaches resulted in more theories of consciousness, such as first-order representationalism, information integration theory, recurrent processing theory or higher-order representationalism. The first-order representationalism assumes that consciousness consists of sensory representations available directly for various activities to the subject. According to the authors the theory is philosophical but it is able to explain both general consciousness (what makes a particular state conscious in general) and specific consciousness (phenomenal quality of a conscious state). They suggest the existence of neural correlates of general consciousness (prefrontal cortex, posterior parietal cortex, and non-specific thalamic nuclei) and specific consciousness (sensory cortex and specific thalamic nuclei), providing experimental data supporting the first-order representationalism

theory [79]. Higher-order theories assume that conscious awareness depends on higher-order mental representations (representing oneself as being in particular mental states). There is also a large body of empirical evidence supporting the higher-order model of consciousness, but also some data disproving the notion (such as that prefrontal cortex lesion does not abolish awareness and the activity of prefrontal cortex does not reflect awareness but attention). Similarly to the previously mentioned model (the first-order representationalism) the higher-order theory resulted from philosophical approach and explains consciousness in terms of higher-order awareness. According to the authors both consciousness and metacognition (important for mental processes and behavior) involve higher-order psychological states. There is some analogy between higher-order awareness and metacognition (mainly the possibility of misrepresentation), but the utility for psychological processing seems to be the greatest difference between the two phenomena [69], [108]. Another theoretical model of consciousness which has been created lately is the consciousness state space (CSS) model. The authors describe it as a "phenomenological model for consciousness and selfhood which relates time, awareness, and emotion within one framework" [17]. Like other models, it is supported by a substantial amount of empirical data and enables to describe the relationship between various aspects of conscious experience. The model assumes two categories of consciousness: core and extended consciousness which can be applied to all phenomenological states. Core consciousness supports minimal selfhood (its scope is here and now) while extended consciousness supports narrative selfhood (involves personal identity across time, memory, imagination and conceptual thought). The consciousness state space (CSS) described in the model is a phenomenological space formed by three dimensions – time, awareness and emotion. The model is supported by neurobiological data, which provide neural correlates for all three dimensions, as well as for core consciousness and extended consciousness [17].

4. Re-evaluation of Experimental Data

Nevertheless, recent studies proved that some previously established data and theories should be reconsidered. For example, some neural processes believed to reflect the neural correlates of consciousness (P300, gamma frequency band, long-range integration) seem to occur even without conscious experience [6]. There are also suggestions that we should look for neural constituents of consciousness instead of "traditional" neural correlates of consciousness [83]. Another problem concerns theoretical basis of research of consciousness. Most of the data have been obtained during conscious perception and contrasted with trials lacking conscious perception, as based on the basic approach designed by B.J. Baars [9]. It is currently suggested that such approach does not reveal neural correlates of consciousness, but lead to some processes prior to conscious experience, or following it [7]. Some researchers look for new paradigms like the Reflexive Imagery Task, in which conscious content is triggered unintentionally and reliably (as a function of external control). The set-related imagery cannot be suppressed by participants instructed to not sub-vocalize the name of a stimulus object [2]. The approach based on the contrast between conscious and unconscious experience resulted in recognizing two aspects of consciousness: content of consciousness (awareness) and level of consciousness (wakefulness), widely used also in clinical diagnosis [70]. However, some researchers suggest a theoretical integration of studies of the contents of consciousness and the level of consciousness [13]. New ideas of levels of consciousness, its psychophysical measurements and relations to neural correlates of consciousness has also been introduced by T. Bachmann [12].

5. Attention and Consciousness

Another important and thoroughly investigated problem concerns the importance of attention for conscious processes. Current research identified brain areas involved in the three attention systems, related to different components of attention and using different neurotransmitters (orienting

network, alerting network and executive network). It is believed that attention (especially the executive network) is extremely important for voluntary control of cognitive processes, emotions and behaviour as well as for focal awareness. Attention is crucial for perception of objects but also for thinking (additional activity in frontal and parietal cortex was observed after focusing attention on mental representations). There is an extensive discussion concerning attention and consciousness. Some researchers support the notion that attention and consciousness are two completely separate processes, while the others believe them to be strongly connected or even being two aspects of one phenomenon. There are some experimental data suggesting the possibility of conscious experience without attention, but some authors attribute this phenomenon to the involvement of different kinds of attention (namely focal awareness and ambient awareness), not the lack of attention. The complexity of attentional processes and various kind of attention (apart from focal awareness and ambient awareness) results in ambiguity of interpretations [6], [11], [65], [72], [89], [101], [105], [106], [127], [137].

6. Problem of "Self" and Default Mode Network

One of the most important issues in research of consciousness is explaining the problem of "self" (generally understood as the neural correlates of self). Neurobiological data suggest a major involvement of cortical midline structures (CMS): medial prefrontal cortex, medial orbital prefrontal cortex, medial parietal cortex, anterior and posterior cingulate cortex in self-consciousness [1], [93], [102]. Detailed study revealed involvement of different brain structures in forming various aspects of self-consciousness. For example activity of ventral and dorsal medial prefrontal cortex and the posterior cingulate cortex is higher when reflecting on the present self than when reflecting on the past self or the other person. Other research proved considerable specialization of medial prefrontal cortex, which ventral part contains information relevant for "self", whereas the dorsal region is responsible for decision-making processes and evaluation (concerning "self" and "other") [31], [33], [121], [131]. The crucial role of posterior cingulate cortex [25], as well as possible interactions with the mirror neuron system must also be considered [116], [110]. There is a considerable discrepancy between researchers in using specific terms, especially self-referential processing and self-reflection, which are often treated as ones having the same meaning.

> Several studies have investigated the neural correlates of self-reflection or self-referential processing. In the literature these terms are used interchangeably and refer to the evaluation process used to decide whether certain environmental cues apply to one's self or not. Technically, self-referential processing is a broader concept in which all information that somehow refers to oneself is processed and encompasses subconscious as well as conscious processing. Self-reflective processing on the other hand implies a conscious process in which a decision is made regarding oneself [131].

Most researchers involved in studies of "self" and "self-consciousness" use the so called self-referential paradigm, based on the self-reference effect [120]. This paradigm uses self-reflection "in which subjects are presented with trait adjectives or sentences and are asked whether the trait or sentence applies to them" [131]. Discrimination between "self" and "other" is of paramount importance for social interactions and depends strongly on the mechanisms of mentalizing explained as the theory of mind [15], [133]. The ability to discriminate between "self" and "other" is attributed to the activity of the posterior cingulate cortex, ventral medial prefrontal cortex and temporo-parietal junction [32], [46], [59], [73], [74], [115]. In general, majority of authors focus on acquiring a lot of neurobiological data in their studies of self. However, a new trend of looking for broader concepts of self can be observed in recent years. Some authors, like G. Northoff attempt a

more philosophical approach [92], try to give more thought to possible interpretations of the term "self", like K. Musholt [86] or suggest various models, such as extended forward model [119] or pattern theory of self [49].

Apart from new models and approaches an important discovery of the direct link between "self" (neural correlates of self) and the so-called "default mode network" opened new perspectives [85], [102], [110]. Raichle et al. demonstrated in 2001 the presence of an extremely important brain network, the "default mode network" (DMN). DMN exhibits increased activity during the resting state as compared to the attention-demanding cognitive tasks, which in turn are governed by the central executive network (CEN, comprising mainly dorsolateral prefrontal cortex and posterior parietal cortex). DMN is responsible for cognitive processes in the brain that are independent on external stimuli (self-focused spontaneous cognition), such as self-reflective thoughts, autobiographical reminiscences or mind-wandering. Current research suggests influence of DMN dysfunctions on ADHD, autism, Alzheimer's disease, depression and schizophrenia. Some authors support the idea of another network, the so-called "salience network" (SN), selecting internal and external signals and controlling subsequent processes in either DMN or CEN, also modulating the activity of both networks. DMN primarily involves the anterior and posterior cingulate cortex, medial prefrontal cortex, precuneus, inferior parietal cortex (angular gyrus region) and inferior temporal cortex. Dorsal anterior cingulate cortex and anterior insula are involved in many complex cognitive and emotional processes like empathy [4], [78], [80], [84], [107], [117], [134]. Recent empirical data suggest altered DMN function in such states of consciousness as sleep, general anesthesia and hypnosis [56]. Furthermore, the network perspective in search of the link between brain and behavior is now popular among researchers [47], [96], [99], [109], [122], [139]. The most ambitious attempt of mapping human brain connectivity as a basis of behavior started in 2013 as the Human Connectome Project [132].

It is impossible in this paper to fully discuss all aspects of self-consciousness, especially from various perspectives. The analyses presented here focused only on two aspects of an extremely complicated topic – methodological problem and empirical data on neural correlates of the self, although such choices are definitely arbitrary. Therefore, some problems concerning self-consciousness, such as complexity of self-consciousness, emergent phenomena, or the relation between consciousness and self-consciousness will be only mentioned briefly. It may be noted, that these problems are largely neglected in most research papers. It has already been mentioned that most authors "reduce" the "self" to the application of the "self-referential paradigm" and focus on experimental procedures to locate neural correlates of the self. However, there are also interesting and precise analyses of the complexity of the self in the search of widely accepted model, based on experimental neurobiological data [26], [48], [81], [82]. For example U. Neisser distinguish between five aspects of self – ecological, interpersonal, extended, private and conceptual [87], while S. Gallagher focuses on the distinctions between "minimal self" and "narrative self" as well as on differences between the sense of self-agency and the sense of self-ownership [48]. The complexity of self-consciousness is also taken into account in psychological analyses [34], [64] or research on some diseases [5], [53], [113], [114]. A lot of effort has been put in recent years into investigating the importance of bodily self-consciousness (the pre-reflective and non-conceptual representation of body-related information) for the model of self-consciousness. Many aspects of the bodily self-consciousness has been analyzed, such as its visual [44], vestibular [100] or multisensory mechanisms of bodily self-consciousness [8, 18], bodily ownership, self-location and peripersonal space [19], [20], [90], [112], out-of-body experiences [71] or illusory own-body perceptions [94].

Another area of interest concerns both developmental and functional link between self-consciousness and episodic autobiographical memory [76], [77], [125]. The problem has been analyzed since the important distinction between different memory systems in 1983 [123]. E. Tulving described three distinct memory systems – procedural, semantic, and episodic, and their

relations to various kinds of consciousness – anoetic, noetic and autonoetic consciousness, respectively, using terminology originally introduced by E. Husserl [123], [124]. Tulving states:

> Each of the three memory systems, in addition to other ways in which it differs from others, is characterized by a different kind of consciousness. I will refer to the three kinds of consciousness as anoetic (non-knowing), noetic (knowing), and autonoetic (self-knowing) [123, p. 3].

Although the distinction between three memory systems and three kinds of memory is widely used by many authors, the nature of the links between the respective memory systems and types of consciousness is unclear. The "link" is usually described as the "relation", "interconnection" or "correlation" between memory and consciousness, consciousness as a "defining property" of memory, or even identified with each other (episodic memory with autonoetic consciousness, semantic memory with noetic consciousness) [51], [124]. S.B. Klein is one of few researchers who actually ask this question.

> So what exactly is the connection between autonoetic awareness and episodic memory? Two possibilities present themselves. Either (as commonly assumed, though seldom stated), autonoetic awareness is (1) intrinsic (i.e., necessary) to episodic memory— i.e., it is a part, or constituent, of 'episodic' content, or (2) it has a relational (i.e., contingent) connection to memory content— i.e., while under normal circumstances it is observed to be coextensive with 'episodic' content, this connection is one of contingency rather than necessity [63, p. 3].

Current experimental findings suggest that the relations between memory systems and various kinds of consciousness are more complex than assumed in the original distinctions. Klein supports the idea of the relation between functionally independent autonoetic consciousness and episodic memory content, rather than the notion of autonoetic consciousness being an intrinsic property of episodic content [63]. Autonoetic self-consciousness must also be distinguished from noetic self-awareness (semantic knowledge about oneself) [128]. Various kinds of consciousness (anoetic, noetic and autonoetic) are often treated as emergent phenomena and discussed as a part of human development [61], [88] or from the evolutionary perspective [43], [95]. Tulving is convinced "that only human beings possess 'autonoetic' episodic memory and the ability to mentally travel into the past and into the future, and that in that sense they are unique" [126, p. 4], but there is a distinct possibility, that to a certain extent, it is also present in some mammals (not only primates) and birds [43]. It is suggested that various levels of consciousness emerge in subsequent stages of ontogenesis [61], [88], and that anoetic (primary) consciousness has a fundamental importance for emergence of higher forms of consciousness [128], [129], [130].

The theories described above are a good example of the widely approved opinion on the relation between consciousness and self-consciousness. It is usually assumed by researchers that self-consciousness is just an aspect of consciousness. The notion was explicitly expressed by F. Crick & C. Koch [29] and further developed in another paper:

> There are many forms of consciousness, such as those associated with seeing, thinking, emotion, pain, and so on. Self-consciousness—that is, the self-referential aspect of consciousness—is probably a special case of consciousness [30, p. 97].

Some other analyses from philosophical point of view describe the relation a little bit differently. For example, U. Kriegel distinguishes transitive and intransitive self-consciousness (on the basis of D. Rosenthal's distinction between transitive and intransitive consciousness) and claims that consciousness depends upon intransitive self-consciousness [66]. T. Bayne argues that self-

consciousness constrains phenomenal unity of consciousness [16], and according to Zahavi and Parnas "the ipseity, the normally tacit or unnoticed 'myness' of the experience […] is a precondition or a medium of any natural, spontaneous and absorbed intentionality [138, p. 700].

7. Working Memory and Consciousness

Another important area of research related to the phenomenon of consciousness concerns working memory - ability to actively maintain and manipulate information (abstract or of a given sensory modality) that is kept concurrently in an easily retrievable state. It is critical for cognition, e.g. for language abilities, problem solving or achieving a goal. The link between working memory and consciousness is unclear. Some authors believe working memory content is always conscious (working memory content equals conscious experience) [9], [14], whereas others treat working memory content and conscious experience as partially overlapping [28] or even completely separate [57], [116]. There are several models of working memory, the most influential being the model of A. Baddeley, suggesting that working memory consists of multiple components (central executive, phonological loop, visuo-spatial sketch pad and episodic buffer) [14]. Other models, like feature model or embedded-processes model, do not propose components of working memory but suggest a critical role of attention [28]. Current research revealed that using words about perception and action leads to activation of neurons in sensory and motor areas of the brain, apart from language areas. The phenomenon was proved also for metaphors [50]. Such findings supported the hypothesis of embodied cognition, which is now accepted by many authors both in cognitive science and in neurobiological research [35], [60], [62], [75], [111], [135]. Problem of relations between cognition and language was discussed by many authors and various solutions were suggested. One of interesting hypotheses addressing the issue is a dual model by L. Perlovsky, assuming that every concept (model) has two parts – linguistic and cognitive, and the connections between them is inborn. Experience allows to acquire the specific content of both parts but inborn links facilitate appropriate word-object associations. It is suggested that people are usually conscious only of the language part of representation, especially for abstract ideas which cannot be directly perceived by the senses [97], [98].

8. Studies of Disorders of Consciousness

The last important research area discussed here is related to clinical diagnosis of the disorders of consciousness (coma, vegetative state/unresponsive wakefulness syndrome, minimally conscious state). Diagnosis of patients with disorders of consciousness is now conducted using standardized behavioral test (e.g. Coma Recovery Scale) in order to avoid misdiagnosis [55]. Some researchers look for new methods of assessing levels of consciousness, as such a diagnosis has great ethical, personal and economical consequences for patients and medical staff [24], [41], [54]. In recent years a lot of effort has been put into studies of disorders of consciousness (minimally conscious state, unresponsive wakefulness syndrome/vegetative state, and coma) using resting-state fMRI as a tool to assess intrinsic functional connectivity of brain networks. Researchers found that intrinsic functional connectivity in many brain regions (especially in the posterior cingulate cortex and precuneus) significantly correlated with consciousness level and chances of recovery [3], [136]. Other studies differentiated between various disorders of consciousness on the basis of functional connectivity for the default mode network (DMN), executive network, salience network (SN), auditory, sensorimotor and visual networks [37], [38]. It was also stated that salience network connectivity (especially between the supragenual anterior cingulate cortex and left anterior insula) correlates with behavioral signs of consciousness, whereas DMN connectivity (especially between the posterior cingulate cortex and left lateral parietal cortex) is a good prediction of recovery of consciousness [103]. This line of study is of special importance because of the practical impact of

its results (influencing decisions in medical practice), apart from its involvement in describing the phenomenon of consciousness.

9. Closing Remarks

Despite the tremendous effort and hundreds of papers published yearly, researchers are still unable to define, precisely describe or characterize the fascinating phenomenon of consciousness. In general, such a vast amount of experimental work can be roughly grouped into several areas discussed above, such as the study of working memory, the role of attention in conscious processes, the problem of "self" (especially the importance of default mode network), the increasingly popular network perspective (brain connectivity – connectomics), and clinical diagnosis of the disorders of consciousness. A lot of effort is also placed on developing new experimental techniques as well as on perfecting the methods of data analysis, which is usually the highest priority for researchers. These methods shed new light on various experimental data and forced researchers to reconsider some of the generally accepted explanations, with the most notable example of the P300 wave (in EEG) as an indicator of consciousness. In fact, the ongoing research on consciousness strongly resembles the effort of building a giant jigsaw puzzle by working on various parts separately and hoping that the whole picture would eventually emerge. However, the main reason for experimental results to be treated with caution stems from the basic difficulty of connecting two different perspectives in the studies of consciousness. There is no balance between these perspectives: while the objective one getting a great, professional care, the subjective "aspect" is usually reduced to the short description of the task (test) involved. Fortunately, there are some attempts to improve this "aspect" of research, usually by introducing new tasks (like the Reflexive Imagery Task), but the main question of "what" is really studied there remains valid. Most researchers are impervious to the problem, focusing solely on the proper experimental techniques and data analysis. It is still a unique attitude, but the need to integrate various perspectives has been recognized and attempts of more philosophical approach have been made by some authors in recent years [39], [40], [52], [86], [92]. Is it possible to conclude that scientific data unambiguously justify reductionism? It is probable that the concept is accepted by most researchers and fundamental for their methodology, but the universal lack of explanation in scientific papers does not allow for drawing this conclusion. There are examples of different positions, like the one presented by Todd E. Feinberg, which he calls a weakly emergent nonreductive physicalism or neurobiological naturalism [45]. We may hope that the future research will give some strong arguments supporting one solution and cognitive science eventually plays an important role in integrating various perspectives.

Acknowledgement

This article was written with the support of the Polish National Science Centre Fund (2012/07/D/HS1/01099).

References

1. Abraham, A., "The world according to me: personal relevance and the medial prefrontal cortex", Frontiers in Human Neuroscience 7, 2013, pp. 341.
2. Allen, A.K., Wilkins, K., Gazzaley, A., Morsella, E., "Conscious thoughts from reflex-like processes: a new experimental paradigm for consciousness research", Consciousness and Cognition 22(4), 2013, pp. 1318-1331.
3. Amico, E., Gomez, F., Di Perri, C., Vanhaudenhuyse, A., Lesenfants, D., Boveroux, P., Bonhomme, V., Brichant, J.F., Marinazzo, D., Laureys, S., "Posterior cingulate cortex-related co-activation patterns: a resting state FMRI study in propofol-induced loss of consciousness", PLoS One. 9(6), 2014, pp. e100012.

4. Andrews-Hanna, J.R., Smallwood, J., Spreng, R.N., “The default network and self-generated thought: component processes, dynamic control, and clinical relevance”, Annals of the New York Academy of Sciences 1316, 2014, pp. 29-52.

5. Arroyo-Anlló, E.M., Bouston, A.T., Fargeau, M.N., Orgaz Baz, B., Gil, R., “Self-Consciousness in Patients with Behavioral Variant Frontotemporal Dementia”, Journal of Alzheimer's Disease 2015 Nov 23. [Epub ahead of print]

6. Aru, J., Bachmann, T., “Phenomenal awareness can emerge without attention”, Frontiers in Human Neuroscience 7, 2013, pp. 891.

7. Aru, J., Bachmann, T., “Still wanted - the mechanisms of consciousness!”, Frontiers in Psychology 6, 2015, pp. 5.

8. Aspell, J.E., Lenggenhager, B., Blanke, O., “Keeping in touch with one's self: multisensory mechanisms of self-consciousness”, PLoS One 4(8), 2009, pp. e6488.

9. Baars, B.J., A cognitive theory of consciousness. New York: Cambridge University Press, 1988.

10. Baars, B.J., In the theater of consciousness. New York: Oxford University Press, 1997.

11. Bachmann, T., “Attention as a process of selection, perception as a process of representation, and phenomenal experience as the resulting process of perception being modulated by a dedicated consciousness mechanism”, Frontiers in Psychology 2, 2011, pp. 387.

12. Bachmann, T., “How to begin to overcome the ambiguity present in differentiation between contents and levels of consciousness?”, Frontiers in Psychology 3, 2012, pp. 82.

13. Bachmann, T., Hudetz, A.G., “It is time to combine the two main traditions in the research on the neural correlates of consciousness: C = L × D”, Frontiers in Psychology 5, 2014, pp. 940.

14. Baddeley, A.D., Allen, R.J., Hitch, G.J., “Binding in visual working memory: the role of the episodic buffer”, Neuropsychologia 49, 2011, pp. 1393-1400.

15. Baron-Cohen, S., Leslie, A., Frith, U., “Does the autistic child have a "theory of mind"?”, Cognition 21(1), 1985, pp. 37-46.

16. Bayne, T., “Self-consciousness and the Unity of Consciousness”, Monist 87 (2), 2004, pp. 219-236.

17. Berkovich-Ohana, A., Glicksohn, J., “The consciousness state space (CSS)-a unifying model for consciousness and self”, Frontiers in Psychology 5, 2014, pp. 341.

18. Blanke, O., “Multisensory brain mechanisms of bodily self-consciousness”, Nature Reviews Neuroscience 13(8), 2012, pp. 556-571.

19. Blanke, O., Metzinger, T., “Full-body illusions and minimal phenomenal selfhood”, Trends in Cognitive Sciences 13(1), 2009, pp. 7-13.

20. Blanke, O., Slater, M., Serino, A., “Behavioral, neural, and computational principles of bodily self-consciousness”, Neuron 88(1), 2015, pp. 145-166.

21. Block, N., “On a confusion about a function of consciousness”, Behavioral and Brain Sciences 18, 1995, pp. 227-247.

22. Block, N., “How can we find the neural correlate of consciousness?”, Trends in Neuroscience 19(11), 1996, pp. 456-9.

23. Block, N., “Two neural correlates of consciousness”, Trends in Cognitive Sciences 9(2), 2005, pp. 46-52.

24. Bonfiglio, L., Piarulli, A., Olcese, U., Andre, P., Arrighi, P., Frisoli, A., Rossi, B., Bergamasco, M., Carboncini, M.C., “Spectral parameters modulation and source localization of blink-related alpha and low-beta oscillations differentiate minimally conscious state from vegetative state/unresponsive wakefulness syndrome”, PLoS One. 9(3), 2014, pp. e93252. Erratum in: PLoS One. 9(4), pp. e95948.

25. Brewer, J.A., Garrison, K.A., Whitfield-Gabrieli, S., “What about the "self" is processed in the posterior cingulate cortex?”, Frontiers in Human Neuroscience 7, 2013, pp. 647.

26. Christoff, K., Cosmelli, D., Legrand, D., Thompson, E., “Specifying the self for cognitive neuroscience”, Trends in Cognitive Science 15(3), 2011, pp. 104-112.

27. Cohen, M.A., Konkle, T., Rhee, J.Y., Nakayama, K., Alvarez G.A., “Processing multiple visual objects is limited by overlap in neural channels”, Proceedings of the National Academy of Sciences of the United States of America 111(24), 2014, pp. 8955-60.

28. Cowan, N., “Multiple concurrent thoughts: The meaning and developmental neuropsychology of working memory”, Developmental Neuropsychology 35(5), 2010, pp. 447-474.

29. Crick F., Koch C., “Towards a neurobiological theory of consciousness”, Seminars in the Neurosciences 2, 1990, pp. 263-275.

30. Crick, F., Koch, C., “Consciousness and neuroscience”, Cerebral Cortex 8(2), 1998, pp. 97-107.

31. D'Argembeau, A., Ruby, P., Collette, F., Degueldre, C., Balteau, E., Luxen, A., Maquet, P., Salmon, E., “Distinct regions of the medial prefrontal cortex are associated with self-referential processing and perspective taking”, Journal of Cognitive Neuroscience 19(6), 2007, pp. 935-44.

32. D’Argembeau, A., Feyers, D., Majerus, S., Collette, F., Van der Linden, M., Maquet, P., Salmon, E., “Self-reflection across time: cortical midline structures differentiate between present and past selves”, Social Cognitive and Affective Neuroscience 3(3), 2008, pp. 244-25.

33. D'Argembeau, A., Cassol, H., Phillips, C., Balteau, E., Salmon, E., Van der Linden, M., “Brains creating stories of selves: the neural basis of autobiographical reasoning”, Social Cognitive and Affective Neuroscience 9(5), 2014, pp. 646-52.

34. DaSilveira, A., DeSouza, M.L., Gomes, W.B., “Self-consciousness concept and assessment in self-report measures”, Frontiers in Psychology 6, 2015, pp. 930.

35. Davis, J.I., Markman, A.B., “Embodied cognition as a practical paradigm: introduction to the topic, the future of embodied cognition”, Topics in Cognitive Science 4(4), 2012, pp. 685-91.

36. Dehaene, S., Sergent, C., Changeux, J.-P., “A neuronal network model linking subjective reports and objective physiological data during conscious perception”, Proceedings of the National Academy of Sciences of the United States of America 100(14), 2003, pp. 8520-8525.

37. Demertzi, A., Gómez, F., Crone, J.S., Vanhaudenhuyse, A., Tshibanda, L., Noirhomme, Q., Thonnard, M., Charland-Verville, V., Kirsch, M., Laureys, S., Soddu, A., “Multiple fMRI system-level baseline connectivity is disrupted in patients with consciousness alterations”, Cortex 52, 2014, pp. 35-46.

38. Demertzi, A., Antonopoulos, G., Heine, L., Voss, H.U., Crone, J.S., de Los Angeles, C., Bahri, M.A., Di Perri, C., Vanhaudenhuyse, A., Charland-Verville, V., Kronbichler, M., Trinka, E., Phillips, C., Gomez, F., Tshibanda, L., Soddu, A., Schiff, N.D., Whitfield-Gabrieli, S., Laureys, S., “Intrinsic functional connectivity differentiates minimally conscious from unresponsive patients”, Brain 138(Pt 9), 2015, pp. 2619-31.

39. De Sousa, A., “Towards an integrative theory of consciousness: part 1 (neurobiological and cognitive models)”, Mens Sana Monographs 11(1), 2013, pp. 100-150.

40. De Sousa, A., “Towards an integrative theory of consciousness: part 2 (an anthology of various other models)”, Mens Sana Monographs 11(1), 2013, pp. 151-209.

41. Di Perri, C., Thibaut, A., Heine, L., Soddu, A., Demertzi, A., Laureys, S., “Measuring consciousness in coma and related states”, World Journal of Radiology 6(8), 2014, pp. 589-97.

42. Edelman, G.M., Gally, J.A., Baars, J., “Biology of consciousness”, Frontiers in Psychology 2, 2011, pp. 4.

43. Fabbro, F., Aglioti, S.M., Bergamasco, M., Clarici, A., Panksepp, J., “Evolutionary aspects of self- and world consciousness in vertebrates”, Frontiers in Human Neuroscience 9, 2015, pp. 157.

44. Faivre N, Salomon R, Blanke O., “Visual consciousness and bodily self-consciousness”, Current Opinions in Neurology 28(1), 2015, pp. 23-28.
45. Feinberg, T.E., “Neuroontology, neurobiological naturalism, and consciousness: A challenge to scientific reduction and a solution”, Physics of Life Reviews 9, 2012, pp. 13-34.
46. Flagan, T., Beer, J.S., “Three ways in which midline regions contribute to self-evaluation”, Frontiers in Human Neuroscience 7, 2013, pp. 45.
47. Foster, P.P., “Role of physical and mental training in brain network configuration”, Frontiers in Aging Neuroscience 7, 2015, pp. 117.
48. Gallagher, S., “Philosophical conceptions of the self: implications for cognitive science”, Trends in Cognitive Science 4(1), 2000, pp. 14-21.
49. Gallagher, S., “A pattern theory of self”, Frontiers in Human Neuroscience 7, 2013, pp. 443.
50. Gallese, V., Lakoff, G., “The brain’s concepts: the role of the sensory-motor system in conceptual knowledge”, Cognitive Neuroscience 22(3/4), 2005, pp. 455-479.
51. Gardiner, J.M., “Episodic memory and autonoetic consciousness: a first-person approach”, Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 356(1413), 2001, pp. 1351-1361.
52. Gierer, A., “Brain, mind and limitations of a scientific theory of human consciousness”, BioEssays 30, 2008, pp. 499-505.
53. Gil, R., Arroyo-Anllo, E.M., Ingrand, P., Gil, M., Neau, J.P., Ornon, C., Bonnaud, V., “Self-consciousness and Alzheimer's disease”, Acta Neurologica Scandinavica 104(5), 2001, pp. 296-300.
54. Gosseries, O., Schnakers, C., Ledoux, D., Vanhaudenhuyse, A., Bruno, M.A., Demertzi, A., Noirhomme, Q., Lehembre, R., Damas, P., Goldman, S., Peeters, E., Moonen, G., Laureys, S., “Automated EEG entropy measurements in coma, vegetative state/unresponsive wakefulness syndrome and minimally conscious state”, Functional Neurology 26(1), 2011, 25-30.
55. Guldenmund, P., Stender, J., Heine, L., Laureys, S., “Mindsight: diagnostics in disorders of consciousness”, Critical Care Research and Practice 2012, 2012, pp. 624724.
56. Guldenmund, P., Vanhaudenhuyse, A., Boly, M., Laureys, S., Soddu, A.., “A default mode of brain function in altered states of consciousness”, Archives Italiennes de Biologie 150, 2012, pp. 107-21.
57. Jacobs, C. Silvanto, J., “How is working memory content consciously experienced? The 'conscious copy' model of WM introspection”, Neuroscience & Biobehavioral Reviews 55, 2015, pp. 510-519.
58. Kanwisher, N., “Functional specificity in the human brain: a window into the functional architecture of the mind”, Proceedings of the National Academy of Sciences of the United States of America 107(25), 2010, pp. 11163-1170.
59. Keysers, C., Gazzola, V., “Expanding the mirror: vicarious activity for actions, emotions, and sensations”, Current Opinions in Neurobiology 19(6), 2009, pp. 666-671.
60. Kiefer, M., Pulvermüller, F., “Conceptual representations in mind and brain: theoretical developments, current evidence and future directions”, Cortex 48(7), 2012, pp. 805-25.
61. Kinsbourne, M., A continuum of self-consciousness that emerges in phylogeny and ontogeny [in:] Herbert S. Terrace and Janet Metcalfe (eds.) The Missing Link in Cognition: Origins of Self-Reflective Consciousness, Oxford University Press, New York, NY, USA, 2005.
62. Kiverstein, J., Miller, M., “The embodied brain: towards a radical embodied cognitive neuroscience”, Frontiers in Human Neuroscience 9, 2015, pp. 237.
63. Klein, S.B., “Making the case that episodic recollection is attributable to operations occurring at retrieval rather than to content stored in a dedicated subsystem of long-term memory”, Frontiers in Behavioral Neuroscience 7, 2013, pp. 3.

64. Klein, S.B., Gangi, C.E., “The multiplicity of self: neuropsychological evidence and its implications for the self as a construct in psychological research”, Annals of the New York Academy of Sciences 1191, 2010, pp. 1-15.

65. Koch, Ch., Tsuchiya, N., “Attention and consciousness: two distinct brain processes”, Trends in Cognitive Sciences 11(1), 2007, pp. 16-22.

66. Kriegel, U., “Consciousness and Self-Consciousness”, Monist 87(2), 2004, pp. 182-205.

67. Lamme, V.A., “Why visual attention and awareness are different”, Trends in Cognitive Sciences 7(1), 2003, pp. 12-18.

68. Lamme, V.A., Roelfsema, P., “The distinct modes of vision offered by feedforward and recurrent processing”, Trends in Neuroscience 23(11), 2000, pp. 571-579.

69. Lau, H., Rosenthal, D., “Empirical support for higher-order theories of conscious awareness”, Trends in Cognitive Sciences 15(8), 2011, pp. 365-73.

70. Laureys, S., “The neural correlate of (un)awareness: Lessons from the vegetative state”, Trends in Cognitive Sciences 9(12), 2005, pp. 556-559.

71. Lenggenhager, B., Tadi, T., Metzinger, T., Blanke, O., “Video ergo sum: manipulating bodily self-consciousness”, Science 317(5841), 2007, pp. 1096-1099.

72. Lepsien, J., Nobre, A.C., “Cognitive control of attention in the human brain: insights from orienting attention to mental representations”, Brain Research 1105(1), 2006, pp. 20-31.

73. Lombardo, M.V., Chakrabarti, B., Bullmore, E.T.; MRC AIMS Consortium, Baron-Cohen, S., “Specialization of right temporo-parietal junction for mentalizing and its relation to social impairments in autism”, Neuroimage 56(3), 2011, pp. 1832-8.

74. Lombardo, M.V., Chakrabarti, B., Bullmore, E.T., Wheelwright, S.J., Sadek, S.A., Suckling, J.; MRC AIMS Consortium, Baron-Cohen, S., “Shared neural circuits for mentalizing about the self and others”, Journal of Cognitive Neuroscience 22(7), 2009, pp. 1623-1635.

75. Mahon, B.Z., Caramazza, A., “A critical look at the embodied cognition hypothesis and a new proposal for grounding conceptual content”, Journal of Physiology-Paris. 102(1-3), 2008, pp. 59-70.

76. Markowitsch, H.J., “Memory and self-neuroscientific landscapes”, International Scholarly Research Notices Neuroscience 2013, 2013, pp. 176027.

77. Markowitsch HJ, Staniloiu A., “Memory, autonoetic consciousness, and the self”, Consciousness and Cognition 20(1), 2011, pp. 16-39.

78. Mason, M.F., Norton, M.I., Van Horn, J.D., Wegner, D.M., Grafton, S.T., Macrae, C.N.,, “Wandering minds: the default network and stimulus-independent thought”, Science 315(5810), 2007, pp. 393-395.

79. Mehta, N., Mashour, G.A., “General and specific consciousness: a first-order representationalist approach”, Frontiers in Psychology 4, 2013, pp. 407.

80. Menon, V., Uddin, L.Q., “Saliency, switching, attention and control: a network model of insula function”, Brain Structure and Function 214(5-6), 2010, pp. 655-667.

81. Metzinger, T., Being no one. The self-model theory of subjectivity, Cambridge: MIT Press, 2003.

82. Metzinger, T., “Empirical perspectives from the self-model theory of subjectivity: a brief summary with examples”, Progress in Brain Research 168, 2008, pp. 215-245.

83. Miller, S.M., “Closing in on the constitution of consciousness”, Frontiers in Psychology 5, 2014, pp. 1293.

84. Molnar-Szakacs, I., Uddin, L.Q., “Self-processing and the default mode network: interactions with the mirror neuron system”, Frontiers in Human Neuroscience 7, 2013, pp. 571.

85. Moran, J.M., Kelley, W.M., Heatherton, T.F., “What can the organization of the brain’s default mode network tell us about self-knowledge”, Frontiers in Human Neuroscience 7, 2013, pp. 391.

86. Musholt, K., “A philosophical perspective on the relation between cortical midline structures and the self”, Frontiers in Human Neuroscience 7, 2013, pp. 536.

87. Neisser, U., “Five kinds of self-knowledge”. Philosophical Psychology 1, 1988, pp. 35-59.

88. Nelson, K., Emerging Levels of Consciousness in Early Human Development [in:] Herbert S. Terrace and Janet Metcalfe (eds.) The Missing Link in Cognition: Origins of Self-Reflective Consciousness, Oxford University Press, New York, NY, USA, 2005.

89. Nelson, S.M., Dosenbach, N.U., Cohen, A.L., Wheeler, M.E., Schlaggar, B.L., Petersen, S.E., “Role of the anterior insula in task-level control and focal attention”, Brain Structure and Function 214(5-6), 2010, pp. 669-680.

90. Noel, J.P., Pfeiffer, C., Blanke, O., Serino, A., “Peripersonal space as the space of the bodily self”, Cognition 144, 2015, pp. 49-57.

91. Northoff, G., “From emotions to consciousness – a neuro-phenomenal and neuro-relational approach”, Frontiers in Psychology 3, 2012, pp. 303.

92. Northoff, G., “Brain and self – a neurophilosophical account”, Child and Adolescent Psychiatry and Mental Health 7, 2013, pp. 28.

93. Northoff, G., Bermpohl, F., “Cortical midline structures and the self”, Trends in Cognitive Sciences 8(3), 2004, pp. 102-107.

94. Olivé, I., Tempelmann, C., Berthoz, A., Heinze, H.J., “Increased functional connectivity between superior colliculus and brain regions implicated in bodily self-consciousness during the rubber hand illusion”, Human Brain Mapping 36(2), 2015, 717-730.

95. Panksepp, J., Northoff, G., “The trans-species core SELF: the emergence of active cultural and neuro-ecological agents through self-related processing within subcortical-cortical midline networks”, Consciousness and Cognition 18(1), 2009, pp. 193-215.

96. Parks, E.L., Madden, D.J., “Brain connectivity and visual attention”, Brain Connectivity 3(4), 2013, pp. 317-38.

97. Perlovsky, L., “Language and cognition interaction neural mechanisms”, Computational Intelligence and Neuroscience 2011, 2011, pp. 454587.

98. Perlovsky, L., Ilin, R., “Neurally and mathematically motivated architecture for language and thought, The Open Neuroimaging Journal 4, 2010, pp. 70-80.

99. Pessoa, L., “Understanding brain networks and brain organization”, Physics of Life Reviews 11(3), 2014, pp. 400-35.

100. Pfeiffer, C., Serino, A., Blanke, O., “The vestibular system: a spatial reference for bodily self-consciousness”, Frontiers in Integrative Neuroscience 8, 2014, pp. 31.

101. Posner, M.I., Rothbart, M.K., “Toward a physical basis of attention and self regulation”, Physics of Life Reviews 6(2), 2009, pp. 103-129.

102. Qin, P., Northoff, G., “How is our self related to midline regions and the default-mode network?”, Neuroimage 57, 2011, pp. 1221-1233.

103. Qin, P., Wu, X., Huang, Z., Duncan, N.W., Tang, W., Wolff, A., Hu, J., Gao, L., Jin, Y., Wu, X., Zhang, J., Lu, L., Wu, C., Qu, X., Mao, Y., Weng, X., Zhang, J., Northoff, G., “How are different neural networks related to consciousness?”, Annals of Neurology 78(4), 2015, pp. 594-605.

104. Raffone, A., Pantani, M., “A global workspace model for phenomenal and access consciousness”, Consciousness and Cognition 19(2), 2010, pp. 580-96.

105. Raffone, A., Srinivasan, N., van Leeuwen, C., “The interplay of attention and consciousness in visual search, attentional blink and working memory consolidation”, Philosophical Transactions of the Royal Society of London. Series B 369(1641), 2014, pp. 20130215.

106. Raffone, A., Srinivasan, N., van Leeuwen, C., “Rapid switching and complementary evidence accumulation enable flexibility of an all-or-none global workspace for control of attentional and conscious processing: a reply to Wyble et al”, Philosophical Transactions of the Royal Society of London. Series B 370(1661), 2015, pp. 20140315.

107. Raichle, M.E., MacLeod, A.M., Snyder, A.Z., Powers, W.J., Gusnard, D.A., Shulman, G.L., “A default mode of brain function”, Proceedings of the National Academy of Sciences of the United States of America 98(2), 2001, pp. 676-82.

108. Rosenthal, D., “Higher-order awareness, misrepresentation and function”, Philosophical Transactions of the Royal Society of London. Series B 367(1594), 2012, pp. 1424-38.

109. Sala-Llonch, R., Bartres-Faz, D., Junqué C., “Reorganization of brain networks in aging: a review of functional connectivity studies”, Frontiers in Psychology 6, 2015, pp. 663.

110. Sandrone, S., “Self through the mirror (neurons) and default mode network: what neuroscientists found and what can still be found there”, Frontiers in Human Neuroscience 7, 2013, pp. 383.

111. Schendan, H.E., Ganis, G., “Electrophysiological potentials reveal cortical mechanisms for mental imagery, mental simulation, and grounded (embodied) cognition”, Frontiers in Psychology 3, 2012, pp. 329.

112. Serino, A., Alsmith, A., Costantini, M., Mandrigin, A., Tajadura-Jimenez, A., Lopez, C., “Bodily ownership and self-location: components of bodily self-consciousness”, Consciousness and Cognition 22(4), 2013, pp. 1239-1252.

113. Shad, M.U., Keshavan, M.S., “Neurobiology of insight deficits in schizophrenia: an fMRI study”, Schizophrenia Research 165(2-3), 2015, pp. 220-226.

114. Shad, M.U., Keshavan, M.S., Steinberg, J.L., Mihalakos, P., Thomas, B.P., Motes, M.A., Soares, J.C., Tamminga, C.A., “Neurobiology of self-awareness in schizophrenia: an fMRI study”, Schizophrenia Research 138(2-3), 2012, pp. 113-119.

115. Singer, T., “The neuronal basis and ontogeny of empathy and mind reading: review of literature and implications for future research”, Neuroscience & Biobehavioral Reviews 30(6), 2006, pp. 855-863.

116. Soto, D., Silvanto, J., “Reappraising the relationship between working memory and conscious awareness”, Trends in Cognitive Sciences 18(10), 2014, pp. 520-525.

117. Stawarczyk, D., Majerus, S., Maquet, P., D'Argembeau, A., “Neural correlates of ongoing conscious experience: both task-unrelatedness and stimulus-independence are related to default network activity”, PLoS ONE 6(2), 2011, pp. e16997.

118. Stevenson, R.J., “Phenomenal and access consciousness in olfaction”, Consciousness and Cognition 18, 2009, pp. 1004-1017.

119. Sugiura, M., “Associative account of self-cognition: extended forward model and multi-layer structure”, Frontiers in Human Neuroscience 9, 2013, pp. 535.

120. Symons, C.S., Johnson, B.T, “The self-reference effect in memory: a meta-analysis”, Psychological Bulletin 121, 1997, pp. 371-394.

121. Tagini, A., Raffone, A., “The 'I' and the 'Me' in self-referential awareness: a neurocognitive hypothesis”, Cognitive Processing 11(1), 2010, pp. 9-20.

122. Taya, F., Sun, Y., Babiloni, F., Thakor, N., Bezerianos, A., “Brain enhancement through cognitive training: a new insight from brain connectome”, Frontiers in Systems Neuroscience 9, 2015, pp. 44.

123. Tulving, E., Elements of episodic memory. New York: Oxford University Press, 1983.

124. Tulving, E., “Memory and consciousness”, Canadian Psychology 26, 1985, pp. 1-12.

125. Tulving, E., “Episodic memory: from mind to brain”, Annual Review of Psychology 53, 2002, pp. 1-25.

126. Tulving E., Episodic memory and autonoesis: uniquely human? [in:] Herbert S. Terrace and Janet Metcalfe (eds.) The Missing Link in Cognition: Origins of Self-Reflective Consciousness, Oxford University Press, New York, NY, USA, 2005.

127. van Boxtel, J.J., Tsuchiya, N., Koch, C., “Consciousness and attention: on sufficiency and necessity”, Frontiers in Psychology 1, 2010, pp. 217.

128. Vandekerckhove, M., Bulnes, L.C., Panksepp, J., “The emergence of primary anoetic consciousness in episodic memory”, Frontiers in Behavioral Neuroscience 7, 2014, pp. 210.

129. Vandekerckhove, M., Panksepp, J., “The flow of anoetic to noetic and autonoetic consciousness: a vision of unknowing (anoetic) and knowing (noetic) consciousness in the remembrance of things past and imagined futures”, Consciousness and Cognition 18(4), 2009, pp. 1018-1028.

130. Vandekerckhove, M., Panksepp, J., “A neurocognitive theory of higher mental emergence: from anoetic affective experiences to noetic knowledge and autonoetic awareness”, Neuroscience & Biobehavioral Reviews 35(9), 2011, pp. 2017-2025.

131. van der Meer, L., Costafreda, S., Aleman, A., David, A.S., “Self-reflection and the brain: a theoretical review and meta-analysis of neuroimaging studies with implications for schizophrenia”, Neuroscience & Biobehavioral Reviews 34(6), 2010, pp. 935-946.

132. Van Essen, D.C., Smith, S.M., Barch, D.M., Behrens, T.E., Yacoub, E., Ugurbil, K.; WU-Minn HCP Consortium, “The WU-Minn Human Connectome Project: an overview”, Neuroimage 80, 2013, 62-79.

133. von dem Hagen, E.A., Stoyanova, R.S., Rowe, J.B., Baron-Cohen, S., Calder, A.J., “Direct gaze elicits atypical activation of the theory-of-mind network in autism spectrum conditions”, Cerebral Cortex 24(6), 2014, pp. 1485-92.

134. Watanabe, M., “Are there internal thought processes in the monkey?--default brain activity in humans and nonhuman primates”, Behavioural Brain Research 221(1), 2011, pp. 295-303.

135. Willems, R.M., Casasanto, D., “Flexibility in embodied language understanding”, Frontiers in Psychology 2, 2011, pp. 116.

136. Wu, X., Zou, Q., Hu, J., Tang, W., Mao, Y., Gao, L., Zhu, J., Jin, Y., Wu, X., Lu, L., Zhang, Y., Zhang, Y., Dai, Z., Gao, J.H., Weng, X., Zhou, L., Northoff, G., Giacino, J.T., He, Y., Yang, Y., “Intrinsic functional connectivity patterns predict consciousness level and recovery outcome in acquired brain injury”, Journal of Neuroscience 35(37), 2015, pp. 12932-46.

137. Wyble, B., Bowman, H., Nieuwenstein, M., “On the interplay between working memory consolidation and attentional selection in controlling conscious access: parallel processing at a cost--a comment on 'The interplay of attention and consciousness in visual search, attentional blink and working memory consolidation”, Philosophical Transactions of the Royal Society B: Biological Sciences 370(1661), 2015, pp. 20140197.

138. Zahavi, D., Parnas, J., “Phenomenal consciousness and self-awareness: A phenomenological critique of representational theory”, Journal of Consciousness Studies 5, 1998, pp. 687–705.

139. Zhang, Y., Du, G., Yang, Y., Qin, W., Li, X., Zhang, Q., “Higher integrity of the motor and visual pathways in long-term video game players”, Frontiers in Human Neuroscience 9, 2015, pp. 98.

DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015), pp. 39—46
DOI: 10.1515/sh-2015-0024

A Composition of Fuzzy Sets

Vitaly I. Levin

Mathematics Department, Penza State Technological University
1-a, Baidukov pr., Penza, 440039, Russia

e-mail: vilevin@mail.ru

Abstract:
A new operation on fuzzy sets – the *r*-composition of *n*-sets – is introduced. The particular cases of this operation are logical conjunction ($r = 1$) or disjunction ($r = n$). In the general case ($1 < r < n$), this operation is purely fuzzy and has no analogs among the operations on fuzzy sets. The operation of *r*-composition is applied to the solution of control problems under uncertainty.
Keywords: fussy sets, logical operations, composition, uncertainty, control problems

1. Introduction

When solving control problems, it is frequently necessary to obtain a quantitative estimate for a certain situation under uncertainty using the evaluations of this situation given by a certain number of independent experts under the same conditions. The presence of uncertainty factor results in evaluations given in the form of the corresponding fuzzy subsets of the set of all possible alternatives. Note that the problem of obtaining an objective quantitative estimate of the studied situation reduces to the integration of individual evaluations of particular experts according to a certain reasonable criterion. Usually, the operation of intersection of fuzzy sets corresponding to individual evaluations of particular experts is used as a base for the integration rule. The new fuzzy set obtained as a result of the intersection is taken as the desired cooperative evaluation of the situation under study [1].

The disadvantages of the cooperative evaluation obtained in this way are its narrowness and lack of reliability. The first disadvantage means that the evaluation set is usually considerably narrower (contains less elements) than the evaluations made by particular experts and may be empty, especially if number of experts is sufficiently large. The second means that the elements that belong to evaluation set usually have small grades of membership to it, especially if experts are sufficiently independent, which results in noticeable differences in their opinions. This approach may be refined in one way or another [2], [4]. However, this refinement does not change its nature. A possible way out that allows us to solve the problem suggests rejecting idea of [1] to choose common part (intersection) of all

individual evaluations as a cooperative evaluation and to replace it with a more flexible and productive principle of choice. This principle takes as a cooperative evaluation the individual evaluation given by a specially constructed "most representative" expert. It is obvious that, at each point of the domain of all possible alternatives, this expert must choose, as a measure of membership of this point to cooperative evaluation, an evaluation among the ones proposed by different experts that, in the general case, is distant from the extremal evaluations produced in this collective and has some "middle" position. And this choice means that the integration of individual expert evaluations into a cooperative one is not made on the basis of operations of fuzzy sets intersection (where minimal estimate of membership is taken) or union (maximal estimate is taken). This does not mean that any other known operations on fuzzy sets are used either. Operation required is a new operation on such sets, namely, their ordered choice. The goal of this paper is to describe this operation and to apply it to problem of making cooperative decisions under uncertainty to solve control and many other problems.

2. Problem Statement

Assume that we deal with a collective of n independent experts, which quantitatively evaluate the same situation under uncertainty conditions (incomplete information). Suppose that the evaluation given by an arbitrary i-th expert has the form of a fuzzy subset of the set of all possible alternatives and is characterized by the corresponding membership function $M_{B_i}(X)$. The problem is to integrate (aggregate) individual evaluations of particular experts into one, cooperative, evaluation of the considered situation. In other words, it is necessary to determine an integrated, cooperative, evaluation set B from some individual evaluation sets $B_i, i=\overline{1,n}$. As was mentioned in the Sec. 1, the conventional approach to the integration of individual evaluations into a cooperative one uses the intersection of fuzzy sets B_i to obtain a new fuzzy set

$$B=\bigcap_{i=1}^{n} B_i \ , \ \ M_B(x)=\min_{1\le i\le n} M_{B_i}(x), \tag{1}$$

which is taken as a cooperative evaluation of the considered situation. However, in view of the disadvantages specified above, this approach is not advisable. Therefore, we suppose that the individual evaluations of particular experts $B_i, i=\overline{1,n}$, are integrated into a cooperative evaluation B by constructing the most representative expert who performs the ordered choice from measures of membership $M_{B_i}(x), i=\overline{1,n}$ of any point (alternative) x to individual evaluations B_i. As a result, we obtain the measure of membership $M_B(x)$ for the cooperative evaluation B (see Sec. 1). Then, from the mathematical standpoint, the posed problem reduces to constructing and studying properties of appropriate functions of ordered choice from membership functions $M_{B_i}(x), i=\overline{1,n}$, and operations on fuzzy sets (individual expert evaluations) $B_i, i=\overline{1,n}$, described by these functions that lead to the fuzzy set (cooperative evaluation) B.

3. Mathematical Apparatus

It is known that the application of continuous logic (CL) with the support $A=[0,1]$ and logical

operations of $\vee = \max$ (disjunction), $\wedge = \min$ (conjunction), and negation $\bar{x} = 1 - x$ allows one to generalize the set-theoretic operations to the case of fuzzy sets [5], [6].

$$M_{A\cup B}(x) = \max(M_A(x),\ M_B(x)), M_{A\cap B}(x) = \min(M_A(x), M_B(x)),\ M_{\bar{A}}(x) = 1 - M_A(x). \quad (2)$$

Here, $M_B(x)$ is the measure of membership of the element x to the set B. It can be seen that the measure of membership of an element to the union (intersection) of two fuzzy sets is defined as disjunction (conjunction) of the continuous logic of measures of membership of this element to each particular set, while the measure of membership of this element to the complement of the fuzzy set is the negation of the measure of membership to this set. The operations of the union and intersection of several fuzzy sets are introduced similarly to (2).

Let us introduce family of new operations of the composition of fuzzy sets. First, we note that the operations of the union and intersection of fuzzy sets (2) are a generalization of the operations of the union and intersection of conventional sets to the case of fuzzy sets that uses well-known operations of fuzzy logic (FL), namely, conjunction and disjunction. The application of new operations that generalize FL-logical determinants (LD) provides a new family of operations on fuzzy sets that have no analogs in operations on conventional sets and reflect more completely the fuzzy nature of the boundaries of fuzzy sets. For this purpose, we introduce a finite set

$$A = \{a_1, a_2, ..., a_n\}, \quad (3)$$

where the r-th element in magnitude is a^r, so that $a^1 \le a^2 \le ... \le a^n$. The function

$$A \to a^r, r = \overline{1,n}, \quad (4)$$

is called the ordinal logical determinant (LD) of the rank r and is denoted by A^r or $|a_i|^r = |a_1, ..., a_n|^r$. The LD A^r is the numerical characteristic of the set A, which is similar to the determinant of a square matrix. It is expressed in terms of its elements by using operations of FL in form (3):

$$A^r = \bigvee_{i_1 \ne ... \ne i_{n-r+1}} a_{i_1} \wedge ... \wedge a_{i_{n-r+1}} \quad (5)$$

Consider a finite collection of fuzzy sets

$$B = \{B_1, B_2, ..., B_n\} \quad (6)$$

Let us introduce a family of operations on this collection

$$B_1(r)B_2(r)...(r)B_n = \overset{n}{(r)}_{i=1} B_i, \quad r = \overline{1,n}, \quad (7)$$

determined by following relation of the measure of membership of the element x to operands

$B_1,...,B_n$ and to the result of the operation $(r)B_i$:

$$M_{\underset{i=1}{\overset{n}{(r)B_i}}}(x) = \left|M_{B_1}(x),..,M_{B_n}(x)\right|^r,\ r=\overline{1,n}. \tag{8}$$

The introduced operation (r) is called the r-composition of fuzzy sets $B_1, B_2,..., B_n$. Thus, the measure of membership of the element of the r-composition of fuzzy sets is defined as an ordinal LD of rank r from the set of measures of membership of this element to particular sets. In the particular case when $r=1$, we obtain the one-composition of fuzzy sets which coincides with their intersection. In another particular case when $r=n$, we obtain n-composition of fuzzy sets that coincides with their union. In general case, for $2\le r\le n-1$ (which is the case if $n\ge 3$) the r-composition is a new operation that is essentially different from both the union and intersection of fuzzy sets. More precisely, this operation is intermediate between operations of union and intersection, which follows from the obvious inequalities

$$M_{\underset{i-1}{\overset{n}{\cap B_i}}}(x) = \bigwedge_{i=1}^{n} M_{B_i}(x) \ \le\ M_{\underset{i-1}{\overset{n}{(r)B_i}}}(x) = \left|M_{B_i}(x)\right|^r \ \le\ \bigvee_{i=1}^{n} M_{B_i}(x) = M_{\underset{i=1}{\overset{n}{\cup B_i}}}(x),\ r=\overline{1,n}. \tag{9}$$

It can be seen from (9) that the operation of the r-composition of fuzzy sets is stronger than the operation of their union but weaker than their intersection, i.e.,

$$x\in \underset{i}{\cap} B_i \to x\in \underset{i}{(r)} B_i \to x\in \underset{i}{\cup} B_i \tag{10}$$

As r increases from 1 to n, the "strength" of the r-composition is almost reduced to the strength of the operation of the intersection of sets, and, while r decreases from n to 1, this strength increases tending to the strength of the operation of interaction from set theory.

Properties of the composition of fuzzy sets and its relation with the union and intersection of fuzzy sets are a consequence of following considerations. Being a generalized operation of union and intersection of such sets, the r-composition of fuzzy sets can be represented in the form of their superposition. Indeed, writing the LD in the right-hand of (8) in detail, we obtain according to (5)

$$M_{\underset{i=1}{\overset{n}{(r)B_i}}}(x) = \bigvee_{i_1\ne ...\ne i_{n-r+1}} \left(M_{B_{i_1}}(x)\wedge ...\wedge M_{B_{i_{n-r+1}}}(x)\right). \tag{11}$$

However, according to (2), the FL conjunction (disjunction) of measures of the membership of the element of fuzzy sets corresponds to the intersection (union) of these sets. Therefore, (9) implies the expression of the r-composition in the form of the union of intersections of sets

$$\underset{i=1}{\overset{n}{(r)}} B_i = \bigcup_{i_1\ne ...\ne i_{n-r+1}} (B_{i_1}\cap ...\cap B_{i\,n-r+1}). \tag{12}$$

Similarly, we obtain the dual expression of the r-composition in form of intersection of unions of sets

$$\overset{n}{\underset{i=1}{(r)}} B_i = \bigcap_{i_1 \neq \ldots \neq i_r} (B_{i_1} \cup \ldots \cup B_{i_r}). \tag{13}$$

The r-composition of fuzzy sets must satisfy the following laws: the distributive law relative to the intersection and union

$$A \cap \left(\overset{n}{\underset{i=1}{(r)}} B_i \right) = \overset{n}{\underset{i=1}{(r)}} (A \cap B_i), \quad A \cup \left(\overset{n}{\underset{i=1}{(r)}} B_i \right) = \overset{n}{\underset{i=1}{(r)}} (A \cup B_i), \tag{14}$$

law of complex (repeated) composition

$$\left(\overset{n}{\underset{i=1}{(r_1)}} B_i \right) (p) \left(\overset{n}{\underset{i=1}{(r_2)}} B_i \right) (p) \ldots (p) \left(\overset{n}{\underset{i=1}{(r_k)}} B_i \right) = (r_p) B_i, \; r_1 < r_2 < \ldots < r_k, \; p \le k, \tag{15}$$

and the generalized de Morgan law

$$\overline{\overset{n}{\underset{i=1}{(r)}} B_i} = (n - \overset{n}{\underset{i=1}{r}} + 1) \overline{B_i}. \tag{16}$$

To prove the first (second) law in (14), it is sufficient to express in it the composition of sets $\overset{n}{\underset{i=1}{(r)}} B_i$ in the form (12) (in the form (13)). Then, we have to apply the distributive law of union relative to the intersection (intersection relative to the union). To prove law (16), it is sufficient to express in it the composition of sets $\overset{n}{\underset{i=1}{(r)}} B_i$ in form (12) or (13). Then, we have to write in detail the expression under the negation sign using de Morgan law. The validity of (15) follows from the definition of the r-composition of sets (8).

4. Method for Solving the Problem

According to Sec. 2, to solve the posed problem of integrating individual evaluations of the particular experts i expressed in the form of fuzzy sets $B_i, i = \overline{1,n}$, into a cooperative evaluation in the form of a fuzzy set B, we construct and use the most representative expert of this collective. This expert executes the function of ordered choice from the measures of membership $M_{B_i}(x), i = \overline{1,n}$ for any given point x to individual evaluations B_i; and the result of this choice is the measure of membership $M(x)$ of the point x to the cooperative evaluation B.

To be precise, the most representative expert executes the function of choice of the r-th

element in increasing order among the elements of the finite set $M(x) = \{M_{B_1}(x), M_{B_2}(x),..., M_{B_n}(x)\}$ or, equally, finds the ordinal logical determinant of rank r

$$\left|M(x)\right|^r = \left|M_{B_1}(x), M_{B_2}(x),..., M_{B_n}(x)\right|^r . \qquad (17)$$

Comparing (17) with (8), we come to the conclusion that if we use terms of fuzzy sets, rather than measures of membership, the most representative expert of a collective of experts performs an operation on fuzzy sets (individual expert evaluations) $B_i, i = \overline{1,n}$, in form of r-composition of these sets (7) with an appropriate value of r, and result of this operation is a fuzzy set (cooperative evaluation) B. The choice of an appropriate value of r is obvious here, since (Sec. 1), at each point x, the most representative expert should choose the measure that is sufficiently distant from extreme evaluations and has average properties. This measure is chosen among the measures $M_{B_i}(x)$ of its membership to individual evaluations B_i given by experts i as measure of its membership to the cooperative evaluation I. This means that we have

$$1 << r << n, \quad r \approx n/2 . \qquad (18)$$

Thus, the integration of individual evaluations of experts i in the form of fuzzy sets $M_{B_i}(x), i = \overline{1,n}$, into cooperative evaluation in the form of the fuzzy set B is the operation of r-composition of pointed sets B_i with an appropriate value of r in accordance with (18). It follows from (17) that the measure of membership of an arbitrary element x to the cooperative evaluation B of the situation is calculated in our approach by an ordinal logical determinant of rank r of the collection of the measures of membership of this element to the individual evaluations of experts $B_1,..., B_n$. Therefore, our approach to the integration of individual evaluations into a cooperative one can be called the rank approach. Formula (12) of the decomposition of the cooperative evaluation $\binom{n}{r} B_i$ into the individual $B_1,..., B_n$ ones implies that the rank approach is equivalent to the following procedure: 1) all possible representative subsets that consist of $n - r + 1$ experts are selecting; 2) in each representative subset, its own cooperative evaluation is obtaining by the method of intersection of the individual evaluations [1]; 3) the best (with the maximal measure of membership $M_B(x)$) evaluation obtained in the representative subsets is taking as a final cooperative evaluation. If we use another formula for the decomposition of the cooperative evaluation into individual ones (13), then the rank approach is equivalent to the following procedure: 1) all possible "check sets" of experts that each consist of r experts are selecting; 2) in each "check set", its own representative evaluation is obtaining by method of integration of individual evaluations [1]; 3) the intersection of all evaluations B is taken as a cooperative evaluation.

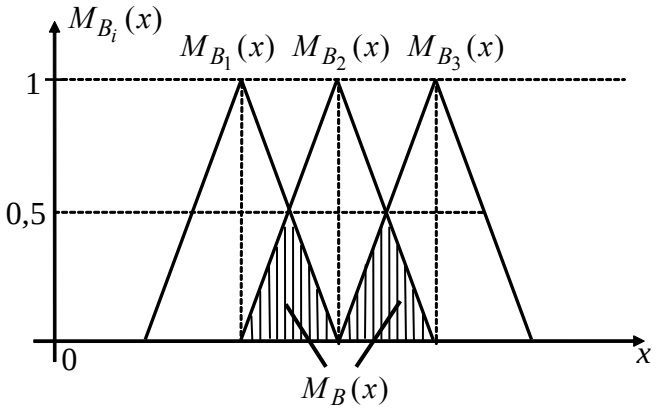


Fig. 1

Example. Three experts $i=\overline{1,3}$ give individual evaluations of the same situation in the form of fuzzy sets B_1, B_2 and B_3, whose membership functions $M_{B_i}(x), i=\overline{1,3}$ are shown in Fig. 1. It is required to integrate the individual evaluations B_i into a cooperative one B.

We will follow the rank approach. In our case, the number of experts $n=3$ and, according to (17), (18), the membership function $M_B(x)$ ofe cooperative evaluation B realized by the most representative expert is

$$M_B(x)=\left|M_{B_1}(x)\ M_{B_2}(x)\ M_{B_3}(x)\right|^2.$$

In other words, the cooperative evaluation B is obtained from the individual evaluations B_1, B_2 and B_3 by the choice of the middle of three measures of membership given by individual evaluations at each point x and the result is presented in the Fig. 1 by the dashed line.

Note that, if the method of intersection [1] is applied to our example, an empty set is obtained as cooperative evaluation B; i.e., there is no evaluation in this case.

5. Conclusion

The introduced operation of the r-composition of fuzzy sets is not a generalization of operations with conventional sets and does not turn into them when we pass from fuzzy sets to conventional ones. It is a new operation that has no analogies among usual set-theoretic operations. The operation of the r-composition shows that there is no gap between union and intersection of fuzzy sets. Both are r-compositions with different values of the index r. Because of the essential novelty of the operation of the r-composition, the opportunity to achieve more efficient logical inference and decision making arises.

References

1. Bellman, R.E., Zadeh, L.A., “Decision Making in Fuzzy Environment”, *Management*

Science, 4, Vol. 17, 1970.

2. Dubois, D., Prade, H., *Fuzzy Sets and Systems: Theory and Applications*, New York: Academic Press, 1980.

3. Zimmermann, H.J., *Fuzzy Sets, Decision Making and Expert Systems*, Kluwer Academic, 1986.

4. Yager, R.R., "Connectives and Quantifiers in Fuzzy Sets", *Fuzzy Sets and Systems*, Vol. 40, 1991.

5. Zadeh, L., *The Concept of Linguistic Variable and Its Application to Approximate Reasoning*, New York: Elsevier, 1973.

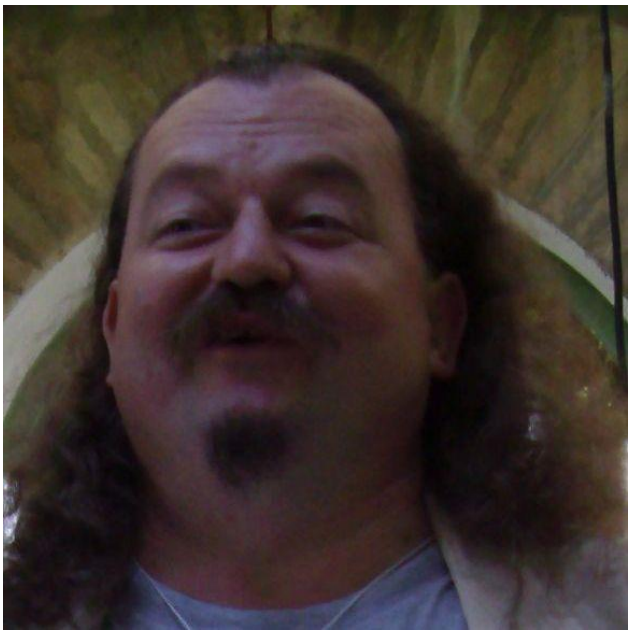
6. Levin, V.I., *Structural-Logical Methods of Analysis of Complex Systems.* Moscow: Nauka, 1987 [in Russian].

DE GRUYTER OPEN

studia humana
QUARTERLY JOURNAL

Studia Humana
Volume 4:4 (2015), pp. 47—52
DOI: 10.1515/sh-2015-0025

On Hungarian Philosophy. Its European Past and European Future



Béla Mester (1962), PhD, Senior Research Fellow of the Institute of Philosophy, Research Centre for the Humanities, Hungarian Academy of Sciences, Budapest, Hungary; share-time associate professor of University of Nyíregyháza when he is an alumnus; member of the editorial boards of *Hungarian Philosophical Review* and *Kellék*; vice-president of the Hungarian Philosophical Society; Doctor universitatis of history of philosophy (ELTE University, Budapest, 1997); PhD of literary studies (UBB University, Cluj/Kolozsvár/Klausenburg, 2003, in Romania, in Hungarian); PhD of political philosophy (ELTE University, Budapest, 2005); fields of research: history of early modern political philosophy, history of Hungarian philosophy.

Tudor Petcu: At the beginning of our dialogue I wish to make reference to the meaning of Hungarian philosophy in the context of European philosophy. I mean I think it would be necessary to present in a relevant way the role that the Hungarian philosophy has played in the evolution of the European philosophy, especially western philosophy. So, what could you say about this topic?

Béla Mester: I can answer as a historian of philosophy who is focussed on the actual research project managed by him as a principal investigator entitled *Narratives of Hungarian Philosophy 1792–1947* (from the Kantian debates in Hungarian philosophy to the prohibition of the academic periodical, entitled *Athenaeum*). Because of my intellectual background, and my field of research, all of my answers will be formulated from the point of view of an historian of the Hungarian philosophy, by other words, with a bias of a historian of philosophy.

Your question refers to one of the fundamental problems of every nation-level historiography of philosophy, amongst them the ones of the greatest philosophical cultures of Europe. It is always a crucial question to find a well-founded link between the universality of philosophy, the role of philosophy in a national culture, and the role of the philosophical tradition of a nation in the universal (European) philosophy. In the self-reflection of the Hungarian philosophy, János Erdélyi's *Philosophy in Hungary* (1865–1866) has formulated a classical solution. In his great Hegelian vision of history of philosophy, the Hungarian story is a long march from the unconscious philosophical elements hidden in the structure of the Hungarian language *(thesis)* through the

cultivation of the mainstream philosophies of the actual epoch in Latin *(antithesis)* till the happy end, when the Hungarian philosophy and its terminology in its native language is in harmony with the top (and end) of the universal philosophy that is Hegelianism *(synthesis)*. Albeit, Erdélyi's vision cannot be continued in the historiography, it has an inevitable hidden influence on the opinions on the connections between philosophy and national culture. In general, a relatively small national philosophical culture like the Hungarian one has three strategies to find its position in the universal scene. We can try finding several star-philosophers in the past or in the present and using them as a wild card for the tournament of philosophy in international level. This method can work on the surface; I can identify Hungarian philosophy with the works of György (Georg) Lukács or with the theory of personal knowledge of Mihály (Michael) Polányi or with the philosophy of science of Imre Lakatos, etc. They are important names in the Hungarian tradition and known authors for the international audience of philosophy. I think it is an inevitable step for the self-understanding of the Hungarian philosophy, but it is not enough without offering a complete *narrative* of the history of the Hungarian philosophical traditions. Another way is to develop a detailed, philologically sophisticated *history of the local receptions* of the mainstream philosophies. It is not too easy and you cannot find a sensational result. If you are the best in this genre, at the end you can write a chapter about the Hungarian, Romanian, etc. reception of Hume or Locke in a Cambridge volume on the Continental reception of British philosophers. At the first glance it is a highly boring field of research, but very important. If you look at the greatest manuals of an epoch of history of philosophy, usually you can find that there is no information about East-Central-Europe, or there are just general phrases without concrete data. (Recently you can see this phenomenon in Jonathan Israel's monograph on *Radical Enlightenment*.) Authors of these manuals are not guilty, they use the data offered by the historians of philosophy of our region; it is our task to modify the position of our region in the map of universal philosophy. However, the research programs of history of reception are needed and important elements of the self-reflection of the Hungarian philosophy; it is not enough alone; and it is counter-productive in several cases. The most interesting stories are based on the reception of different trends; sometimes they did not communicate with each other, both of them were visible from a Hungarian (or other Central-European) perspective, only. It would be fruitful a coordinated research-program to investigate the common philosophical patterns of our region from a comparative perspective.

Tudor Petcu: Which are the main philosophical approaches assumed over the years in the different academic milieus in Hungary? Can we talk about a strong Hungarian phenomenology, or about any analytical Hungarian philosophy, or so? Every country where philosophy was assumed as a field of research has had a specific and general philosophical tradition, as for example England, very well-known through its analytical philosophy, or Germany through its idealism or phenomenology expressed by Edmund Husserl or Martin Heidegger. In this case, what about the philosophical tradition in Hungary?

Béla Mester: I think we should be careful with the concept of "national spirit" of philosophical trends. However, we can feel the differences of the philosophical climate of the national cultures of Europe; we should not forget that they are constructions of historiographies of philosophy embedded in different national cultures. However, Descartes and Leibniz were French and German persons, they did not identify themselves as *French or German philosophers;* nationalisation of their philosophies is a product of the centuries after their lifetime. This constructed and historical feature of the concept of the national character of philosophy is the clearest in the Hungarian case when the first program to make "Hungarian philosophy" (1830) was identical with the program to formulate a national narrative of the philosophical heritage of Hungary.

Nowadays, boundaries of a philosophical part of a national culture have become more malleable than they were ever, both from the points of view of the linguistic and geographical boundaries.

Hungarian philosophers in the neighbouring countries (e.g. Romania) are active participants of the philosophical lives of both countries. (A Hungarian philosophical periodical entitled *Kellék* is registered both in Romania, and in Hungary; another Hungarian philosophical periodical in Transylvania, entitled *Többlet* has a series of special issues for the presentation of the PhD-schools of Hungary, etc.) Hungarian philosophers of West Europe, and of the world, amongst them ancient emigrants, can participate in the Hungarian daily philosophical life. A new phenomenon in Hungarian culture is the presence of the Central European University (CEU). However, it is an international institution with international faculty members, established by the laws of New York State; it has become an integrated part of Hungarian cultural life. Its philosophical department was one of the best tens in Europe by a recent independent evaluation.

Concerning the present trends of Hungarian philosophy we should mention at first the name of László Tengelyi, a great figure of the international scholar community in the field of phenomenology. He died in the last year, just after the conference by the opportunity of his 60th birthday. However, he has spent his last years as a German professor in Wuppertal, he has always remained an important figure of the community of Hungarian philosophers; he was an active member of the advisory board of the *Hungarian Philosophical Review,* he has regularly participated in Hungarian conferences, and had publications in Hungarian. His figure mirrors the importance and quality of (German- and French-style) phenomenology in the contemporary Hungarian philosophical life.

Its counterpart is a significant Hungarian tradition of logic, based on our old tradition of mathematics. After its "war of independence" against the "dialectical logic" of the official Marxism, it has achieved an estimated position within the Hungarian philosophical life. The international significance of this discipline is mirrored in the long and multi-coloured list of authors of the special issue of *Hungarian Philosophical Review* in English *in memoriam* Imre Ruzsa, the father of the modern Hungarian logics (2010). School of logic of our philosophical life has been connected with both the intellectual workshops of philosophy of science, and with the analytical philosophy. The former one is a relatively old tradition in Hungarian philosophy, the last one has appeared relatively later than in the neighbouring philosophical cultures. (It is a strange fact of the history of philosophy that the Vienna Circle has just a single member of Hungarian origin, and has almost zero influence on Hungary in the time when the cultural connections between Vienna and Budapest were vivid in other cultural fields.) In the last years, it was one of the most significant events of our philosophical life an open debate between the protagonists of the analytical and phenomenological traditions about the concept and meaning of philosophy. (Several years ago it was my task to edit a Hungarian special issue of the periodical entitled *Filozofia* of the Slovakian Academy of Sciences, as a twin of the special Slovakian issue of *Hungarian Philosophical Review*. By my conception as an editor, a report on this debate has represented our everyday scholar activities in a nutshell, for the Slovakian audience.) Philosophy of language has an important position; it is a field of research what is important both for analytical and phenomenological traditions, and for the logicians, as well.

Historical point of view was always important in Hungarian philosophical tradition. Within this scholar community, Hungarian researches of the history of antiquity had traditionally estimated position in the international scene. Researches of early modernity, and Kantianism had always a distinguished importance in Hungarian philosophy, partly because of the role of the Cartesian and Kantian tradition in the history of Hungarian philosophy. A Hungarian speciality is the philosophical orientation of a branch of Hungarian sinology. This intellectual workshop has always genuine theories in the field of the interpretation of the history of Chinese thought; their last achievement is a new history of Chinese philosophy based on the traditions of Hungarian sinology,

with an interesting analysis from the point of view of the (European–Chinese) comparative history of philosophy.
Political philosophy and philosophy of law in Hungary, called "the country of lawyers", has always a distinguished role in Hungarian philosophy, after the collapse of Communism had a relatively dominant position in the public sphere.

Aesthetics has a continuous tradition from the end of the 18th century, and it has significant intellectual workshops nowadays, as well. There is an actual research project for writing its history from its beginning, written in Latin till our age.

Tudor Petcu: Western philosophy has always accorded a huge attention to the relation between philosophy and theology although there is basically difficult to find too many common denominators, first of all because of their comprehensive logics. Of course, from this point of view there would be a lot to say, especially if we would need to take into account the modal logics as a way to explain the Reality in comparison with theology mostly based on a mystical worldview which has its own logics. But we shouldn't forget about the different Christian efforts in the Middle Age to create a liaison, a strong connection between philosophy and theology, as Saint Anselm or Thomas Aquinas did. Anyway, what can you say about the way by which was defined the relation between philosophy and theology in Hungary and who were the main Hungarian philosophers focused on the analyses of this topic?

Béla Mester: In Hungarian philosophy, amongst the philosophers with Catholic identity, there has always been a significant neo-Thomist tradition from the end of the 19th century till nowadays. As a field of research, philosophy of religion has traditionally strong positions, especially from a historical point of view, both in the research centres of the church and state universities, and in our academy of sciences. There is a Catholic intellectual workshop for a new Christian philosophy, and on the other side has emerged a new, modernised atheist argumentation. Despite of these important phenomena, the main characteristics of the relationship of philosophy and religion in Hungarian tradition is mainly rooted in cultural identity of the philosophical authors, not in the question of the relationship between knowledge and faith, or similar classical topics. For example, Hungarian Cartesian movement, and the Cartesian debates of the 17th century has appeared within the Protestant, dominantly Calvinist institutional network. In the same time, a Suarez-style late scholasticism was an exclusive Catholic discipline. Later, however, the Kantian debate (1792–1822) was organised by the new, religiously neutral public sphere of the printed brochures and periodicals, their main protagonists were mainly Protestants on both sides. As late as the age of the neo-Kantian philosophy of values in the end of the 19th century and in the beginning of the 20th century, the most important Hungarian school of this kind of philosophy has not any Catholic members. (It is the circle of Károly Böhm who was born in Banská Bystrica, today in Slovakia, was living for decades in Budapest and died as a professor in Cluj (Kolozsvár, or Klausenburg, in Transylvania) in 1911. Today there is a lecture room called "Sala Böhm Károly" for his memory in UBB University.) In the same time, a young philosopher (Ákos Pauler, an emblematic figure of the interwar period of philosophy in Hungary) with Catholic identity has developed his ethics on different foundations. He has not any Protestant disciples. At the same time, this strong denominational determination is does not work in today Hungarian philosophy, we must calculate with it as an important historical element.

Tudor Petcu: As far as I know, one of the most Hungarian philosophers was Ágnes Heller, who joined the communist party and so she began to develop an interest in Marxism. So, please describe us in some words her philosophical personality, so influenced by the school of the continental philosophy.

Béla Mester: Ágnes Heller belonged to the circle of the disciples of György Lukács. Albeit, Lukács was a member of the Hungarian Communist emigrant enclave in Moscow, and has come back as an aspirant for the leadership of the cultural life, after the Communist political turn (1948) he has been marginalised in political and cultural life. He and his disciples were always heretics of the Marxism in the eyes of the rulers of the country. In the years before Heller's emigration, she and other members of the same circle were the participants of the movement for creating a Marxist anthropology, and ethics, connected with the existentialism of this epoch. Based on the Hungarian philosophical traditions, all of the members of this circle has founded his or her opinions with serious researches in the topics of history of philosophy, connected their field of interest. (In the case of Heller these historical topics were the Hegelian movement in Hungary, Aristotle's ethics, and the Renaissance ideal of human being.) In the Communist bloc, there were only two relevant intellectual workshops of this movement: Budapest school, and the Praxis Circle in Zagreb. (There were several very important individual authors of this genre in Poland, as well.) They have appeared in the scene of politics with the Korčula petition against the Soviet occupation of Czechoslovakia. (Korčula is a Croatian island when there were usual summer universities in this time, offering a free meeting point for the reform-Marxist philosophers of the Communist bloc.) It is symptomatic that almost all the significant figures of this scene had to emigrate in the seventies both from Poland and Hungary, and the periodical of the Croatian Philosophical Society; entitled *Praxis* was prohibited in the same time. In the Hungarian case the turning point was the "philosophers' trial" in 1972, just after the death of György Lukács, in accordance with the Conservative turn of the Hungarian Communist politics, against the economic reform (1968), and its possible consequences for the culture and politics. After the trial, the majority of the disciples of Lukács left the country, and the main figures of the second generation of the Budapest school (by the slang of the Hungarian intelligentsia the "Lukács-kindergarden") became inland dissidents in Hungary, without a normal job. However, Ágnes Heller lived in Australia and in the USA; at the same time she remained the follower of the Continental tradition. In her new works written in America, and after the collapse of Communism, again in Hungary, from her earlier period remained an interest in the ethical and anthropological problematics. In the time of her emigration the biggest influence on her was the intellectual climate of the New School in New York. In here she was the heir of the position of Hannah Arendt. New School itself has been established by European (mainly German) emigrants, as well. The intellectual positions of Arendt and Heller had important similarities; they were refugees of different totalitarian regimes, and followers of European Continental philosophical traditions in America. Arendt's totalitarianism-book has a special importance for the Hungarians, because of its additional chapter about the revolution of 1956 omitted from some editions. Both the anti-totalitarian political philosophy of Arendt and her model as a public intellectual have been deep influence on Ágnes Heller; it is an important addition for the interpretation of Heller's later works.

Tudor Petcu: We shouldn't forget to highlight the contemporary philosophical theories in Hungary, because in our days it's very hard to find a philosophical task given the technological revolution and the development of pragmatism. I am saying that because the general question that is addressed even in the British and American schools of philosophy is the following: what role can play philosophy in our days, in a society where science is evolving on and on? But in spite of this fact and according to the question I have mentioned above, there are numerous contemporary philosophical views related especially to politics, science and economics. So, which are the most important contemporary Hungarian philosophical theories and approaches?

Béla Mester: I should speak first of all about the institutional embedment of philosophy in Hungary in the Communist era, after its collapse, and today. The Communist political turn after the WWII has destroyed the institutions of philosophy. There were three years without any academic periodical of philosophy, later, a few volumes of *Philosophical Yearbook* was the only terrain for

the publications. Philosophical studies were possible in an institute directly controlled by the Communist party, only, in the Stalinist era. In Kádár's Hungary, the situation seemingly has been normalised; an academic periodical has been (re)founded, and philosophy became an integral part of the higher education. The price of this normalisation was a highly restricted position of philosophy in higher education and in intellectual life; (emission of MAs of philosophy was the privilege of the ELTE University in Budapest, in every second year, not for too many students). After the collapse of communism, Hungarian philosophy as an institutional system and as a scholar community has been reconstructed, soon. Hungarian Philosophical Society has been (re)established in the last years of Communism, amongst the other early endeavours of the reestablishment of the civil society; new philosophical intellectual workshops, periodicals, educational programs, and PhD schools have been established in every significant Hungarian university. Emigrants and inland dissidents have appeared in the universities, with their new points of view. Several philosophers of the research institute of the Academy of Sciences who was artificially separated from the university sphere, and from the possibility of to teach the youth has become professors in the universities. In this situation, philosophy has achieved relatively better positions in public sphere; several philosophers assumed the role of the public intellectual in the media (e.g. Ágnes Heller). In spite of the presence of philosophy in public sphere, it remained a kind of elitism in the behaviour of our scholar community. It was partly a reaction to the ideological-political usage of philosophy, struggle for the autonomy of philosophy as an academic discipline. (There were similar reactions amongst the scholars of literary studies, against the social determination of literature, formulated by Marxism, and for the autonomy of artworks.) A consequence of his (partly hidden) elitism is that applied forms of philosophy, e.g. applied ethics have relatively smaller role in Hungarian philosophy that in other countries in our region.

Nowadays, the institutional background in the education has restricted again. Philosophy is a part of the curricula of just a few secondary grammar schools, and the right of the teachers of philosophy for teaching ethics is continuously contested by the authorities. Programs of philosophy and PhD-schools are in a dangerous situation in almost every university. A new tone of the language of Hungarian politics, which has turned gradually to an anti-intellectual, pseudo-plebeian rhetoric, does not offer a good chance for try a significant role of philosophy in the public affairs. Under conditions of an anti-intellectual political language, and an elitist philosophical self-identity, there are two types of the reflections to the modern world.

The first one is trying to understand our scientist modern world. Hungarian tradition of philosophy of science can offer relevant answers for scientist worldview, by the philosophical analysis of the keywords of different disciplines, which are not, reflected ones within the framework of these disciplines. In the last years were important philosophical discussions e.g. about the meaning(s) of the (different) concept(s) of the evolution, on the possibility of the demarcation between artificial and human minds, etc.

Another way is a kind of a well-established philosophical critique of several phenomena by the disciplines like bioethics, ecological philosophy, and so on. Albeit, these applied philosophies have not enough strong positions in the academic sphere of philosophy, they have a significant laic audience in the circles around several cultural periodicals, and in the sphere of the Hungarian branch of the international movement of *philosophical cafés*.

Maybe, this scene will be the basis of the reestablishment of Hungarian philosophical tradition. We must remember that in the 1880s, *Philosophical Circle of Budapest* (ancestor of Hungarian Philosophical Society, established in 1901) was the initiator of the reform of the social embedment of the Hungarian philosophy, out of the academic sphere, as a part of the vivid cultural life of the Budapest cafés.