11

th Annual South-East European
Doctoral Student Conference

Infusing Research and Knowledge in South-East Europe

Edited by
K. Dimopoulos, P. Gkasis, E. Kalyva, T. Lagkas, Z. Tatsioka

SOUTH-EAST
EUROPEAN
RESEARCH
CENTRE

SEERC

Proceedings of the 11th South-East European Doctoral Student Conference

Under the 2nd Young Researchers' Skills Development Week

Edited by
K. Dimopoulos, P. Gkasis, E. Kalyva, T. Lagkas, Z. Tatsioka

Preface

These proceedings represent the collection of contributions to the eleventh (11th) Annual SEERC Doctoral Student Conference that took place under the 2nd Young Researchers' Skills Development Week (YRW2017) hosted by the University of Sheffield International Faculty, CITY College and organised by the South East European Research Centre in Thessaloniki, Greece.

The annual SEERC Doctoral Student Conference has grown and evolved to the Young Researchers' Skills Development Week. The key aim remains to provide an opportunity for PhD students and young researchers to receive advice from experts in their chosen field of research and to enhance their skills by attending specifically designed workshops and by developing and presenting academic papers. Having identified academic isolation as a problem that many doctoral students face, SEERC aims to bring researchers together for establishing collaborative links between disciplines, for testing the ground for innovative ideas and for engaging the wider academic community.

The audience of the conference expanded beyond the boundaries of South East Europe confirming the need for Doctoral Students to come together, discuss their experiences and gain external feedback for their work as well as listen to the progress and methodology of fellow PhD candidates.
The current proceedings comprise of research from Albania, Armenia, Czech Republic, Greece, Italy, Kosovo* and F.Y.R. of Macedonia.

I hope that you enjoy the conference.

Prof. Panayiotis H. KETIKIDIS
Chairperson of YRW2017

This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence".

Conference Organization

The eleventh (11th) Annual SEERC Doctoral Student Conference that took place under the 2nd Young Researchers' Skills Development Week (YRW2017) was organized by the South East European Research Centre (SEERC), an overseas research centre of the University of Sheffield, establish as a non-profit legal entity in Thessaloniki, Greece. SEERC was founded by CITY College, the University's International Faculty, in 2003.

Organizing Committee

Dr. Efrosini Kalyva, Chair, *The University of Sheffield International Faculty, CITY Colleg, Greece*
Dr. George Eleftherakis, *The University of Sheffield International Faculty, CITY College, Greece*
Dr. Kostas Dimopoulos, *The University of Sheffield International Faculty, CITY College, Greece*
Dr. Pavlos Gkasis, *The University of Sheffield International Faculty, CITY College, Greece*
Dr. Thomas Lagkas, *The University of Sheffield International Faculty, CITY College, Greece*
Dr. Zoi Tatsioka, *The University of Sheffield International Faculty, CITY College, Greece*
Ms. Eleni Tsimiga, *South-East European Research Centre (SEERC), Greece*

Scientific Committees

Enterprise, Innovation and Development

Dr. Dilay Celebi, Istanbul Technical University, Turkey
Dr. Alok Choudhary, The University of Sheffield, UK
Dr. Ana Cruz, The University of Sheffield International Faculty, CITY College, Greece

Dr. Gurdal Ertek, Sabanci University, Turkey
Dr. Thanassis Fassas, The University of Sheffield International Faculty, CITY College, Greece
Dr. Andrea Genovese, The University of Sheffield, UK
Dr. Alexandros Kapoulas, The University of Sheffield International Faculty, CITY College, Greece
Prof. Paul Latreille, The University of Sheffield, UK
Dr. Milos Milovancevic, The University of Nis, Serbia
Dr. Nikolaos Mylonidis, University of Ioannina, Greece
Dr. Dimitrios Nikolaidis, The University of Sheffield International Faculty, CITY College, Greece
Dr. Konstantinos Priporas, Middlesex University London, UK
Dr. Alexandros Psychogios, The University of Hull, UK
Dr. Leslie T. Szamosi, The University of Sheffield International Faculty, CITY College, Greece
Dr. Zeljko Tekic, The University of Novi Sad, Serbia
Dr. Robert Wapshott, The University of Sheffield, UK
Dr. Anna Watson, University of Hertfordshire, UK
Dr. Nick Williams, The University of Sheffield, UK
Dr. Alexandros Zangelidis, University of Aberdeen, UK
Prof. Sinisa Zaric, The University of Belgrade, Serbia

Information and Communications Technologies

Dr. Jose María Alvarez Rodríguez, Universidad Carlos III de Madrid, Spain
Prof. Costin Badica, University of Craiova, Software Engineering Department, Romania
Prof. Tudor Balanescu, University of Pitesti, Romania
Prof. Omer Faruk Bay, Gazi University, Turkey
Assoc. Prof. Alexander Chatzigeorgiou, University of Macedonia, Greece
Prof. Betim Cico, SEEU Tetovo, FYR of Macedonia
Dr. Tony Cowling, The University of Sheffield, UK
Dr. Anastasios Diamantidis, The University of Sheffield International Faculty, CITY College, Greece
Dr. Konstantinos Dimopoulos, The University of Sheffield International Faculty, CITY College, Greece

Prof. Christos Douligeris, University of Piraeus, Greece
Dr. Dimitris Dranidis, The University of Sheffield International Faculty, CITY College, Greece
Dr. Anabel Fraga, Universidad Carlos III de Madrid, Spain
Prof. Neki Frasheri, Polytechnic University of Tirana, Albania
Assoc. Prof. Akli Fundo, Polytechnic University of Tirana, Albania
Assist. Prof. Mathias Funk, Eindhoven University of Technology, The Netherlands
Dr. Christos Georgiadis, University of Macedonia, Greece
Dr. Marian Gheorghe, the University of Sheffield, UK
Prof. Florin Gorunescu, University of Craiova, Romania
Dr. Fabrizio Granelli, University of Trento, Italy
Mr. Thanos Hatziapostolou, The University of Sheffield International Faculty, CITY College, Greece
Prof. Florentin Ipate, University of Pitesti, Romania
Prof. Petros Kefalas, The University of Sheffield International Faculty, CITY College, Greece
Prof. Evangelos Kehris, Technologal Education Institute (T.E.I.) of Serres, Greece
Prof. Juan Llorens, Universidad Carlos III de Madrid, Spain
Dr. Valentín Moreno, Universidad Carlos III de Madrid, Spain
Dr. Pantelis Papadopoulos, Aarhus University, Denmark
Dr. Iraklis Paraskakis, South-East European Research Centre, Greece
Assist. Prof. Biljana Risteska Stojkoska, Ss. Cyril and Methodius University, FYR of Macedonia
Dr. Ilias Sakellariou, University of Macedonia , Greece
Prof. Demetrios Sampson, University of Piraeus, Greece
Dr. Anthony Simons, The University of Sheffield, UK
 Ms. Anna Sotiriadou, The University of Sheffield International Faculty, CITY College, Greece
Dr. Ioanna Stamatopoulou, The University of Sheffield International Faculty, CITY College, Greece
Dr. Mike Stannett, The University of Sheffield, UK
Dr. Anca Vasilescu, University of Brasov, Romania
Dr. Simeon Veloudis, South-East European Research Centre (SEERC), Greece
Dr. Husnu Yenigun, Sabanci University, Turkey

Prof. Katerina Zdravkova, Ss. Cyril and Methodius University, FYR of Macedonia

Society and Human Development

Dr. Basak Alpan, Middle East Technical University, Ankara, Turkey
Dr. Panagiotis Bamidis, Aristotle University of Thessaloniki, Greece
Dr. Odeta Barbullushi, European University of Tirana, Albania
Prof. Stefan Bouzarovski, University of Manchester, United Kingdom
Ms. Agnes Brunet, The University of Sheffield International Faculty, CITY College, Greece
Dr. Elissavet Chrysochoou The University of Sheffield International Faculty, CITY College, Greece
Dr. Angeles F Estevez, Universidad de Almeria, Spain
Dr. Tonin L. Gjuraj, European University of Tirana, Albania
Dr. Anna Emmanouel, The University of Sheffield International Faculty, CITY College, Greece
Dr. Elena Griva, University of Western Macedonia, Florina, Greece
Dr. Stella Karapa, The University of Sheffield International Faculty, CITY College, Greece
Dr. Aristea Ladas, The University of Sheffield International Faculty, CITY College, Greece
Dr. Rod Nicholson, University of Sheffield, United Kingdom
Dr. Evangelos Paraskevopoulos, The University of Sheffield International Faculty, CITY College, Greece
Dr. Paschalia Patsala, The University of Sheffield International Faculty, CITY College, Greece
Mr. George Pavlidis, The University of Sheffield International Faculty, CITY College, Greece
Dr. Saska Petrova, University of Manchester, United Kingdom
Dr. Suzie Savvidou, The University of Sheffield International Faculty, CITY College, Greece
Dr. Klio Semoglou, University of Western Macedonia, Florina, Greece

Dr. Zoi Tatsioka, The University of Sheffield International Faculty, CITY College, Greece
Dr. Nikolaos Tsigilis, Aristotle University of Thessaloniki, Greece
Dr. Ana Vivas, The University of Sheffield International Faculty, CITY College, Greece
Dr. Alexander Wochnik, University of Manchester, United Kingdom
Dr. Antonia Ypsilanti, Sheffield Hallam University, United Kingdom

Sponsoring Institutions

South East European Research Centre (SEERC), Greece
The University of Sheffield International Faculty, CITY College, Greece
The University of Sheffield, United Kingdom

Table of Contents

Enterprise, Innovation and Development

Information and Communication Technologies

Society and Human Development: Psychology, Politics, Sociology, and English Studies

Enterprise, Innovation and Development

Interactions of monetary policies in SEEC in an EMU context. A Global VAR model.
(Focusing on the Bulgarian Case)

Mr Petros Golitsis

Business Administration and Economics Department, The University of Sheffield International Faculty, CITY College

e-mail: pgolitsis@citycollege.sheffield.eu

Abstract. This paper/thesis discusses the interactions of monetary policies in the Southeastern European Countries (SEEC) in a European Monetary Union (EMU) context, by modelling via a Global Vector Autoregressive Model (G-VAR) the interdependencies arising between the member states and the related financial institutions and authorities. The EMU and its relation to monetary or economic policy interactions has been heavily and effectively researched by numerous researchers including, indicatively, the Nobel laureate Mundell (1961) who theoretically and empirically considered and examined the effects of monetary and fiscal policies coordination on real output, interest rates and exchange rates with the aim of increasing the benefits that could arise from an optimum currency area (OCA). A G-VAR model for SEE, however, has not been applied and foreign exchange reserves have not yet been considered within such a contextual framework. There is a gap to fill in on the theoretical and empirical relation of the aforementioned variables using econometrics and we will do so by using a multi-simultaneous equations system with weak exogeneity i.e. a G-VAR. The incorporated variables are: the foreign exchange reserves, the exchange rates, the growth approximated by the industrial production index (I.P.I.), the inflation rate approximated by the consumer price index (C.P.I.) and the monetary policy which is quantified through interest rates and specifically by the money and market rate. The variables that will be treated as weakly exogenous within the G-VAR system are the euro and the money and market rate. The frequency of the data is monthly and will cover the period from 2000 to 2015. The analysis is conducted with the use of secondary data which is acquired through publicly available published data and reports from Central Banks, the European Central Bank (ECB), Eurostat, OECD and the World Bank. The European Countries that are considered are Greece, Romania, Bulgaria, Serbia and FYROM. The European Monetary Union and its role are captured and quantified by the related interest rate which is also the money and market rate. The main task of the project is to capture the transmission mechanism from the monetary to real economy by considering the role and the importance of stability promoted by the usage and adequacy of international reserves in the case of SEE countries, which adds to the understanding of the economic policy effect on real and nominal variables, improves and suggests a better macroeconomic policy design and also adds to the efficiency of the implementation of monetary policy capturing complexities that are related to OCA. This part of the thesis focuses on the Bulgarian Case through a VAR model.

1. Introduction

1.1   Literature review and research objectives

The main idea behind this research is to use and model macroeconomic and financial variables in the case of the region of Southeastern Europe (SEE) in its relation to European Monetary Union (EMU), using a Global Vector Autoregressive Model (G-VAR). The investigated variables are the foreign exchange reserves, exchange rates, industrial production index (I.P.I.), consumer price index (C.P.I.) and the monetary policy approximated by the money and market rate. This thesis will initially focus on the existing literature and on the research questions and objectives, and then on the related literature review that will address the investigated variables, both for the SEE countries and the EMU. Then it will proceed on the applied methodologies that are being used within this broader area of monetary economics and international monetary and economic relations and interactions. Indicatively the methodologies and the tests that will be elaborated include Vector Autoregressive models (VAR), Vector Error Correction Model (VECM), G-VAR, lag length criteria and impulse response functions (IRF's). The main aim of this thesis is the implementation and the interpretation of the results of the proposed and properly justified G-VAR methodology and its extensions i.e. global impulse response functions (GIRF's) and global variance decomposition (GVDC) for Greece, Romania, Bulgaria, Serbia and FYROM in an EMU context. The frequency of the data is monthly and will cover the period from 2000 to 2015.

   The group of Southeastern European Countries (SEEC), the European Monetary Union (EMU) and the European Union (EU), are all facing challenges that seem to be unprecedented in the areas of finance, sovereign debt crisis and its related management within an EMU context, policy coordination and even geopolitical changes and threats. The global financial crisis, known as the Great Recession, that occurred in 2008 in USA was transformed through the credit crunch, the liquidity squeeze and the massive changes of capital flows into a debt crisis in EU and

specifically in EMU. The structure of EMU, coupled with the policies chosen, for the given differences of a non-integrated economic union, led to an instability that stresses further the differences of the agents that we are interested in this thesis i.e. the SEE countries, the EMU and the European Union (EU). It is important to note that the countries of Greece, Romania, Bulgaria, Serbia and FYROM could be split into three groups: EMU members, EU members, and none of the above, a fact that by its own underlines the complexity of the topic. The policy options seem to be rather limited too and the co-existence and coordination of the member states seems to be a challenge that must be addressed.

Within the context of this topic, the modelling G-VAR framework will capture the dependence of the economies and the importance of the flows and spillover effects that are being generated by the co-movements in the monetary policies across SEE and EMU. This thesis will consider both monetary policy 'coordination' and monetary policy 'discretion' to capture the differences between the member states, and through this to improve, if applicable or to the best possible degree, the efficiency of economic policy making and macroeconomic policy design that can be achieved through coordination. The topic of economic policy coordination is thoroughly addressed by the literature, indicatively or conventionally starting with the paper of Cooper (1969) that considers the international framework within which an increasing economic integration occurs. Kydland and Prescott (1977) accumulated on the above extensions and implications including optimization sets and rules, commitment to pre-chosen decisions and possible and applicable discretion of economic policy. The main and the more important stream of this literature address the tradeoff between 'rules vs discretion' that consider both single-country and multi-country approach. A detailed literature and the evaluation of this stream is effectively provided by Kehoe (1987) and Curie and Levine (1985), but it could consider a rather early one from our current perspective.

While the majority of researchers have concentrated on the above, this thesis seeks to apply from a different perspective a G-VAR methodology, an approach that studies the monetary transmission mechanism and channels, in their relation to exchange rate framework in terms of reserves, regimes and currency fluctuations, and on their impact on real and nominal economy, that to the best of our knowledge, contributes and fills in the existing gaps in the literature of SEE. Specifically, the proposed methodology for this topic in this area has not been used and thus allows us to capture and clarify further the interdependencies between the SEE countries in their relation to E.M.U. The aim is towards understanding further the transmission mechanism of monetary policy to real economy variables in the case of different even though neighboring and economically linked countries. It has to be noted that a related approach was used by Dragomirescu-Gaina and Phillipas (2015), who studied the effects and the interactions of fiscal, instead of monetary which is used in our case, policies in the E.U. context, by modelling additionally the interdependencies

arising between the private and the public sector, without additionally, compared to this thesis, paying special attention to SEE countries, E.U. and none E.U. ones.

Specifically, to further clarify the objectives, the aim of this study could initially be summarized in the following research question:

What is the role of monetary policies in which countries are embedded, on sustaining economic and financial stability and promoting real growth in SEE within an EMU context?

The main research question furthermore could be disaggregated into secondary questions. The secondary research questions, both theoretical and empirical, are:

1. What are the different transmission mechanisms by which the monetary effect through the money and market rate, foreign exchange reserves and exchange rates contributes to real and nominal economy as they are approximated by the industrial production index and indirectly by the consumer price index respectively?
2. To what extent does each transmission path affect the nominal and the real performance of the economy?
3. What is the "ideal" level of foreign exchange reserves that SEE countries should hold?
4. Is it a proper decision for the SEE countries to eventually join E.M.U. following the Greek example or not?

The aforementioned research questions could be further split or related to the following research objectives of this thesis which are:

RO1: To identify and analyse the monetary transmission mechanism and its channels in the case of SEE in an EMU context.
RO2: To analyse the main concepts, tools and developments in international reserve (foreign exchange reserve) practices in relation to financial stability and monetary efficiency.
RO3: To show that the stability of international reserves in the long run is a prerequisite towards an E.M.U. entrance and the broader co-integration of SEE with E.M.U. and E.U.
RO4: To test and relate foreign exchange reserves with the stability of the exchange rate regimes and exchange rate values overtime in the case of South Eastern Europe (SEE).
RO5: To identify and analyse the factors that drive exchange rates in the Balkans (South Eastern Europe). The theories of purchasing power parity (PPP), interest rate

parity (IRP) will be tested and will be related to real economic performance and if applicable to foreign exchange reserves.

RO6: To evaluate and measure the stability of exchange rate regimes in SEE countries.

RO7: To draw macroeconomic policy design recommendations for SEE Central Banks and governments.

The main methodology that will address these research objectives is G-VAR, i.e. a type a simultaneous equation system which is suitable, as it will be discussed and justified later, for this multi-country case in the context of EMU.

At the empirical level, it has to be noted, that this thesis incorporates the above, and to the best of our knowledge, a G-VAR model has not been used to address the transmission mechanism and its relation to aforementioned variables in the case of SEE and furthermore in their relation to the EMU.

Overall, the objective of this thesis is, first, to develop a model that associates the international reserves not only with exchange rate regimes, but additionally with real and nominal variables like IPI and CPI respectively and second, to do so in relation to economic policy and especially monetary policies in the case of South Eastern European countries (SEEC) within a broader context of and in relation to the European Monetary Union (EMU). The conclusions of this work are expected to be incorporated into further theory building within the broader area of monetary economics focusing both on monetary transmission mechanism and foreign exchange regimes and reserves.

2. Literature review

The primary interest of this literature review is to determine how the monetary transmission mechanism works and to show how a nominal variable like interest rates eventually alters the performance of real economy that could be approximated indicatively by Industrial production index (IPI), considering the Consumer Price Index (CPI) as an additional link between the real and the nominal economy. CPI could be seen as a key variable that at the same time absorbs a part of the monetary 'waves' and also works as an indicator that quantifies the relation of the accumulated productivity of an economy to realized and demanded output. Thus, it must be considered as a 'bridge' variable within the final simultaneous system of equations that will allow us to determine the dynamics, the channels and the 'Granger causalities' of the system as a whole, which means that it must be included and reviewed. The aforementioned variables are related directly and indirectly to exchange rates, exchange rate regimes and the maintained foreign exchange reserves of the central banks (CBs) and thus these variables must be reviewed too, by

considering the related literature within the context and the research interests of the investigated topic.

Thus, within this literature review part, we will initially present and elaborate the monetary transmission mechanism focusing on money and market rates and issues related to monetary policy 'coordination' and monetary policy 'discretion', and then we will proceed to foreign exchange reserves and regimes to establish the framework that will allow us to make a synthesis of the aforementioned variables that will enable us to better capture their effect or their relation to the real and nominal economy as they are approximated by the IPI and CPI respectively.

2.1 Monetary transmission mechanism

Within this framework we will initially focus on a monetary policy overview and we will then proceed to the monetary transmission mechanism, addressing separately both the interest rate channel and the credit channel. It has to be noted that financial markets and information asymmetry will be considered too. Current monetary paradigms based on nominal anchors, Inflation-targeting as a dominant monetary paradigms and exchange rate targeting as intermediary monetary targets will act as channels relating all parts of this research. The level of pass-through as a criterion for determining the exchange rate regime and the euroization (dollarization) as it is applicable in some SEE countries will be addressed, given that it is an inevitable aspect of the monetary policy in the emerging markets like the one of FYROM, but of Bulgaria and Serbia too.

Defining the mechanism: the monetary transmission

According to Taylor (1995) the monetary transmission mechanism is the "process through which monetary policy decisions are transmitted into changes in real GDP and inflation" (p. 11). Broadly speaking we could define the mechanism as the process that incorporates the effect of nominal to real variables and vice versa. Researchers in order to explain and capture the tendencies of the monetary mechanism impose emphasis on and are interested in variables like interest rates, money supply in its relation to monetary base, exchange rates and asset prices. Also within this context, the role of financial institutions and banks is taken under consideration. More specifically econometricians that aim to capture and quantify the relationship between the monetary policy shocks and the real output, focus mainly on three types of variables: the exchange rates, the short-term interest rates and the long-term rates too.

Boivin et al. (2010) have provided a literature review of the ways that monetary policy is conducted and they have focused on how the monetary

transmission mechanism works. Analytically, central banks purchase specific assets that vary over-time or over-space and they do so partially expecting the 'markets' to buy the greater proportion. They could aim indicatively to cause an influence on consumption through wealth effects something that could be understood within the broader context of open market operations. A recent change of monetary policy conducting from the central banks involves the purchase of different type of assets that are related, apart from corporate bonds, to real estate assets (mortgages) something which is done by focusing mainly on the prices of the assets instead of their evaluation (Issing, 2011).

Devereux and Engel (2007) focus on exchange rate fluctuations within the context of monetary transmission mechanism. They stress that even though domestic goods and services are price sticky, in domestic currency terms, the nominal exchange rate changes alter the value of the real exchange rate. These changes according to the aforementioned researchers are incapable of capturing the comparative prices of identical or similar products internationally and thus they could vary significantly. This could be attributed to the fact that the 'pass-through' of the exchange rates to retail prices is rather limited and thus the fluctuations tend to be around to the real exchange rate. However, it would be good to note that the 'pass-through' to the prices of some intermediate goods could be statistically significant and thus it could cause an effect on expenditure patterns. Overall, Devereux and Engel (2007) capture the 'trade-off' that seems to exist between the exchange rate volatility (which could increase the expenditure significantly) and, on the other hand, the inefficiency of it when it is around the real exchange rate (within the PPP context), signals towards the implementation of fixed exchange rate regime or the entrance to a currency union like the euro zone.

It has been noted that in developing countries or countries that are under international aid and programs the monetary transmission mechanism seems to be rather unstable and consequently less effective, something which is attributed to underdeveloped or undercapitalized financial intermediaries. For example, Fetai (2013) focuses on the macroeconomic effects of economic policy, both monetary and fiscal, and their supplementary role in stabilizing the economy in the case of a small open economy (FYROM).

2.1.3 The Interest rate channel

Nominal and real interest rates tend to vary based on the changes of 'rational expectations' and the stickiness of goods and wages (Taylor, 1995). The theory supports that at least in the short-run, an increase both in the nominal interest and the exchange rate could lead to a subsequent rise of the real interest and real exchange rate, respectively. On the other hand, in the long-run, real interest and real exchange rates reach their 'equilibrium' along the adjustment of prices and expectations. Given

that prices tend to be sticky (mainly downwards) inflation tends to persist in not changing at least in the case that the change of interest rates is not that persistent or unexpected.

Researchers, including Calvo et al. (1995) support that monetary stability can be sustained in the case of an open economy by setting a nominal anchor that could be either the nominal exchange rate or the money supply. Such a neoclassical claim is counter-argued by researchers that support that institutions, at least in the short-run, target real variables like the real exchange and the real interest rate.

The "interest-rate smoothing" i.e. the frequent and relatively small change of the interest rate could be inefficient due to the fact that the macroeconomic policy tends to work with an inertia and to such a large extend (Sack and Wieland, 2000). However, minor adjustments of the short-run interest rate are commonly being used by CBs. The aforementioned scholars support that the interest rate 'smoothing' could be efficient or even better close to an optimum if three criteria are met: first, the 'forward looking' behaviour of all market participants, second, if the measurement of the 'error' is related and reset according to some of the main macroeconomic variables takes place, and third, if the involved uncertainty that concerns the main structural parameters is also implemented. On top of that, their CBs also consider the forward-looking expectations, uncertainty related to data, and last but not least, involved uncertainty in the parameters.

Overall, the key optimization question that CBs must answer is: how often and to what degree the interest rate should be altered for its given relation to the main macroeconomic variables? Taylor (1995) claims that the solution is an 'interest rate rule' that is based on changes of two key variables that are the result of the taken differences of four variables, i.e. the difference between the realized and the targeted inflation, and the difference between the nominal and the potential or trend output. It is good to note here that the trend or potential output is not an actual variable but a proxy that is the result of the average growth. Furthermore, the variation of the real exchange rate suggests inverse changes in net exports (deflated one) and thus altering the real output too. Differently stated, aggregate consumption and fixed capital formation (investment) as part of the real output are negatively related to the real interest rate.

2.2 Foreign exchange rates: the regimes, the reserves and the value

Literature on foreign exchange reserves and foreign exchange shows that there is no "ideal"-"correct" exchange rate regime for all countries at all times (Frankel, 1999) and that the concept of "ideal"-optimal reserves is apart from multi-factorial, dynamic and not of primary importance if other key macroeconomic variables are co-integrated between the member states that make a union.

Exchange rate stability is considered to be a prerequisite for economic and financial integration, but also it could be used, in its relation to international reserves, as an index that can capture the condition and the dynamics of an economy within the broader context and the evolution of the European Monetary Union. Key economic variables like international reserves, inflation, expected inflation, growth rates, output gaps and interest rates, to name but a few, and key theories like Purchasing Power Parity, Interest Rate Parity and Balance of Payments, are interrelated one to another and all could be used in order to understand the stability of exchange rate regimes and the related stationarity of the exchange rates that could lead in the medium or in the long run to a real economic and financial integration of SEE countries to European Union (E.U.).

The above mentioned variables and theories are related to macroeconomic policy design and its implications in a bi-directional manner, i.e. running in both ways, a fact that further increases the complexity of the topic. It is important to note, that such a complexity that goes along with lag issues too, can be quantified and addressed to its details with a GVAR model. A model that according to Ericsson and Reisman (2012) depicts several interesting features from multiple potential channels for the international transmission of macroeconomic and financial shocks, to a standardized economically appealing choice of variables for each country or region examined that captures the systematic treatment of long-run properties through cointegration analysis, and by preserving at the same time the flexible dynamic specification through Vector Error Correction ModellingModelling (VECM).

2.2.1 Optimum Currency Area (OCA)

One of the key points of this research is to conclude if the non eurozone members of SEE should eventually join EMU and in order to answer such a question we have to initially review the concept of the Optimum Currency Area (OCA) that was introduced in the literature by Mundell (1961). An OCA, or alternatively known as OCR (optimal currency region) is any geographical region that would be better off economically (i.e. economic efficiency would be maximized) if the region as a whole ended up sharing a single common currency. It focuses on the optimal characteristics that would allow the merger of currencies to occur and thus the creation of a new currency would be realized. This theoretical concept is commonly used to argue if a region could become a currency union or not, something that could be seen as one of the final stages in economic integration and not as a step towards it, as it seems to be the case of the EMU. No need to state that OCA is expected to be larger than a single country. According to Baldwin and Wyplosz (2004) euro was created based on the argument that individual European countries do not form an optimal currency area on their own, but Europe as a whole does. The OCA theory has been used extensively

in recent years in the case of EMU and EU and it is commonly argued (indicatively see Krugman (2015) and Ricci (2008)), that the region did not meet the criteria for an OCA to occur and that happened not only at the time the euro was introduced but also on the coming years. The economic 'difficulties' that the area is facing are attributed to this and to the collective failure of EMU and EU to move towards an actual OCA.

It would be interesting to provide here a statement of the famous economist Milton Friedman that opposed the idea before its implementation. He stated in *Times (November 19, 1997)*:

Europe exemplifies a situation unfavourable to a common currency. It is composed of separate nations, speaking different languages, with different customs, and having citizens feeling far greater loyalty and attachment to their own country than to a common market or to the idea of Europe.

Friedman and other scholars stress the obvious, that these differences impose a real constraint on the key factor of the procedure towards an OCA, which is the labour mobility. Thus, even if EU meets some measures that characterize an OCA, the low labour mobility (an enormously low one compared to USA) combined with the fact that the region seems not to be willing to move towards a fiscal federalism that could mitigate the regional economic differences and the different ability of each part of the zone to absorb internal and external shocks. Some authors though argue that the EU and EMU crisis pushed towards more federalization in a fiscal policy context (Caporaso et al., 2014).

2.2.2 Foreign exchange reserves

Another important issue that must be addressed in its relation to the aforementioned variables is the one of the international reserves and specifically the foreign exchange reserves (also known as forex reserves). It has to be noted that reserves seem to be of a greater than expected importance in the case of relatively small, weak and historically not that stable economies and countries, like the ones in South Eastern Europe including Greece, apart from Bulgaria, Romania, Serbia and FYROM. Thus, the optimal level of international reserves, given that they enhance not only the economic but the broader stability of the country, must be considered. Indicatively at this introductory stage, Jeanne and Ranciere (2011) address this issue for emerging market economies. Their primary focus is to determine the optimal level of international reserves for a small open economy that seeks insurance against sudden stops in capital flows, something that really interests the specific investigated countries of this research, given that the supposedly more strong country of SEE i.e. Greece, experienced such an incident in 2015 in a very hard form. The sudden stop of capital flow in the case of Greece ended up to capital controls and other forms of

financial and capital limitations. Such an incident has also occurred in the broader region, and specifically in Cyprus in 2013. The aforementioned authors propose a formula that could determine that "ideal" level.

The financial crisis and the depletion of sizable international reserves, from 'fear of floating' to the 'fear of losing international reserves' is elaborated by Aizenman and Sun (2012) in a rather creative and coherent way. The size of international reserve depletion during the global 2008–2009 crisis, where only about half of the emerging markets drew down their reserves as part of the adjustment mechanism, is discussed and explained. The exchange market pressure and absorption by international reserves, the related emerging markets, and the fear of reserve loss during the 2008–2009 crisis is also discussed by Aizenman and Hutchison (2012) where they evaluate how the global financial crisis emanating from the US was transmitted eventually to emerging markets, a transmission that really interests this thesis given that it focuses on the monetary policy effect and the transmission channels or mechanism from EMU to SEE countries. The monetary transmission mechanism that attempts to explain how policy-induced changes in the nominal money stock or the short-term nominal interest rate impact real variables such as aggregate output and employment will be analysed and will be tested using the proposed methodology of G-VAR for each SEE country separately. The variables that will be used respectively are the short-term nominal interest rate approximated as stated before by the money and market rate, and from the real economy the IPI as a proxy for growth.

The optimal value of international reserves both in emerging and industrialized countries is related or even directly linked to exchange rates and the respective concept of balance of payments that is related in its turn to interest rates. Thus, the importance of other factors like balance of payments and interest rates that are related to the stability of exchange rate must be stressed and this will be done at this introductory stage by focusing on some influential articles of this area. The balance of payment constrained growth and convergence is elaborated, both from a theoretical and from an empirical perspective, by Garcimartin et al. (2014). The authors "dare" to challenge the balance of payments constraint hypothesis that was developed by Thirwall (1979). The commonly "accepted" i.e. "not rejected" hypothesis has been empirically supported ever since. The challengers support that this hypothesis fails to interpret correctly the necessary conditions in order for convergence to occur. They aim to construct a model that is able to reconcile the balance-of-payments-constraint hypothesis with convergence (their work is applied to Organization for Economic Cooperation and Development (OECD) countries). The balance of payments constraint and hypothesis as an explanation of international growth rate differences was also presented by the aforementioned researcher. This influential paper had been supporting and showing since then that if long-run balance of payments equilibrium on current account is a requirement, then a country's long run growth rate can be approximated by the ratio of the growth of exports to the income

elasticity of demand for imports. Even though this ratio is not going to be used directly, but via interest rate, inflation rate and IPI differential between the tested countries, the shocks and possible disequilibrium will be addressed quantitatively within the G-VAR and specifically by using the global variance decompositions (GDCs) and the global impulse response functions (GIRFs). The G-VAR methodology is able to capture the 'Granger causalities' in their bidirectional or unidirectional "patterns" between the SEE countries and EMU and can quantify how sudden changes of the money and market rate of EMU countries can alter the performance of nominal and real variables of these countries.

International reserves and the global financial crisis are presented also by Dominguez et al. (2012). This study examines whether pre-crisis international reserve accumulations, as well as exchange rate and reserve policy decisions made during the global financial crisis, can help to explain cross-country differences in post-crisis economic performance. The international reserves and the rollover risk are analysed additionally by Bianch et al. (2012) focusing on the theoretical framework, in order to quantitatively investigate the optimal accumulation of international reserves as a hedge against rollover risk. The optimal precautionary reserves for low-income countries through a cost-benefit analysis, are also studied by Kim et al. (2011). Their paper develops a cost-benefit approach that allows a quantification of the optimal level of international reserves in low-income countries.

The question, opposed to aforementioned emerging economies, whether industrialized countries hold also the right foreign exchange reserves is addressed by Goldberg et al. (2012). The three researches, all of them being central bankers, discuss how that central banks should hold foreign currency reserves is a key tenet of the post-Bretton Woods international financial order. They stress that the recent growth in the reserve balances of industrialized countries raise questions about what level and composition of reserves are "right" for these countries. According to them, a look at the rationale for reserves and the reserve practices of selected countries suggests that large balances may not be needed to maintain an effective exchange rate policy over the medium and long-term. Moreover, countries may incur an opportunity cost by holding funds in currency and asset portfolios that, while highly liquid, produce relatively low rates of return.

Last but not least, indicatively at this stage of this research, optimal holdings of international reserves and self-insurance against sudden stop are analysed through a Probit model, to stress a methodological tool, by Calco et al. (2012). On this paper the issue of the optimal stock of international reserves is addressed in terms of a statistical model in which reserves affect both the probability of a 'Sudden Stop' –as well as associated output costs– by reducing the balance-sheet effects of liability dollarization.

3. Data

3.1 Data availability

The data that are downloaded, in order to answer empirically the research questions and objectives, come from different sources like European Central Bank, Eurostat, National Statistical Services of the investigated countries, South Eastern Central Banks and Over-the-Counter (OTC) Interbank.

The required data for all five variables are available and described for the investigated countries i.e. Greece, Bulgaria, Romania, Serbia and FYROM. The variables are IPI (industrial production index), consumer price index (CPI), foreign exchange rate, foreign exchange reserves and interest rate. However, some limited access to foreign exchange reserves applies in the case of FYROM in terms of the start date, but it has to be noted that the Central Banks of this specific SEEC provide access to the variable if it is requested to. The same applies for the start date of foreign exchange reserves in the case of Greece but to a lower extend.

3.2 Data Description

In this section all five variables for the five investigated countries will be presented graphically and described analytically one by one. The data range (start and end date), frequencies, units of measurement and sources will be stated.

[...]

3.2.2 Data Description for the case of Bulgaria

3.2.2.1 Industrial production index (IPI)
The data of IPI are downloaded from the National Statistical Institute of Bulgaria from 1st January of 2000 until 31st of August of 2015. The frequency of data, as stated above is monthly and the units of the index are transformed into percentage changes from the previous year. It has to be noted that 2010 is used as the base year i.e. 2010=100.

Figure 7: Industrial production index (IPI), Bulgaria

BULGARIA INDUSTRIAL PRODUCTION MOM
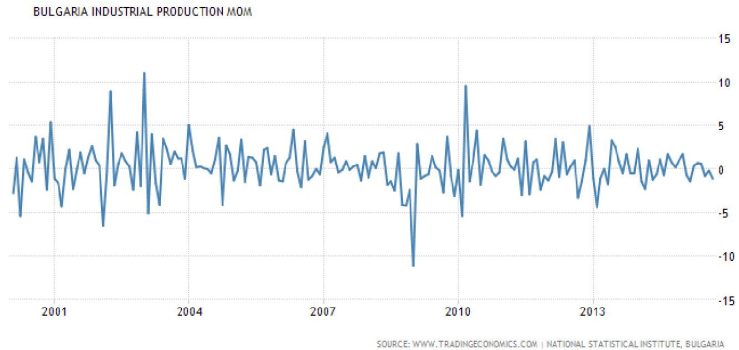
Source: National Statistical Institute of Bulgaria

3.2.2.2 Consumer price index (CPI)

The data is acquired from the National Statistical Institute of Bulgaria from 1st January of 2000 until 31st of August of 2015. The frequency of data is monthly and the units of the index are given in index points. The units will be transformed into percentage changes from the previous year. It has to be noted that 1995 is used as the base year i.e. 1995=100. The start date available is 1st of January of 1990, but the variables from 1990 to 1999 are dropped given that the available start date for all five variables is 2000.

Figure 8: Consumer price index (CPI), Bulgaria

BULGARIA CONSUMER PRICE INDEX (CPI)
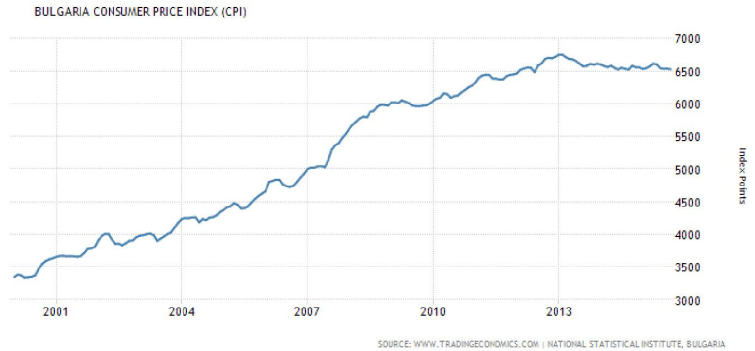
Source: National Statistical Institute of Bulgaria

3.2.2.3 Foreign exchange rate (Leva to dollar rate)

The third variable is foreign exchange rate. The chosen ratio is the Lev/Dollar. The data is downloaded from Over-the-Counter (OTC) Interbank from 1st of January of 2000 to 31st of August of 2015. The frequency of observation is transformed into monthly. The used method of aggregation is average. The values are in Lev to Dollar.

Figure 9: Foreign exchange rate, Lev to Dollar

3.2.2.4 Foreign exchange reserves

The fourth variable is the foreign exchange reserves of the Central Bank.

The data is downloaded from the National Bank of Bulgaria from 1st January of 2000 until 31st of August of 2015. The frequency of the data is on a monthly basis and the values are in millions of Lev. The units will be transformed into percentage changes from the previous year. Prices are current ones.

Figure 10: Foreign exchange reserves, Bulgaria

BULGARIA FOREIGN EXCHANGE RESERVES

SOURCE: WWW.TRADINGECONOMICS.COM | BULGARIAN NATIONAL BANK
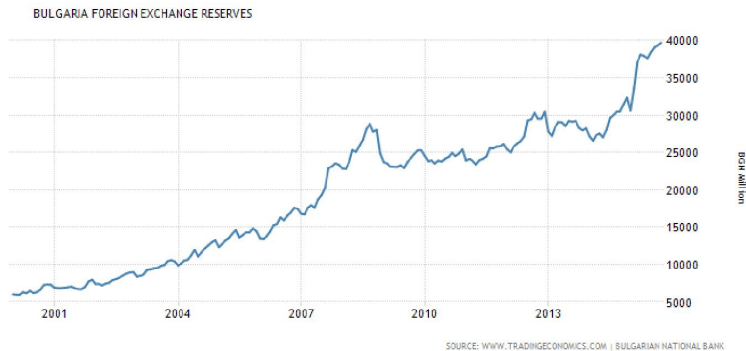
Source: Bulgarian National Bank

3.2.2.5 Interest rate (the money market rate)

The fifth variable is the interest rate (or the money and market rate). We will be using the 1 day interbank rate as a proxy of the interest rate. The data is downloaded from the 1st of January of 2000 to 31st of August of 2015, even though the available start date is 1st of January of 1992. The 1 day rate is chosen, instead of the 3th month one, because the start date of the later is 1st of January of 2005. Values are available in a daily frequency and thus we use an aggregation method (using the average) to transform values into monthly ones. The variable is in percentages. The source is the Bulgarian National Bank.

BULGARIA UP TO 1 DAY INTERBANK RATE

SOURCE: WWW.TRADINGECONOMICS.COM | BULGARIAN NATIONAL BANK

Source: Bulgarian National Bank

[...]

4. A G-VAR model for determining the impact of monetary policy on real and nominal variables of SEE countries in an EMU context

4.1 The Model

There is a growing body of research that uses, amongst other methodologies, G-VAR models to study the interactions of economies. The theory and practice of G-VAR Modelling is broadly discussed by Pesaran (2014) that introduced the model back in 2000 and elaborated and applied it with various co-authors (Dees, S., Di Mauro, Pesaran, M.H., Smith, R. (2007), Pesaran, M.H. and Smith, R. (2006), Pesaran, M.H., Schueramann, T., Treutler, B.J. and Weiner, S.M. (2006) and Pesaran, M.H., Schueramann, T., Weiner, S.M. (2004)).

According to these key researchers the G-VAR has proven to be a very useful approach to analyse interactions in the global macro-economy and other data networks, where both the cross-section and the time dimensions are large. Their work surveys the latest developments in the G-VAR modelling, examining both the theoretical foundations of the approach and its numerous empirical applications.

Moreover, it has to be noted that Pesaran (2014) provides a synthesis of existing literature and highlights areas for future research.

G-VAR models apart from capturing the international co-movement, additionally they are more flexible compared to VAR models in addressing varying co-variation across variables and also they analyse more efficiently the long-run dynamics and the cointegrating properties of the series. A cointegrating G-VAR for example in a Vector Error Correction format could be written as such:

$$\Delta Xit = Biddt - \Pi iZit\text{-}1 + Bi0*\Delta X*it + Uit \quad (1.1)$$

$$\text{where } Zit\text{-}1 = (Xi't\text{-}1, X*it\text{-}1) \text{ and } \Pi i = (I - Bi1, - Bi*0 - Bi*1)$$

A system that clearly shows the structure of the system in addressing, through the incorporation of lagged values, the cross-section and time series relation between the variables and the countries.

On top of that, Impulse response analysis is used to capture and analyse the effect of a typical shock (commonly of a one standard deviation) on the time path of all variables within the system of the equations. Furthermore In a G-VAR specification, impulse response functions could be varying overtime (i.e. are not constant) as they could depend on the time varying distance between monetary fundamentals across different countries (for the fiscal ones see Favero (2013).

4.2 From VAR to GVAR

Given that VAR models were used historically before Global VAR models and in a way they could be seen as a prerequisite to comprehend them, we will briefly introduce them too, to help the reader to capture the relative complexity of this proposed methodology. VAR models that were introduced to the research of applied macroeconomics by Sims (1980) were being used and presented by a considerable number of researchers, such as Brooks (2008), Verbeek (2008), Greene (2002), Baltagi (1998), Thomas (1996), Pesaran et al. (1995), Griffiths et al. (1992) and Epstein (1991)).

As it is widely and econometrically known VAR models (Vector Autoregressive models) are commonly being used for multivariate time series analysis. The structure is the one of a system that uses each variable one by one as a linear function of the current to past lags of itself and past lags of the other related or chosen variables.

In order to provide a mathematical example we consider two different time series variables that are expected to be measured. We denote these two variables by using $yt,1$ and $yt,2$. The Vector Autoregressive model in the case that the research chooses to use only one past value, i.e if it is of a lag one, it is named as a VAR of an

order one, and it is denoted as a VAR(1). Note that the endogenous variables on the left hand side (LHS) of the system are at their current values i.e. at t=0, and the ones on the right hand side (RHS), the exogenous ones are in their lagged forms. The system in a general case, where 'p' stands for the number of lags, a VAR(p), is as follows:

$$y_{1t} = \beta_{10} + \beta_{11} \, y_{11 \, t-1} + \dots + \beta_{1k} \, y_{1 \, t-k} + \alpha_{11} \, y_{2 \, t-1} + \dots + \alpha_{1k} \, y_{2 \, t-k} + u_{1t}$$

$$y_{2t} = \beta_{20} + \beta_{21} \, y_{2 \, t-1} + \dots + \beta_{2k} \, y_{2 \, t-k} + \alpha_{21} \, y_{1 \, t-1} + \dots + \alpha_{2k} \, y_{1 \, t-k} + u_{2t} \quad (1.2)$$

Note, as stated, that each variable is a linear function of the lag p values for all variables in the set and also u_t are the residuals differently noted for each estimated equation.

A VAR(2) will incorporate two lagged values for all variables that are added to the RHS of the two respective equations. The number of lags can be determined with lag length criteria (Brooks, 2014). In the case of two y-variables there would be four variables on the right hand side of each equation, two lag one variables and two lag two variables, and so forth, ending up in general to the VAR(p) model, where the first p lags of each variable in the system will be used as regression predictors for each variable.

It would be good to note that VAR models are a specific case of more general Vector Autoregressive Moving Average models (VARMA). VARMA models for multivariate time series include the VAR structure above along with moving average terms for each variable. Even further, these are special cases of ARMAX models, which are ARMA models with exogenous inputs. This type of model allows the addition of other predictors that are outside the multivariate set of principal interest. This attribute is used within Vector Error Correction models (VECM) where the Error Correction Term (ECT) is used only as an exogenous variable on the right hand side (RHS) of the system of equations and it is also being used within G-VAR when exogeneity, weak or not, is introduced too.

VAR models are more flexible and adaptable than other univariate models as they 'allow the value of a variable to depend on more than just its own lags or combinations of white noise terms' (Brooks 2008, p.291). According to Brooks 'predetermined variables include all exogenous variables and lagged values of the endogenous variables'(Brooks 2008). VARs enable forecasting better than traditional structural models. Sims (1980) states that in comparison with large-scale structural

models VAR processes are more accurate in terms of out-of-sample forecasts, which may be explained by the nature of the identifying restrictions on the structural models. Brooks (2008) maintains that, similarly to ARMA models, VARs are 'atheoretical', as the theoretical information they employ about variable relationships for model specification is rather poor. However, information on the structure of the model is gained by the 'valid exclusion restrictions that ensure identification of equations from a simultaneous structural system' (p.292). According to Brooks, in cases of small samples, 'degrees of freedom will rapidly be used up, implying large standard errors and therefore wide confidence intervals for model coefficients'. VARs do not ensure stationarity of components. However, when stationary variables are required to examine the statistical significance of coefficients, for example, in hypothesis tests, VAR components should be stationary, which is rather questioned by many researchers who favour the application of VAR models.

Stationarity, which is a functional tool in time series analysis, is a process that transforms raw data into stationary ones. To determine whether a series is stationary, the Dickey-Fuller or Augmented Dickey-Fuller unit root test is employed, and the appropriate lag length is determined by Akaike and Schwarz criteria (Maddala, 2009; Gujarati, 2009). In regression models, if x and y series are non-stationary (integrated), representing the x and y relationship as a simple OLS relationship, will generate a spurious regression (Asari et al., 2011). Variable stationarity is typically tested by the Augmented Dickey-Fuller test and the Phillips-Perron test, proposed by Dickey and Fuller (1979) and Phillips and Perron (1988), respectively.

When two or more series are cointegrated, we say that they move together over time, which implies that they are related in the long run (Salvatore and Reagle, 2011; Gujarati, 2009). In order to determine the number of cointegration vectors, the specific process employs two tests, the maximum Eigenvalue test and the Trace test (Johansen and Juselius, 1990).

Granger causality test, on the other hand, enables to determine the direction of the influence of one variable on another in the short run (Maddala, 2009; Gujarati, 2006). Some empirical tests employed in this research, apart from G-VAR, are going to be based on the methodology adopted in the paper of Shuguang and Zaiyong (2008), established earlier on the well-known research of Granger (1969) and further analysed in Quinn et al. (2011).

Lag selection is a rather complicated topic. According to Brooks (2008), plenty of tests can be used to determine lag selection and results do not tend to coincide.

According to Brooks (2008, p.325), Impulse Response Function 'traces out the responsiveness of the dependent variables in the VAR to shocks to each of the variables', while Variance Decompositions 'give the proportion of the movements in the dependent variables that are due to their 'own' shocks, versus shocks to the other

variables' (p.326). In other words, and as stated by Lütkepohl (2008), impulse response functions describe how the economy reacts over time to exogenous impulses, namely shocks (impulses are often modelled in the context of a VAR). Thus, Impulse Response Function describes the reaction of endogenous macroeconomic variables at the time of the shock and over subsequent points in time. VDCs test decompose variance of the forecasted error of a given variable into proportions susceptible to shock in each variable within the model constructed, and IRF, captures the dynamic responses of every dependent variable to one period standard deviation shock to the system (Agung, 2009; Erjavec and Cota, 2003).

It is important to briefly explain the concept of exogeneity given that it links up to a degree the VAR models to G-VAR models. The concept as it is known has been elaborated in an influential and important article of Engle, Hendry and Richard (1983) and as its Greek origin or its etymology clearly suggests, it refers to variables that are generated outside the system or the equation that is being used. The dependent variables, as they are generated within the system, are described as the endogenous ones. The term of exogeneity is useful and applicable to cases where regression equations reciprocate to components of the economy that could be considered as structural entities embodying causal relationships running from the explanatory variables to the dependent variables (Pollock, 1999), a fact that will allow us to quantify the transition mechanism of the monetary policy in our case and to better capture and determine the interdependencies between the SEEC and the EMU and specifically the impact of the EMU money and market rate that is expected to Granger cause unidirectionally the SEE economies.

5 Implemantation of the methodology – Findings, results and analysis

This section is composed of two broader parts. The first part will use and show how the VAR and VECM models are applied for each country separately and the second part will apply the G-VAR model for all five countries at once.

5.1 The VAR and VECM models for each country seperately

On this part we will determine the relationship between the investigated variables using unit root tests, cointegration, Pairwise Granger causality tests, the lag length criteria, VAR, VECM, Impulse response functions and Variance decomposition.

Before we proceed though it is good to briefly consider the structure of the VAR models as it is presented on the table below.

5.1.2 The case of Bulgaria - Empirical tests and the first findings

The empirical tests employed in this part of the research are replicating a methodology that was introduced by the research of Granger (1969) and developed further by Quinn et al. (2011). The methodology uses Granger causality tests within the framework of both Vector Autoregressive Models (VAR) and Vector Error Correction Models (VECM). The applied tests start from the unit root tests and cointegration one and proceed through VAR and VECM to Variance Decompositions (VDCs) and Impulse Response Functions (IRFs). VDCs and IRFs are used in order to capture and analyze further the dynamics of Granger causalities in a broader macroeconomic and open economy context.

It has to be noted additionally that the Classical Linear Regression Model (CLRM) is initially being used (see appendix) even though the problems of autocorrelation and heteroscedasticity are indicatively detected (amongst other problems that violate some key assumptions of CLRM). Thus even though this is not an appropriate methodology to be used, it allows us to construct the Error Correction Term (ECT), which is necessary for the final VECMs. According to Brooks (2008), ECT is the lagged residual of the initial regression, i.e. ECT = u(-1). Notably enough, the residuals are also used as an additional approach that test the cointegrating properties of the variables (this is the Unit root test on residuals approach to cointegration).

5.1.2.1 Test for Stationarity

According to Granger (1987) a condition for cointegrating variables, that has to be met, is that all of them must be integrated of the same order. In order for this to apply, various unit roots tests must be used to determine the order of integration order of all investigated variables. On this part we use the Augmented Dickey Fuller tests (Dickey–Fuller, 1979), by considering three different test specifications, i.e. including intercept, trend and intercept and without trend and/or intercept. All the results concerning the five researched variables at a level of significance and at first difference are available on appendix. On this section we discuss the final and used results that allow us to conclude and to proceed.

Below we can see a table that groups the unit root test. It is clearly indicated that all five variables are not stationary in level i.e. they are not integrated of order zero. A conclusion that can be reached by using the prob-rule or the respective provide statistics (ADF, etc). For a more detatiled presentation see the tables at appendix B.

TABLE: GROUP UNIT ROOT TEST SUMMARY (IN LEVEL)

Group unit root test: Summary
Series: LCPI, LEXC, LFS, I, IP
Date: 01/17/16   Time: 13:08

Sample: 2002M01 2015M12
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.73622	0.0413	5	832
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.33968	**0.3670**	5	832
ADF - Fisher Chi-square	10.6457	**0.3858**	5	832
PP - Fisher Chi-square	12.4911	**0.2535**	5	835

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

The next group table shows also that all five variables are stationary in level, i.e. they are integrated of order one (for all related equations and the respective statistics see appendix B).

TABLE: GROUP UNIT ROOT TEST SUMMARY (IN FIRST DIFFERENCE)

Group unit root test: Summary
Series: DI, DIP, DLCPI, DLEXC, DLFS
Date: 01/17/16   Time: 13:34
Sample: 2002M01 2015M12
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-34.3302	0.0000	5	830
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-30.8177	0.0000	5	830
ADF - Fisher Chi-square	452.694	0.0000	5	830
PP - Fisher Chi-square	452.118	0.0000	5	830

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

It is also good to depict these variables on their first difference on one graph, given that all five variables become stationary in their first difference and given that the the VAR and the VECM will be using those.

Figure: All five variables in their first difference. The case of Bulgaria.
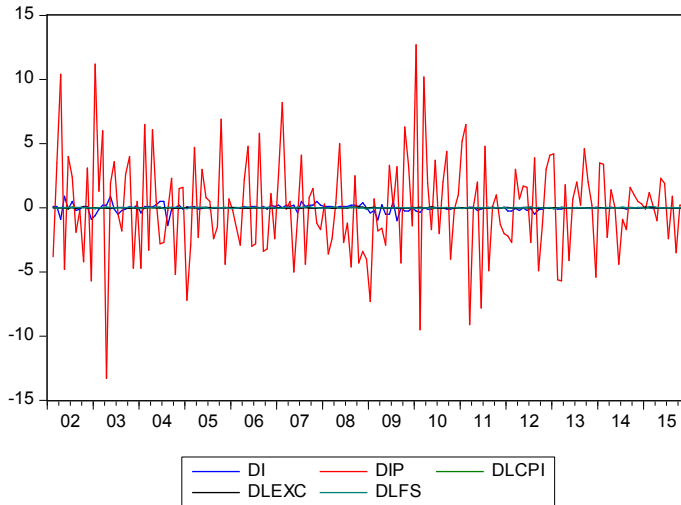
It has to be noted also that the lag length criteria was used and the E-Views generated the table below (using the Schwarz Info Criterion, Akaike, Final Prediction Error etc). All five variables are considered in their first difference i.e. they are all stationary. The results suggests varying lags, i.e. 0, 1 and 7 (see the table below and the appendix too) which means that for the given nature of VAR and VECM we will use 1 and 7 lags. If the number of used lags -as an automatic preset choise within E-Views- is increased to double digit numbers, the 7 lags that are proposed from the LR statistic insist up to a given number of lags, but does not insist in all cases (e.g. if 15 lags are preseted, as an automatic lag selection)then the proposed lag is 12. Note though that the one lag which is suggested by the FPE and AIC is always the proposed number of lag, no matter of the chosen automatically suggested initial number of lags. Overall

the research follows all suggested criteria given in terms of lags (excluding the ones that suggest 0 lags which is not applicable in VAR models). Though it has to be noted that the Lag selection is a rather complicated topic that requires further research. In terms of Brooks (2008), plenty of tests are used to determine lag selection and results do not tend to coincide. The final findings of this first part of the research though keeps on being persistent at different lags.

Table: The lag length criteria

VAR Lag Order Selection Criteria
Endogenous variables: DI DIP DLCPI DLEXC DLFS
Exogenous variables: C
Date: 01/17/16   Time: 13:57
Sample: 2002M01 2015M12
Included observations: 159

Lag	LogL	LR	FPE	AIC	SC	HQ
0	757.9526	NA	5.30e-11	-9.471101	-9.374595*	-9.431911*
1	789.6288	60.96189	**4.88e-11***	**-9.555080***	-8.976041	-9.319938
2	803.9981	26.75039	5.58e-11	-9.421360	-8.359790	-8.990268
3	817.3253	23.97222	6.47e-11	-9.274533	-7.730430	-8.647489
4	835.1628	30.96312	7.12e-11	-9.184438	-7.157803	-8.361443
5	860.6198	42.58843	7.13e-11	-9.190186	-6.681019	-8.171240
6	876.3627	25.34714	8.09e-11	-9.073745	-6.082046	-7.858848
7	916.7643	**62.50799***	6.76e-11	-9.267475	-5.793244	-7.856627
8	933.0016	24.10065	7.70e-11	-9.157252	-5.200489	-7.550453

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5.1.2.2 Testing for Cointegration

The test for cointegration is conducted within the Johansen framework (see Johansen 1988; Johansen and Juselius, 1990). The default parameters specified initially are intercept and no trend (in cointegrating equations (CE) and the lag intervals are 4. After that we assume no deterministic trend in data –a choice that goes along with the properties of some of our variables. Note also that all five assumtions in terms of time trend and intercept are used and the respective table can be seen below). These tests are used, as stated, to check any long–run movement of the five variables.

The specific test was applied in level variables expecting the exhibition of long–run relationships between the variables (Brooks, 2008). More specifically, it is maintained that "as long as the two variables are I(1) and are linearly combined, in most cases we expect their combination to be also I(1)", (ibid, p. 335). It is further argued that cointegration of variables exists if their linear combination is stationary, which implies that two series are moving together in the long run, eventually establishing long –term or equilibrium phenomena. On the figure below all five variables are at level, that is, not differenced, as suggested by Brooks (2008).

Figure: The time graph of all five variables
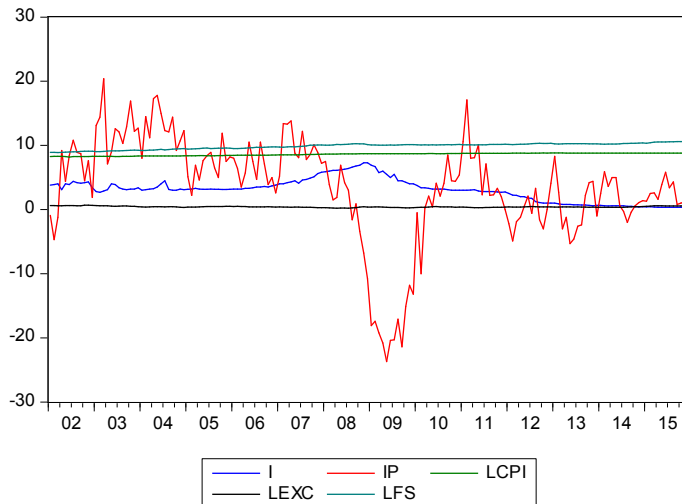
Table: Cointegration tests / The Johansen technique

COINTEGRATION. ALL FIVE VARIABLES IN LEVEL.

Sample (adjusted): 2002M06 2015M12
Included observations: 163 after adjustments
Trend assumption: **Linear deterministic trend**
Series: LCPI LEXC LFS I IP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.262126	79.93872	69.81889	0.0063
At most 1	**0.097356**	**30.38968**	**47.85613**	**0.6989**
At most 2	0.037585	13.69398	29.79707	0.8574
At most 3	0.032716	7.449532	15.49471	0.5260
At most 4	0.012363	2.027722	3.841466	0.1545

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.262126	49.54905	33.87687	0.0003
At most 1	**0.097356**	**16.69569**	**27.58434**	**0.6062**
At most 2	0.037585	6.244453	21.13162	0.9776
At most 3	0.032716	5.421810	14.26460	0.6879
At most 4	0.012363	2.027722	3.841466	0.1545

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Sample (adjusted): 2002M06 2015M12
Included observations: 163 after adjustments
Trend assumption: **No deterministic trend (restricted constant)**
Series: LCPI LEXC LFS I IP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.267684	107.7586	76.97277	0.0000
At most 1 *	0.168359	56.97713	54.07904	0.0269
At most 2	0.096356	26.92738	35.19275	0.2925
At most 3	0.037535	10.41222	20.26184	0.5993
At most 4	0.025296	4.176280	9.164546	0.3865

Trace test indicates **2 cointegrating eqn(s) at the 0.05 level**

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.267684	50.78148	34.80587	0.0003
At most 1 *	0.168359	30.04975	28.58808	0.0323
At most 2	0.096356	16.51515	22.29962	0.2632
At most 3	0.037535	6.235943	15.89210	0.7611
At most 4	0.025296	4.176280	9.164546	0.3865

Max-eigenvalue test indicates **2 cointegrating eqn(s) at the 0.05 level**

The application of the Johansen Technique in testing the cointegrating equations (Brooks, 2008, p. 350-355), demonstrate that a co-integrating relation does exist. Specifically, there is one cointegrating equation at the 5% level of significance, given that the null hypothesis in the remaining four cases is not rejected according to provided prob-values or the respective statistics and the given critical values in the first table above (with linear deterministic trend) and two cointegrating equations if no deterministic trend is chosen). Overall, some variables appear to be cointegrated, which enables incorporating an Error Correction Term (E.C.T.) within the Vector Autoregression Model (VAR) (Brooks, 2008). Thus, the final model applied on this part will be a VECM model and not just a VAR.

Table: GROUP COINTEGRATION SUMMARY

SUMMARIZING 5 COINTEGRATION ASSUMPTIONS

Date: 01/17/16   Time: 13:07
Sample: 2002M01 2015M12
Included observations: 163
Series: **LCPI LEXC LFS I IP**
Lags interval: 1 to 4

Selected
(0.05 level*)
Number of
Cointegrating
Relations by
Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	2	1	1	1

| Max-Eig | 2 | 2 | 1 | 1 | 1 |

5.1.2.3 Vector Autoregression (VAR), Vector Error Correction (VECM), Granger Causality models

If at a VAR model the Error Correction Term (ECT), i.e. residuals with one lag (given that cointegration has been established), then the model becomes a Vector Error Correction Model (VECM); however, prior to this, it should be checked whether the stability condition holds for the VAR, namely, whether the roots are the characteristic polynomial and are within the unit root circle (Brooks, 2008). The stability VAR test is provided in the table below:

Table: Stability test (VAR)

Inverse Roots of AR Characteristic Polynomial
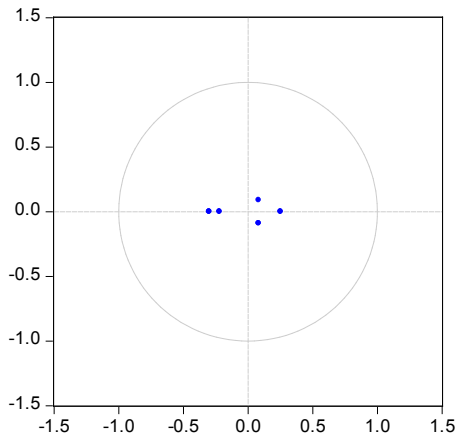
The table that follows is the VAR(1) table that enables using the t-statistics (within the brackets) in order to test the statistical significance of the variables.

Table: VAR(1):

Vector Autoregression Estimates
Date: 01/17/16   Time: 14:09
Sample (adjusted): 2002M03 2015M12
Included observations: 166 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DI	DIP	DLCPI	DLEXC	DLFS
DI(-1)	-0.056831	-1.098462	-0.006237	0.000341	0.000758
	(0.07548)	(1.09501)	(0.00351)	(0.00739)	(0.01005)
	[-0.75294]	[-1.00316]	[-1.77468]	[0.04609]	[0.07546]
DIP(-1)	-0.000878	-0.301007	0.000151	0.000831	0.000441
	(0.00523)	(0.07589)	(0.00024)	(0.00051)	(0.00070)
	[-0.16784]	[-3.96652]	[0.61968]	[1.62116]	[0.63278]
DLCPI(-1)	-1.453968	-20.64662	-0.067133	-0.204698	0.151116
	(1.68071)	(24.3829)	(0.07826)	(0.16465)	(0.22381)
	[-0.86509]	[-0.84677]	[-0.85783]	[-1.24320]	[0.67519]
DLEXC(-1)	0.475752	3.505702	-0.043933	0.212310	0.075278
	(0.79017)	(11.4634)	(0.03679)	(0.07741)	(0.10522)
	[0.60209]	[0.30582]	[-1.19407]	[2.74266]	[0.71541]
DLFS(-1)	**2.386397**	4.587770	0.014164	-0.038750	0.108953
	(0.59525)	(8.63560)	(0.02772)	(0.05831)	(0.07927)
	[4.00906]	[0.53126]	[0.51101]	[-0.66450]	[1.37451]
C	-0.042775	0.031161	0.002912	0.000830	0.008577
	(0.02208)	(0.32034)	(0.00103)	(0.00216)	(0.00294)
	[-1.93718]	[0.09728]	[2.83221]	[0.38385]	[2.91683]
R-squared	0.107145	0.100675	0.038795	0.067728	0.018578
Adj. R-squared	0.079243	0.072571	0.008757	0.038595	-0.012091
Sum sq. resids	10.93991	2302.496	0.023719	0.104995	0.193998
S.E. equation	0.261485	3.793494	0.012176	0.025617	0.034821
F-statistic	3.840067	3.582224	1.291549	2.324751	0.605763
Log likelihood	-9.819506	-453.8140	499.2937	375.8201	324.8635
Akaike AIC	0.190596	5.539927	-5.943298	-4.455664	-3.841729
Schwarz SC	0.303078	5.652409	-5.830816	-4.343183	-3.729247
Mean dependent	-0.021687	0.033133	0.002990	-0.000230	0.010138
S.D. dependent	0.272505	3.939118	0.012229	0.026126	0.034612

Determinant resid covariance (dof adj.)	1.09E-10
Determinant resid covariance	9.06E-11
Log likelihood	741.6325
Akaike information criterion	-8.573886
Schwarz criterion	-8.011479

For the given values of t-statistics within brackets, a Granger causality seems to run from Foreign Reserves to Interest rate (with a positive sign) suggesting a uni-directional causality that we will elaborate further in the coming tests. This is the strongest finding holding in 0.01 level of significance and it will be captured again strongly in VECM where additionally will be determinded that this uni-directional Granger causality holds in the short run and not in the long run.

Table: Pairwise Granger Causality Tests, with 1, 7 and 12 lags
The Pairwise Granger Causality Tests with 1 lag
Pairwise Granger Causality Tests
Date: 01/17/16   Time: 14:01
Sample: 2002M01 2015M12
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
DIP does not Granger Cause DI	166	0.11101	0.7394
DI does not Granger Cause DIP		1.16908	0.2812
DLCPI does not Granger Cause DI	166	1.57568	0.2112
DI does not Granger Cause DLCPI		**3.18113**	**0.0764**
DLEXC does not Granger Cause DI	166	0.96068	0.3285
DI does not Granger Cause DLEXC		0.07085	0.7904
DLFS does not Granger Cause DI	166	17.7609	**4.E-05**
DI does not Granger Cause DLFS		0.00328	0.9544
DLCPI does not Granger Cause DIP	166	1.05080	0.3068
DIP does not Granger Cause DLCPI		0.83069	0.3634
DLEXC does not Granger Cause DIP	166	0.20718	0.6496
DIP does not Granger Cause DLEXC		**3.04497**	**0.0829**
DLFS does not Granger Cause DIP	166	0.36172	0.5484
DIP does not Granger Cause DLFS		0.25654	0.6132

Null Hypothesis:	Obs	F-Statistic	Prob.
DLEXC does not Granger Cause DLCPI	166	1.42575	0.2342
DLCPI does not Granger Cause DLEXC		1.70623	0.1933
DLFS does not Granger Cause DLCPI	166	0.08054	0.7769
DLCPI does not Granger Cause DLFS		0.37393	0.5417
DLFS does not Granger Cause DLEXC	166	0.36044	0.5491
DLEXC does not Granger Cause DLFS		0.37442	0.5415

The Pairwise Granger Causality Tests with 7 lags
Pairwise Granger Causality Tests
Date: 01/17/16   Time: 14:03
Sample: 2002M01 2015M12
Lags: 7

Null Hypothesis:	Obs	F-Statistic	Prob.
DIP does not Granger Cause DI	160	2.03281	0.0548
DI does not Granger Cause DIP		**3.96453**	**0.0005**
DLCPI does not Granger Cause DI	**160**	**3.75609**	**0.0009**
DI does not Granger Cause DLCPI		1.01577	0.4226
DLEXC does not Granger Cause DI	160	1.65126	0.1256
DI does not Granger Cause DLEXC		1.38856	0.2144
DLFS does not Granger Cause DI	**160**	**2.57736**	**0.0156**
DI does not Granger Cause DLFS		0.78500	0.6009
DLCPI does not Granger Cause DIP	160	1.20789	0.3021
DIP does not Granger Cause DLCPI		1.05516	0.3956
DLEXC does not Granger Cause DIP	160	0.81871	0.5732
DIP does not Granger Cause DLEXC		0.95481	0.4667
DLFS does not Granger Cause DIP	160	0.13898	0.9950
DIP does not Granger Cause DLFS		0.21430	0.9817
DLEXC does not Granger Cause DLCPI	160	1.14312	0.3395
DLCPI does not Granger Cause DLEXC		1.15736	0.3310
DLFS does not Granger Cause DLCPI	**160**	**3.66940**	**0.0011**
DLCPI does not Granger Cause DLFS		**3.20029**	**0.0035**
DLFS does not Granger Cause DLEXC	160	0.19360	0.9864
DLEXC does not Granger Cause DLFS		0.83585	0.5593

The Pairwise Granger Causality Tests with 12 lags
Pairwise Granger Causality Tests
Date: 01/17/16   Time: 14:08
Sample: 2002M01 2015M12
Lags: 12

Null Hypothesis:	Obs	F-Statistic	Prob.
DIP does not Granger Cause DI	**155**	**3.10144**	**0.0007**
DI does not Granger Cause DIP		1.82261	0.0507
DLCPI does not Granger Cause DI	155	1.74346	0.0647
DI does not Granger Cause DLCPI		0.56964	0.8632
DLEXC does not Granger Cause DI	**155**	**2.64221**	**0.0034**
DI does not Granger Cause DLEXC		0.88631	0.5626
DLFS does not Granger Cause DI	**155**	**2.37388**	**0.0085**
DI does not Granger Cause DLFS		0.86128	0.5877
DLCPI does not Granger Cause DIP	155	1.45190	0.1508
DIP does not Granger Cause DLCPI		1.16689	0.3136
DLEXC does not Granger Cause DIP	155	1.31298	0.2186
DIP does not Granger Cause DLEXC		0.80442	0.6454
DLFS does not Granger Cause DIP	155	0.59576	0.8425
DIP does not Granger Cause DLFS		0.30086	0.9883
DLEXC does not Granger Cause DLCPI	155	1.01280	0.4410
DLCPI does not Granger Cause DLEXC		1.02335	0.4315
DLFS does not Granger Cause DLCPI	155	1.24764	0.2579
DLCPI does not Granger Cause DLFS		2.42732	0.0071
DLFS does not Granger Cause DLEXC	155	0.31806	0.9851
DLEXC does not Granger Cause DLFS		0.56146	0.8694

As we can observe on the tables above the most persistent findings are the one already captured by the VAR(1), i.e. the Granger causality running from Foreign Reserves (FS) to (Interest rate)I at 0.01 level of significance, but additionaly at the same level of significance with 7 lags (see the VAR(7) on appendix too) the Granger causality is running from Interest rate to Industrial Production, from inflation (CPI) to Interest rates and also there is a bidirectional Granger causality between FS and CPI. At 0.05

level of significance, the Granger causality is running from FS to I also at the VECM(7) with 4 variables excluding the exchange rate, which is a variable that gives only a weak finding overall, holding at 0.10 level of significance (Granger causality running from IP to EXC, along with another weak finding, i.e. Granger causality running from I to CPI).

It is worth noting that the above Granger causalities are observed apart from the above stated VARs in the VECM(1), VECM(7) (see the appendix).

Table: VECM

Vector Autoregression Estimates
Date: 01/17/16   Time: 14:23
Sample (adjusted): 2002M03 2015M12
Included observations: 166 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DI	**DIP**	DLCPI	DLEXC	DLFS
DI(-1)	-0.057811	-0.588582	-0.006909	0.002092	0.002338
	(0.07682)	(1.08840)	(0.00356)	(0.00748)	(0.01020)
	[-0.75259]	[-0.54078]	[-1.93910]	[0.27967]	[0.22916]
DIP(-1)	-0.000902	-0.288470	0.000134	0.000874	0.000480
	(0.00526)	(0.07448)	(0.00024)	(0.00051)	(0.00070)
	[-0.17160]	[-3.87293]	[0.55127]	[1.70695]	[0.68693]
DLCPI(-1)	-1.472174	-11.18050	-0.079605	-0.172186	0.180441
	(1.70307)	(24.1304)	(0.07899)	(0.16585)	(0.22620)
	[-0.86443]	[-0.46334]	[-1.00775]	[-1.03822]	[0.79772]
DLEXC(-1)	0.467945	7.565262	-0.049282	0.226253	0.087854
	(0.79933)	(11.3256)	(0.03708)	(0.07784)	(0.10617)
	[0.58542]	[0.66798]	[-1.32924]	[2.90663]	[0.82752]
DLFS(-1)	2.391535	1.916240	0.017683	-0.047926	0.100677
	(0.60096)	(8.51491)	(0.02787)	(0.05852)	(0.07982)
	[3.97950]	[0.22505]	[0.63440]	[-0.81893]	[1.26132]
C	-0.042793	0.040387	0.002900	0.000862	0.008605
	(0.02215)	(0.31386)	(0.00103)	(0.00216)	(0.00294)
	[-1.93184]	[0.12868]	[2.82240]	[0.39963]	[2.92493]
ECT	0.001381	**-0.717909**	0.000946	-0.002466	-0.002224
	(0.01826)	(0.25873)	(0.00085)	(0.00178)	(0.00243)
	[0.07561]	**[-2.77474]**	[1.11677]	[-1.38661]	[-0.91701]

The Error Correction term is statistically significant in the case of the second equation (see all equations-representations on appendix too) at a 0.01 level of significance. A finding that could be characterized as a strong and a also a consistent one with the cointegration properties of the five variables, suggesting a long run Granger causality running from one or two variables to IP. The Impulse Response Functions and the Variances decomposition will allow us to determine which variable or variables are the ones that cause the long run relationship. The ect also is negative which stress the long run properties of the co-movement of the investigated variables.
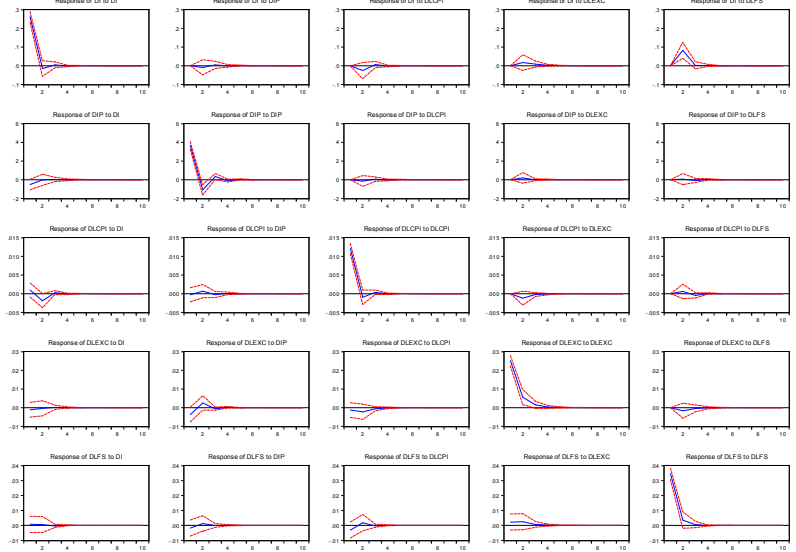
5.1.2.4 Variance Decompositions (VDCs) and Impulse Response Function (IRF)

We will start this section by defining initially both Impulse Response Functions and Variance Decompositions. Indicatively Brooks (2008, p.325) defines the first one as a process that "traces out the responsiveness of the dependent variables in the VAR to shocks to each of the variables" and the latter one as process that quantifies "the proportion of the movements in the dependent variables that are due to their "own" shocks, versus shocks to the other variables" (p.326). Differently stated (Lütkepohl, 2008) Impulse Response Functions capture how the economically and finance related times series variables react to exogenous "impulses", named alternatively as shocks.

By using Impulse Response Functions within the context of VAR models and by assuming initially "no responses at standard errors" we can obsere on the provided tables below that the "Impulse responses" indicate the usage of mainly one lag for all investigated series, a fact that is consistent with the statistical significance of the parameters within the VAR model in the case of one used lag. Also, it is has to be noted that all five variables are treated as Impulses and Responses and the automatic selection of the ten periods of E-Views is kept as set, an assumption that seems to be an appropriate one and also it is further supported by the VAR Lag exclusion Wald tests. Additionally though within VECM by using t and F statistics we capture simple causalities existing within the specific used sample, which means that insufficient evidence of the dynamic properties of the model is provided. A limitiation that we could overcome by using Variance Decompositions (Brooks, 2008).

Table: Impulse response functions

Response to Cholesky One S.D. Innovations ± 2 S.E.
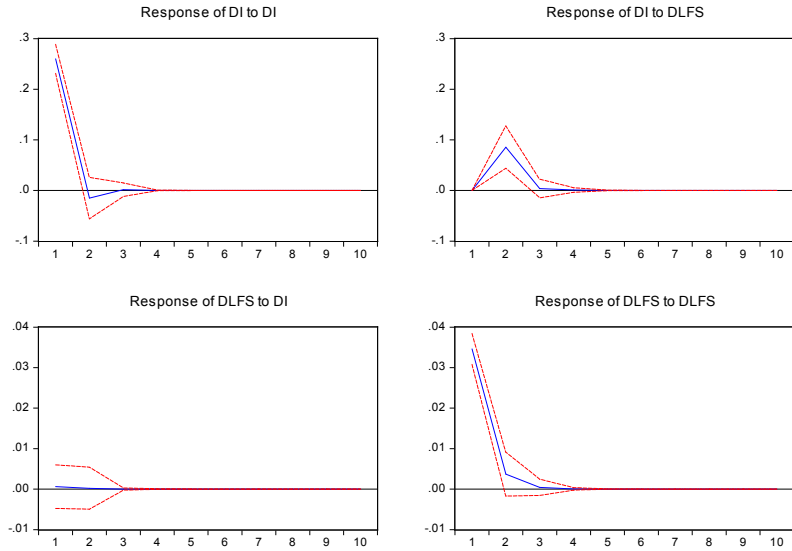
Variance Decompositions are techniques that partition the Variance of the Forecasted Error for every used variable. Something that can be done by splitting into proportions the shocks in each variable within the model constructed. Differently stated this decomposition of variance captures the part of information each series contributes to the other series witin the VAR or VEC model. It can determine what part of the forecasted Error Variance of each variable can be explained by the external shocks to the other related variables (Erjavec and Cota, 2003; Agung, 2009).

Table : Variance Decomposition

VARIANCE DECOMPOSITION WITH ONE LAG

Varian
ce
Decom
position

of DI:

Period	S.E.	DI	DIP	DLCPI	DLEXC	DLFS
1	0.261485	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.276507	89.71430	0.061682	**0.908826**	**0.429432**	8.885765
3	0.276741	89.57701	0.088044	**0.937810**	**0.516085**	8.881046
4	0.276763	89.56588	0.088500	**0.942474**	**0.520109**	8.883041
5	0.276764	89.56526	0.088611	**0.942502**	**0.520415**	8.883211
6	0.276764	89.56522	0.088616	**0.942528**	**0.520428**	8.883211
7	0.276764	89.56521	0.088617	**0.942528**	**0.520429**	8.883211
8	0.276764	89.56521	0.088617	**0.942528**	**0.520429**	8.883211
9	0.276764	89.56521	0.088617	**0.942528**	**0.520429**	8.883211
10	0.276764	89.56521	0.088617	**0.942528**	**0.520429**	8.883211

Variance Decomposition
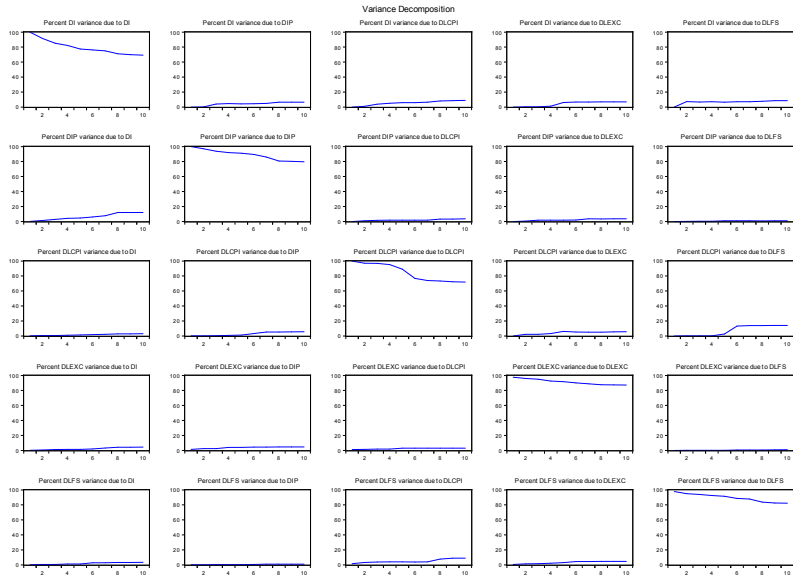
For all applied related tests and tables see the appendix. It would be good though to comment the long run Granger Causality, that seems according to the tables above to run mainly from CPI and EXC to I. A finding that adds to the overall understanding

of the dynamic behaviour of the variables and also seems to go along with the related economic theory. Overall, we could say that in the case of Bulgaria, for this given data set (from 2002-2015) the determinants of the Interest rates (between these chosen variables) seem to be the Foreign Reserves in the short run and the inflation (CPI) and the exchange rate (EXC) in the long run.

6 Conclusion

Overall, wraping up the above results we could support that Granger Causality runs from exogenous variable/s to industrial production on the long run at 0.01 level of significance. The ECT is negative, showing quick adjustment after the shocks. Variance decomposition and impulse response functions suggest that the long run Granger causality runs from Interest rates to Industrial Production. At 0.01 level of significance within VECM(1) there is a Granger Causality running from Foreign reserves to Interest rates in the Short Run, and from CPI to Exchange Rates in the Long run (PPP holds). Within VECM(7) Granger Causality runs from Interest rate to Industrial Production (at 0.01 level of significance). Note that signs are as expected i.e. lower rates higher IP.

On top of that, in the context of policy implications someone could suggest that If the above are combined then there is a policy implication that shows if the Central Bank of Bulgaria decreases the foreign reserves (it will happen when/if Bulgaria joins EMU) then Interest rates will go down and thus IP will be further boosted, thus it could work as a constant stimulus of growth etc.

Overall, macroeconomic policy analysis, design and application require taking under consideration interdependencies that exist across markets, regions, union blocks (like E.U. and E.M.U) and economies. At the same time national economies must be considered both from a global and a domestic perspective and transmission channels must be studied and understood.

A GVAR model of the global economy is a model that allows us to further elaborate on the above and relate all five countries. Specifically, GVAR allows us to analyse and capture the interdependencies within a macroeconomic context and furthermore to understand the transmission channels and the responsiveness of economies to both external and internal shocks that are related to the effects of changing macroeconomic conditions.

This research contributes both on an academic and practical level in a number of directions including the broader area of G-VAR and its extensions, the area of international economics and relations, monetary economics, economic and macroeconomic policy design and implementation and real growth too.

Bibliography

Agung, G. (2009). *Time Series Data Analyses Using E-Views*. Chichester. Wiley.

Aizenman, J. & Hutchison, M.M. (2012). The Exchange market pressure and absorption by international reserves: Emerging markets and fear of reserve loss during the 2008–2009 crisis, *Journal of International Money and Finance*, Elsevier.> [Accessed 16.06.2015].

Aizenman, J. & Sun, Y. (2012). The financial crisis and sizable international reserves depletion: From 'fear of floating' to the 'fear of losing international reserves'?, *International Review of Economics & Finance,* Elsevier. > [Accessed 16.06.2015].

Alexander, C. (2001). *Market models: A guide to financial data analysis*. John Wiley & Sons Ltd.

Alogoskoufis, G. S. and Philippopoulos, A. (1992) Inflationary expectations, political parties and the exchange rate regime: Greece 1958-1989. *European Journal of Political Economy*, 8(3), pp. 375-399.

Aristei, D. & Gallo, M. (2012). The Relationship Between Bank and Interbank Interest Rates during the Financial Crisis: Empirical Results for the Euro Area. Available from: <http://economics.soc.uoc.gr/macro/docs/Year/2012/papers/paper_3_70.pdf>. [Accessed 30.05.2015].

Arnone, M. & Romelli, D. (2013). Dynamic central bank independence indices and Inflation rate: A new empirical exploration. *Journal of Financial Stability.* Elsevier. Vol.9(3). pp. 385-398.

Asari, F. F. A. H., Baharuddin, N. S., Jusoh, N., Zuraida Mohamad, Shamsudin, N. & Jusoff, K. (2011) A Vector Error Correction Model (VECM) Approach in Explaining the Relationship Between Interest Rate and Inflation Towards Exchange Rate Volatility in Malaysia. *World Applied Sciences Journal* 12. pp. 49-56.

Baldwin, R., Wyplosz, C. (2004). *The Economics of European Integration*. New York: McGraw Hill.

Balassa, B. (1964) The Purchasing-Power Parity Doctrine: A Reappraisal. *Journal of Political Economy*, 72(6), pp. 584-96.

Baltagi, B. H. (2002). *Econometrics* (3rd ed.). Berlin: Springer-Verlag.

Baltas, N. C. (2013) *The Greek financial crisis and the outlook of the Greek economy*. [Online]. Available from: http://www.econ.aueb.gr/en/uploadfiles/AllDP192013.pdf [Accessed 05.09.2015].

Beetsma, R.M., Debrun, X., Klaasen, F. (2001). Is fiscal policy coordination in EMU desirable? *International Monetary Fund*.

Beetsma, R.M., Guiliodori, M., Klaasen, F. (2008). The effects of public spending on trade balances and budget deficits in the European Union. *Journal of European Economic Association, 6,* pp. 414-423.

Beetsma, R.M. and Bovenberg, A.L. (1998). Monetary union without fiscal coordination may discipline policymakers, *Journal of International Economics, 45,* pp. 239-258.

Bianchi, J., Hatchondo, J.C. & Martinez, L. (2012). The international reserves and the rollover risk is analyzed, *Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper No. 151,* nber.org. > [Accessed 17.06.2014].

BMI Research (2015). *Greece country risk report*. [Online]. Available from: http://web.a.ebscohost.com/ehost/detail/detail?sid=8dd9aaef-b2de-4548-9810-43c4b11acc26%40sessionmgr4002&vid=2&hid=4201&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=bth&AN=101808400 [Accessed 04.09.2015].

Boivin, J. and Giannoni, M. (2006) Has Monetary Policy Become More Effective? *The Review of Economics and Statistics*, 88(3).

Boivin, J., Kiley, M. T., Mishkin, F. S. (2010) How has the monetary transmission mechanism evolved over time?. *National Bureau of Economic Research*, No. w15879.

Bordo, M. D., Johung, L., Markiewicz, A. (2013) A fiscal union for the Euro: Some lessons from history. *CESifo Economic Studies* 59, pp. 449-488.

Bordo, M. D. (2003) *Exchange rate regime choice in historical perspective*. [Online]. Available   from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.491.8228&rep=rep1&type=pdf [Accessed 02.09.2015].

Brooks, C. (2014). *Introductory Econometrics for Finance (3*[rd]ed.). Cambridge: University Press Cambridge UK.

Brooks, C. (2008). *Introductory Econometrics for Finance (2*[nd]ed.). Cambridge: University Press Cambridge UK.

Buiter, W.H. (2003) Ten Commandments for a fiscal rule in the E(M)U. *Oxford Review of Economic Policy 19,* pp. 84-99.

Caglayan, M., Mouratidis, K. & Saeidinezhad, E. (2011). Monetary Policy Effects on Output and Exchange Rates: Results from U.S., U.K. and Japan. University of Sheffield. Available at: <http://www.shef.ac.uk/polopoly_fs/1.119502!/file/2011016.pdf> [Accessed 29.05.2014].

Calvo, G.A., Izquierdo, A. & Loo-Kung, R., (2012), Optimal holdings of international reserves and self-insurance against sudden stop, Nber.org. [Online]Available at http://www.nber.org/papers/w18219 [Accessed 09.09.2015].

Calvo, G. et al. (1995). Targeting the real exchange rate: Theory and evidence. *Journal of Development Economics*, 47, pp. 97-133.

Caporaso, J., Durrett, W.., Kim, M., (2014). 'Still a regulatory state? The European Union and the financial crisis' *Journal of European Public Policy*. [Online] Available at: http://www.tandfonline.com/doi/abs/10.1080/13501763.2014.988638?journalCode=rj pp20&#preview [Accessed 09.09.2015].

Case, K. E., Fair, R. C., Oster, S. M. (2012.) *Principles of Economics*. 10th edition. Pearson Education, Inc.

Chan, T.H. (2011): *A structural modeling of exchange rate, prices and interest rates between Malaysia-China in the liberalization era.* mpra.ub.uni-muenchen.de. [Accessed 08.06.2014].

Clarida, R. et al. (2000) Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory. *The Quarterly Journal of Economics*, 115(1), pp.147-80.

Clarida, R. et al. (2002) A simple framework for international monetary policy analysis. *Journal of Monetary Economics*, *49*(5), pp. 879-904.

Cooper, R. (1969). Macroeconomic Adjustment in Interdepedent Economies, *Quarterly Journal of Economics,* 98(11), pp. 1-24.

Currie, D. and Levine, P. (1985) Single macropolicy rules for the open economy, *The Economic Journal,* 95, pp. 60-70.

Daianu, D., D'Adda, C., Basevi, G., Kumar, R. (Eds.), (2014). The eurozone crisis and the future of Europe: The political economy of further integration and governance, Palgrame Macmillan.

Deceanu, L., Pintea, M., Thalassinos, E., and Zampeta, V. (2010) New dimensions of country risk in the context of the current crisis: A case study for Romania and Greece. *European Research Studies*, 13(3), pp. 225-236.

Dees, S., Di Mauro, Pesaran, M.H., Smith, R. (2007). Exploring the international linkages of the euroarea: a Global VAR analysis, *Journal of Applied Econometrics,* 22(1), pp. 1-38.

Dellas, H. and Tavlas, G. S. (2012) The road to Ithaca: the Gold Standard, the Euro and the origins of the Greek sovereign debt crisis. Bank of Greece. Eurosystem. Available from: www.bankofgreece.gr/BogEkdoseis/Paper2012149.pdf [Accessed 03.09.2015].

Devereux, M.B. and Engel, C. (2007). Expenditure switching versus real exchange rate stabilization: Competing objectives for exchange rate policy. *Journal of Monetary Economics*, 54(8), pp.2346-74.

Dickey, D. & Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a Unit Root. *Journal of the American Statistical Association*. Vol. 74(366).pp. 427-431.

Dixit, A. and Lambertini, L. (2003). Interactions of commitment and discretion in monetary and fiscal policies. *American Economic Review 93,* pp. 1522-1542.

Dragomirescu-Gaina, C. and Phillipas, D. (2015), Strategic interactions of fiscal policies in Europe: a global VAR perspective, *IAEC,* Working Paper.

Dritsaki, M., Dritsaki C. & Adamopoulos, A. (2004). A causal Relationship between *Trade,* Foreign Direct Investment and Economic Growth for Greece. *American Journal of Applied Sciences* vol.1(3), pp. 230-5.

Dominguez, K.M.E., Hashimoto, Y. & Ito, T., (2012). International reserves and the global financial crisis, *Journal of International Economics,* Elsevier. > [Accessed 15.06.2014].

Duasa, J., (2007). Malaysian foreign direct investment and growth: Does stability matter. *Journal of Economic Cooperation*, Vol.28(2), pp.83-98.

Einaudi, L. (2000) From the franc to the 'Europe': the attempted transformation of the Latin Monetary Union into a European Monetary Union, 1865-1873. *Economic History Review*, 53(2), pp. 284-308.

Engle, R.F., D.F. Hendry and J.-F. Richard, (1983), Exogeneity, *Econometrica*, 51, 277–304.

Ericsson, N.R. & Reisman E.L., (2012). Evaluating a Global Vector Autoregression for Forecasting, *International Advances in Economic Research*, Vol. 18, Issue 3, pp. 247-258.

Erjavec, N. & Cota, B.(2003). Macroeconomic Granger Causal Dynamics in Croatia: Evidence based on a Vector Error-Correction Modeling Analysis. *Ekonomski Pregled*. Vol.54(1), pp.139-156.

Epstein, R. J. (1987). *A History of Econometrics*. Amsterdam: North-Holland.

Fatas, A. and Mihov, I. (2003). On constraining fiscal policy discretion in EMU. *Oxford Review of Economic Policy 19,* pp. 112-131.

Favero, C.A. (2013). Modelling and forecasting government bond spreads in the euro area: A GVAR model. *Journal of Econometrics,* vol. 177(2), pp. 343-356.

Fetai, B. (2013). Assessing Monetary and Fiscal Policy Interaction in a Small Open Economy: the Case Republic of FYROM. *Transition Studies Review*, 20, pp. 89-104.

Fitousi, J.P. and Saraceno, F. (2013). European economic governance: The Berlin-Washington Consensus. *Cambridge Journal of Economics 37,* pp. 479-496.

Frankel, J. A. (1999). No single currency regime is right for all countries or at all times. *National Bureau of Economic Research*. [online]. Available from: http://www.nber.org/papers/w7338 [Accessed 02.09.2015].

Galí, J. and Gambetti, L. (2008). On the sources of the great moderation. *American Economic Journal:Macroeconomics,* 1(1), pp. 26-57.

Garcimartin, C., Alonso, J.A. & Rivas, L., (2014). Balance-of-payments-constrained growth and convergence: one more piece of the jigsaw, *Journal of Post Keynesian Economics*, Vol. 36, (3), pp. 555-585.

Ghosh, A., Glude, A. M., Wolf, H. (2012). *Exchange rate regimes: classification and consequences,* Working paper, 149, November 2012. [Online]. Available from: http://www.researchgate.net/profile/Anne-Marie_Gulde/publication/228966970_Exchange_rate_regimes_Classification_and_consequences/links/0046352445a04224d8000000.pdf [Accessed 10.9.2015].

Gibson, H. D., Palivos, T., Tavlas, G. S. (2013). *The crisis in the euro area: an analytic overview: Proceedings of the 2013 Special Conference held at the Bank of Greece.* Athens, Bank of Greece.

Goldberg, L.S., Hull, C. & Stein, K.S., (2013). Do industrialized countries hold the right foreign exchange reserves? *Current Issues in Economics and Finance, Vol. 19, No. 1, 2013*.

Granger, C. W. J. (1987) Developments in the study of cointegrated economic variables. *Oxford Bulletin of Economics and Statistics*.Vol.1(48), pp.213-228.

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods, *Econometrica*. Vol. 37(3). pp. 424-438.

Greene, W. H. (2002). *Econometric Analysis* (5th ed.).United States of America: Prentice-Hall, Inc.

Griffiths, W. E., Hill, R. C. & Judge, G. G. (1992). *Learning and Practicing Econometrics.* Singapore: John Wiley & Sons.

Gujarati, D. N. (2009) Basic Econometrics. 5th edition. McGraw-Hill.

Gul, E. & Ekinc, A. (2006). The causal relationship between nominal Interest Rates and Inflation: The case of Turkey. *Scientific Journal of Administrative Development*. Vol.4, pp. 54-69.

Hacker, S. (2010). The Effectiveness of Information Criteria in Determining Unit Root and Trend Status. *CESIS Electronic Working Paper Series*. No.213. pp.1 – 33.

Halpern, L. and Wyplosz, C. (2001) Economic transformation and real exchange rates in the 2000s: the Balassa-Samuelson connection. *Economic Survey of Europe*, 1, pp. 227-40.

Hebous, S. (2011). The effects of discretionary fiscal policy on macroeconomic aggregates: A reappraisal. *Journal of Economic Surveys 25,* pp. 674-707.

Issing, O. (2002). On macroeconomic policy coordination in EMU. *Journal of Common Market Studies 40,* pp. 345-358.

Issing, O. (2011). Lessons for Monetary Policy: What Should the Consensus Be? *Center for Financial Studies*, Working Paper No. 2011/13.

Jeanne, O., Ranciere, R. (2011). The Optimal Level of International Reserves For Emerging Market Countries: A New Formula and Some Applications, *The Economic Journal,* Wiley Online Library > [Accessed 17.06.2014]

Johansen, S. & Juselius, K. (1990). *Maximum likelihood estimation and inference on cointegration with application to the demand for money*. Oxford Bulletin of Economics and Statistics.Vol.52(2). pp. 169-210.

Johansen, S. (1988) Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*. Vol.12(1), pp.231 – 254.

Kehoe, P.J. (1987). Coordination of fiscal policies in a world economy. *Journal of Monetary Economics* 19, pp. 349-376.

Kim, J.I., Dabla-Norris, E. & Shirono, K. (2011). Optimal precautionary reserves for low-income countries: a cost-benefit analysis, *IMF Working Papers,* papers.ssrn.com. > [Accessed 12.06.2014].

Kohler, M. (2010). Exchange Rates during financial crises. *BIS Quarterly Review*. pp.39-50. Available at:< http://www.bis.org/publ/qtrpdf/r_qt1003f.pdf >. [Accessed 30.05.2014].

Kose, N., Emirmahmutoglu, F. & Aksoy, S. (2012). The interest-rate Inflation relationship under an Inflation targeting regime: The case of Turkey. *Journal of Asian Economies*.Vol.23(4). pp.476-485. Elsevier Science Inc.

Kose, M.A., Otrok, C. & Prasad, E., (2012). Global business cycles: convergence or decoupling, *International Economic Review,* Volume 53, Issue 2, pp. 511–538.

Kouretas, G. P. and Vlamis, P. (2010) The Greek crisis: causes and implications. *Panoeconomicus*, 57(4), pp. 391-404.

Krugman, Paul (19 July 2015). "The Euroskeptic Vindication". NY Times, [Online]. Available at: http://krugman.blogs.nytimes.com/2015/07/19/the-euroskeptic-vindication/?_r=1[Accessed 09.09.2015]

Kydland, F.E. and Prescott, E.C. (1977). Rules rather than Discretion: The Inconsistency of optimal plans.*The Journal of Political Economy*, Volume 85 (3), pp 473—492.

Landauro, I. (2012). *Carrefour checks itself out of Greece*. [Online]. Available from: http://www.wsj.com/articles/SB10001424052702303822204577467833359744926 [Accessed 04.09.2015].

Lazaretou, S. (2003). *Greek monetary economics in retrospect: the adventures of the drachma.* [Online]. Available from: http://www.bankofgreece.gr/BogEkdoseis/Paper200302.pdf [Accessed 03.09.2015].

Lazaretou, S. (2005). Greek monetary economics in retrospect: The adventures of the Drachma. *Economic notes*, 34(3), pp. 331-370.

Levine, P. and Brociner, A. (1994). Fiscal policy coordination in EMU: A dynamic game approach. *Journal of Economic Dynamics and Control 18,* pp. 699-729.

Lothian, J. and Taylor, M. (2004). Real Exchange Rates Over the Past Two Centuries: How Important is the Harrod-Balassa-Samuelson Effect? *CRIF Working Paper series*, 9.

Luetkepohl, H. (2011)*Vector Autoregressive Models*, EUI Working Paper, ECO 2011/30.

Luetkepohl, H. (2008). Impulse response function. *The New Palgrave Dictionary of Economics*. 2nd.ed.

Maddala, G.S. & Lahiri, K. (2009) *Introduction to Econometrics.*4th editions. Wiley.

Malliaropoulos, D. (2010) How much did competitiveness of the Greek economy decline since EMU entry?. *Eurobank Research, Economy & Markets*, 5(4), pp. 1-16.

Mauro, F.D. & Pesaran, M.H. (2013), *The GVAR Handbook: Structure and Applications of a Macro Model of the Global Economy for Policy Analysis*, Oxford University Press.

Mishkin, F. (2008). *The economics of money, banking, and financial markets,* 8th edition, Pearson International Edition.

Mishkin, F. (2008). Challenges for Inflation Targeting in Emerging Market Countries. *Emerging Markets Finance & Trade*, 44(6), pp. 5-16.

Moffett, M., Stonehill, A., Eiteman, D. (2009). *Fundamentals of multinational finance.* 3[d] edition. USA, Pearson Education, Inc.

Mohanty, D. (2012). Evidence on Interest Rate Channel of Monetary Policy Transmission in India. *Reserve Bank of India Working Paper.* Series 6/2012.
Moody's Investors Services, Inc (2009) *Moody's rating symbols and definitions*.
[Online]. Available
from:https://www.moodys.com/sites/products/AboutMoodysRatingsAttachments/Mo
odysRatingsSymbolsand%20Definitions.pdf [Accessed 04.09.2015].

Mumtaz, H. & Sunder-Plassmann, L. (2010). Time-varying dynamics of the real Exchange Rate. A structural VAR analysis. Bank of England. *Working Paper No.382.*

Mundell, R. A. (1961). A Theory of Optimum Currency Areas. *American Economic Review* 51 (4): pp. 657–665.

Mundell, R.A. (1997) Currency areas, common currencies, and EMU. *The American Economic Review*, 87(2), pp. 214-216.

Obstfeld, M. and Rogoff, K. (2000). Do we really need a new international monetary compact? *National Bureau of Economic Research*, No. w7864.

Obstfeld, M. and Rogoff, K. (2000). New directions for stochastic open economy models. *Journal of international economics*, 50(1), pp. 117-53.

Obstfeld, M., et al. (2005). The trilemma in history: tradeoffs among exchange rates, monetary policies, and capital mobility. *Review of Economics and Statistics*, 87(3), pp. 423-38.

Pesaran, M. H. (2014). Theory and Practice of GVAR Modeling, *University of Southern California, Center for Applied Financial Economics (CAFE) Research Paper Series No. 14.04*.

Pesaran, M.H., Schueramann, T. and Weiner, S.M. (2004). Modelling Regional Interdepencies using a Global Error-Correcting macroeconomic model, *Journal of Business and Economic Statistics,* 22(2), pp. 129-162.

Pesaran, M.H. and Smith, R. (2006). Macroeconomic Modelling with a Global Perspective, *CESifo Working Paper 1659*.

Pesaran, M.H., Schueramann, T., Treutler, B.J. and Weiner, S.M. (2006). Macroeconomic Dynamics and Credit Risk: A Global Perspective, *Journal of Money, Credit and Banking,* Blackwell Publishing, vol. 38(5), pp. 1211-1261.

Pesaran, M.H. & Wickens, M. R. (1995). *Handbook of Applied Econometrics*. Volume I: Macroeconomics, Blackwell Publishing: Oxford.

Phillips, P.C. & Perron, P. (1988). *Testing for a unit root in time series regression*. Biometrika. Vol.75(2). pp.335-346.

Pollock, D.S.G. (1999). *A Handbook of Time Series Analysis, Signal Processing, and Dynamics,* Academic Press Inc.

Primiceri, G. (2005). Time Varying Structural Vector Autoregressions and Monetary Policy. *The Review of Economic Studies*, 72(3), pp.821-52.

Pukthuanthong, K. & Roll, R. (2011). Gold and the Dollar (and the Euro, Pound, and Yen). *Journal of Banking & Finance* .Vol. 35. pp. 2070-2083.

Ricci, L.A. (2008). "A Model of an Optimum Currency Area". *Economics: the Open-Access, Open-Assessment E-Journal* 2 (8), pp. 1–31.

Sack, B. and Wieland, V. (2000). Interest-Rate Smoothing and Optimal Monetary Policy: A Review of Recent Empirical Evidence. *Journal of Economics and Business*, 52, pp. 205-28.

Salvatore, D. & Reagle, D. (2011). *Statistics and Econometrics*. 2nd edition. Schaum's Outlines.

Samuelson, P.A. (1964) Theoretical notes on trade problems. *The Review of Economics and Statistics*, 46(2), pp. 145-54.

Selçuk, B. and Yılmaz, N. (2011) The Effects of Global Crisis into Euro Region: A Case Study of Greek Crisis. *European Journal of Economic and Political Studies,* 4(2), pp. 49-72.

Shaari, M. S. , Hussain, N. E. & Abdullah, H. (2012). The Effects of Oil Price Shocks and Exchange Rate Volatility Inflation: Evidence from Malaysia. *International Business Research* Vol.5(9). pp.106-112.

Sims, C. A. (1980). Macroeconomics and Reality .*Econometrica.*Vol.48. pp.1-48.

Shugnang, L. & Zaiyong, H. (2008). An analysis the stability of long-run determinants of the Gold price. *World Economy Study.* 02, 2008.

Taylor, J. (1995). The Monetary Transmission Mechanism: An Empirical Framework. *Journal of Economic Perspectives*, 9(4), pp. 11-26.

Taylor, M. P. (2003). Purchasing Power Parity. *Review of International Economics*, 11(3), pp. 436-452.

Thirlwall, A.P. (1979). Balance of payments constraint as an explanation of international growth rate differences, *BNL Quarterly Review,* Vol. 32, (128), ideas.repec.org, pp. 45-53.

Thomas, R. L. (1997). *Modern Econometrics: An Introduction*. Harlow UK: Addison-Wesley-Longman Ltd.

Quinn, C., Coleman, T. & Kiyavash (2011) A Generalized Prediction Framework for Granger Causality. *Workshop on Network Science for Communication Network,* pp. 1-6.

Verbeek, M. (2008). *A Guide to Modern Econometrics* (3rd ed.). Chichester: John Wiley & Sons.

Vij, M. and Kapoor, M. C. (2007) Country risk analysis. *Journal of Management Research,* 7(2), pp. 87-102.

Worstall, T. (2012) *Why Coca Cola is leaving Greece.* [Online]. Available from: http://www.forbes.com/sites/timworstall/2012/10/13/why-coca-cola-is-leaving-greece/[Accessed 04.09.2015].

A Proposed Framework for University - Industry Interactions: The case of South - East European Countries

Besart Hajrizi[1],

[1] The University of Sheffield, The University of Sheffield International Faculty, School of Management

Abstract - The aim of this research is to propose a University - Industry Collaboration (UIC) framework for South East European Countries (SEEC). To facilitate the UIC the paper identifies the drivers, benefits and obstacles but also some of the organizations forms and types of interactions as initials to a proper UIC framework for SEEC. The main purpose of the paper is to address conceptual frameworks from different levels of stakeholders to a proper organizational form and type of an interaction at SEEC.

Keywords: University – Industry Collaboration, Innovation, Conceptual Frameworks, Proposed Framework, Entrepreneurship.

1. Introduction

Nowadays, South East European Countries are embracing the need to create a more connected and functioning relationship between government, business and universities to increase the level employment, productivity and for economic development in general. Based on the importance of the interaction between government, industry and universities, a model, called Triple Helix model, was developed by Henry Etzkowitz and Loet Leydesdorff in the 1990s. The Triple Helix model of innovation means an extensive and active collaboration between actors and argues that the creation of the knowledge base depends on the synergies created between the main actors of the economy, university, industry and government. The Triple Helix of university, industry and government relations has been described as a 'highly charged intellectual enterprise (Todeva and Etzkowitz, 2013).

This research study is focused on the collaboration between universities – industry that is possible by many factors, such as publications, workshops or conferences, staff recruitment and the most significant factors are personal exchange of information, knowledge and experiences advantage (Ankrah and Al-Tabbaa, 2015). *Universities* educate people for the region and train talented problem solvers, provide cultural amenities to a local area (Goddard and Chetterton, 1999), and provide direct assistance to industrial firms in their innovative activities (Chesbrough et al., 2006; Mowery et al., 2001). *Firms* that can build links with university research may be more productive and may be able to gain higher status and value in the commercial exploitation of their knowledge (Zucker et al., 1998). They may even be more likely to innovate if they interact together (Feldman, 1994). A framework of university – industry collaboration is proposed for the South – East European Countries as a tool which facilitates the collaboration between universities – industry actors.

There has been a substantial increase in these collaborations and interactions in several developed and transitional nations, which is attributed to a combination of pressures on both industry and universities (Giuliani and Azra, 2009; Meyer-Krahmer and

Schmoch, 1998). For industry, pressures have included rapid technological change, shorter product life cycle and intense global competition that have radically transformed the current competitive environment for most firms (Bettis and Hitt, 1995; Weight et al., 2008). With regards to universities, pressures have included the growth in new knowledge and the challenge of rising costs and funding problems, which have exerted enormous resource burdens on universities to seek relationships with firms to enable them to remain at the leading edge in all subject areas (Hagen, 2002). These pressures on both parties have led to an increasing stimulus for developing University – Industry collaborations that aim to enhance innovation and economic competitiveness at institutional levels, through knowledge exchange between academic and commercial domains (R et al., 2013).

2. Literature Review

A systematic review of the literature was performed to assess the current knowledge and collate scattered findings to present them in a way that is more relevant, reliable and provides collective insights and guidance to meet the needs of academics, practitioners and decision-makers.

2.1. Systematic Literature review method

The main objective of this study was to establish what is known about the key aspects of University – Industry collaboration, and find out how these aspects may be related. Guided by this objective, the methodology is based on the work performed by Tranfield et al. (2003) towards carrying out the review. The systematic review covered relevant articles to answer the following research questions related to UIC:

- What are the relations between geographical proximity with organizational forms and types of knowledge interaction between universities – industry?
- What are the drivers, benefits and barriers for university-industry co-creation in different tiers of geographical proximities?

To exclude some of the studies, in this article is used Farrington's methodological quality scale by implementing five criteria to assess the methodological quality of evaluation studies, including: internal validity, descriptive validity, statistical conclusion validity, constructs validity and external validity.

The first issue relates to the study's boundaries. The current research reports and discusses articles that have been included in academic journals during the period 2000 and 2016. This indicates the potential of some relevant studies to be excluded from the review. Nonetheless, this is an acceptable practice in systematic review (Pittaway and Cope, 2007), as all important contributions in each research field would usually appear continuously in subsequent journal papers. The second limitation concerns the selection of keywords applied to control in the inclusion criteria of the papers. However, to mitigate the consequences of this issue, a careful approach has been followed in the inspection process that incorporates three steps: title, abstract, and full text. Importantly, this would ensure that all relevant studies have been consulted.

The table below shows the key and the most cited authors for the keywords of the paper.

2.1.1. Organizational forms and types of interaction between universities – industry in different geographical proximities

Geography is an important determinant of firms' collaborative behaviour regarding innovation, and this article argues that geographical proximity to universities and industries' propensity to collaborate with local universities in the innovation process is winding, as the relationship depends on the characteristics of firms and universities, and on the related choices made by managers in firms and academics working in universities (Laursen, Reichstein and Salter, 2015). Geographical proximity is important for knowledge exchange especially when knowledge is "person-embodied, concept-dependent, spatially sticky and socially accessible only through direct physical interaction" (Laursen and Reichstein, 2015).

The most famous forms pursued in practice and discussed in the literature are: Joint ventures, Networks, Consortia and Alliances (Barringer and Harrison, 2000), which varies depends on the degree to which participants are linked. Different researchers present different typologies on University – Industry relationships. For instance, Chen (1994) classified the forms of University – Industry collaboration for technology exchange according to the duration of the relationship and the technology flow. Santoro and Gopalakrishnan (2000), on the other side suggest four classifications for University – Industry collaborations, including: research support (i.e. endowment/Trust fund), cooperative research (i.e institutional agreements, group arrangements, institutional facilities, and informal intentions), knowledge transfer (i.e. hiring of recent graduates, personal interactions, institutional programs, cooperative education), and technology transfer (i.e. product development and commercialization activities through university research centers).

However, another framework proposed by Bonarccorsi and Piccaluga (1994) consisted on six main categories, namely: Personal Informal Relationships, Personal Relationships, Third Party, Formal Targeted Agreements, Formal Non-Targeted Agreements and Creation of Focused Structures. This framework has been extended by Bonarccorsi and Piccaluga (1994) to reflect additional information in terms of three dimensions: a) Organizational resources involvement from the university, b) Length of agreement, and c) degree of formalization. So, if the firm's contact with the university is with an academic without any agreement signed with the university there is no organizational resources involvement. The length of the agreement between universities and firms could vary from short in the case of Personal Formal Relationships, too long in the case of specific or Focused Structures. The issue of formalization is very important because of the argument that increasing formalization and monitoring of the relationship in a University – Industry collaboration could lead to conflict and distrust among the parties in their attempt to maintain the autonomy of their organizations in the face of increasing interdependence (Santoro and Gopalakrishnan, 2000, Ring and Van De Ven, 1994).

Figure 1: Geographical proximity and organizational forms
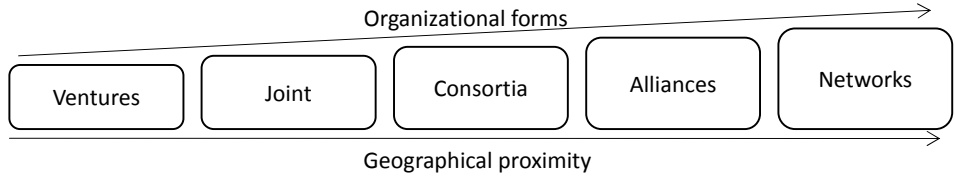
Adapted from Ankrah and Al-Tabbaa, 2015

The relationship between geographical proximity to universities and firms' propensity to collaborate with local universities in the innovation process is winding, as the relationship depends on the *characteristics of firms and universities*, and on the *related choices* made by managers in firms and academics working in universities. So, based on the most famous pursued in practice and discussed organizational forms, the literature show that the most famous organizational forms if Universities and Industries are far away from each other are Networks and the most famous organizational forms if Universities and Industries are nearby each other are Joint Ventures as an organizational form advantage (Ankrah and Al-Tabbaa, 2015)

The term knowledge interaction is used to describe all types of interactions between organizations and/or individuals from the firm side and the university side, directed at the exchange of knowledge within innovation processes.

Table 1: Types of knowledge interactions between university and firms

Types of knowledge interaction	Formalization of interaction	Transfer of tacit knowledge	Personal (face to face) contact
Employment of graduates by firms	+/-	+	-

Conferences or other events with firm and university participation	-	+/-	+
New firm formation by university members	+	+	+/-
Joint Publications	-	+	+
Informal meetings, talks, communications	-	+	+
Joint supervision of PhD and Masters theses	+/-	+/-	+/-
Training of firm members	+/-	+/-	+
Mobility of researchers between universities and firms	+	+	+
Sabbatical periods for university members	+	+	+
Collaborative research, joint research programmes	+	+	+
Lectures at universities, held by firm members	+	+/-	+
Contract research and consulting	+	+/-	+
Use of university facilities by firms	+	-	-
Licensing of university patents by firms	+	-	-
Purchase of prototypes, developed at universities	+	-	-
Reading of publications, patents etc.	-	-	-

+: interaction typically involves formal agreements, transfer of tacit knowledge; +/-: varying degree of formal agreements, transfer tacit knowledge, personal contacts; -: interaction typically involves no formal agreements, no transfer of tacit knowledge, no personal contacts.

Source: (Schartinger et al., 2002)

Mohnen & Hoareau (2002) find that size, government support, patenting and scientific industry status contributes positively towards explaining R&D collaborations with universities relative to other types of cooperation. Capron & Cincera (2002) also confirm the importance of firm size and government support as significant drivers for R&D cooperation with universities (Veugelers and Cassiman, 2003). Based on the table above, collaborative research (joint research programs) between universities and firms involves formal agreements and requires personal (face to face) contact. On the other hand, reading of publications and patents typically involves no formal agreements and no personal contacts between people from two different institutions (Schartinger, Rammer, Fischer and Frohlich, 2002).

To exchange knowledge, direct *face-to-face* contact is often required to help individuals explain to one another knowledge emerging from research activities that are still fluid and only partial formed (Storper and Venables, 2014). However Gertler posits that firms have to find ways of establishing common interests and aligned incentives with their academic partners and this can only be done by *"being there"* in order to establish a common background and shared set of expectations and understandings about the nature of the collaboration (Gertler, 2015).

Finally, geographical proximity can play an important role in shaping university-industry collaboration, but that the type of university in the local area shapes the likelihood that a firm will collaborate with a university.

2.1.2. Drivers, benefits and barriers for university-industry co-creation

A large variety of potential drivers exists for university and industry to collaborate, which drivers for both actors are discussed separately. Governments are actively encouraging collaborations between universities and industry as a means of improving innovation efficiency and thereby enhance wealth creation (Barnes et el., 2002). Universities are increasingly turning their attention to encouraging University – Industry collaboration in response to government policy and as an institutional strategic policy (Howells et al., 1998; Perkmann et al., 2011). Universities offer extensive access to a wide variety of research expertise and research infrastructure, whiles industry offers extensive access to a wide range of expertise in product development/commercialization, market knowledge (Sherhood et al., 2004) and employment opportunities for universities graduates (Lee and Win, 2004; Santoro and Betts, 2002). So, one of the most significant reasons why universities can be motivated to build relationships with industry is to take advantage of these strengths for mutual advantages (Ankrah and Al-Tabbaa, 2015). Universities are motivated to collaborate with industry because they reduce their dependence on public pursue (Logar et al., 2001), but also Industry funding usually involves less bureaucratic red tape than public funding. Faculty members may be

motivated by personal financial gain to enter into relationships with industry (Siegel et al. 2004). Furthermore, Harman and Sherwell (2002) suggest that an important incentive for universities to partner with industry is publication in journals, as producing accessed-publicly information would emphasize the original mission of universities in disseminating the knowledge (Newberg and Dunn, 2002).

On the other side, Industry has a large variety of potential benefits to collaborate with universities and constantly is trying to get benefits from governmental programs by collaborating with the universities. A very significant driver for industry to enter into University – Industry collaboration is to seek to commercialize universities – based technologies for financial gain (Siegel et al. 2003). Another driver for industry to enter into University – Industry collaborations is to gain access to students for summer internships or hiring (Ankrah et al., 2013; Siegel et al., 2003), but also faculty member or senior researchers can also be hired to consult during the time they are allowed to work outside of the universities (Perkmann et al., 2011). Firms also partner with universities because of the possibility of benefiting financially from serendipitous results of research activity, innovative outputs, cost savings especially those relating to knowledge creation and exploitation (George et al., 2002).

The level of incentives does not correspond with the level interaction between actors, because the level of interaction depends significantly on the possibilities to communicate. So, if motives are higher to interact internationally because of the benefits, the possibilities are higher in a regional orientation perspective to interact.

A report of the Joint Project of the U.S. National Council of University Research Administration and the Industrial Research Institute recommends the following principles for university – industry endeavors in regional and international orientations:

- Successful UIC should support the mission of each partner;
- Institutional policies should focus on fostering appropriate long-term partnerships between actors;
- Universities and Industry should focus on the benefits of each actor to ensure timely conduct of the research and the development of the research findings.

Below, is a summary of the motives for interaction between university and industry:

Table 2: Drivers of University – Industry Collaboration

University	Industry
Enhancement of teaching	Sourcing latest technological advances
Funding/financial resources	Laboratory usage
Source of knowledge and empirical data	Personnel resources/cost savings
Political pressure	Risk sharing for basic research
Enhancement of reputation	Stabilising long term research projects
Job offers for graduates	Recruiting channel

Source: Rohrbeck and Arnold, (2006)

There is high degree of interactions between academics and external organizations, but there are also a range of factors that constrain such interactions. Lambert has considered companies and universities as two different entities which are natural partners even though their cultural and mission's differences are significant and sometimes tend to constrain their interactions (Lambert, 2003). The most important constraints considered by the scientists are lack of time, bureaucracy, and insufficient rewards and these constraints vary by the disciplines. At the core constraints to University – Industry collaborations are the different institutional norms governing public and private knowledge (Dasgupta and David, 1994). Based on Brunnel, D'Este and Salter perspective, they focus on three potential mechanisms to reduce the obstacles to University - Industry collaboration: experience of collaboration, breadth of interaction and inter-organizational trust.

Research on inter - organizational alliances shows that collaboration experience is a critical determinant of the success or failure of subsequent alliances (Hagedoorn and Schakenraad, 1994). Involvement in a variety of channels of collaboration may contribute to better equip the firm to manage conflicts over the orientation of research for engaging in a broad range of interaction channels which creates substantial synergies between channels, and this broad engagement contributes to strengthening the firm's capacity (Brunnel, D'Este and Salter, 2010). High level of trust helps to reduce the dears that one

of the partners will act opportunistically, expresses the capacity of firm and university to work together to resolve problems, and demonstrates a willingness to understand and adjust behavior to align with the needs and expectations of partners (Zaheer et al., 1998).

3. Research methodology

To propose a framework on UIC, the use of qualitative research method for the whole research is necessary.

Focus groups will further support the research proposed model. Thus, through a systematic literature review, besides identifying different types of interactions, organizational forms, barriers and drivers of interaction, on the second stage through the focus groups the research was oriented to the actor's and stakeholder's behavior according to the levels and conceptual frameworks considering the components of each level.

Essentially, qualitative analyses are based on hypotheses raised before starting the focus group discussions. To test the following hypotheses, focus groups were organized in three different countries from SEE (Greece, Albania and Kosovo):

H1: There is a positive correlation between geographical proximity and the level of knowledge and innovation capacity;

H2: Industry has a positive tendency for collaboration with university, more than university with industry;

H3: The level of education at industry is positively related with the level of collaboration with university;

**H4**: Micro level of the stakeholders is the base of a proper UIC?

3.1. Research outcomes

Recently, there has been an increasing role of the Universities that can play in contributing to economic growth. Results show that there is a negative correlation between geographical proximity and the level of knowledge and innovation capacity. *This means that as lower as the distance between University and Industry is, the higher is the level of knowledge exchange and innovation capacity, but results even show that industry is more interested in collaboration with universities rather than university with industry* (Laursen K., 2015).

Above there is a broad scale of conceptual frameworks and components which are going to be researched and analyzed on the next stages. Because the study is an inductive study, it will start from the micro level with individual stakeholders to the macro level with community stakeholders, which will result with a framework for this community (SEEC).

The paper after identifying drivers and barriers, organizational forms and types of interactions, identified some conceptual frameworks considering the level of the stakeholder. The application of these conceptual frameworks at SEEC facilitates UIC, which enables the generation of the innovations and makes more efficient the utilizations of resources. So, SEEC need more entrepreneurial and engaged universities who are willing to interact with government and industry through cross-emplyoments, internships, research projects etc.

Figure 7: Conceptual frameworks in different levels and components
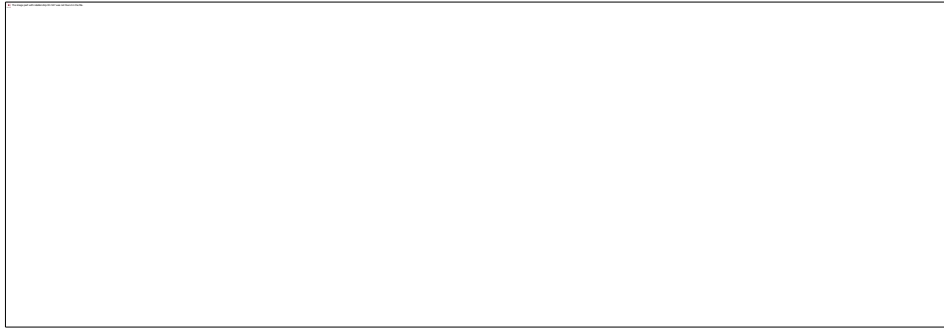
As the final common proposal from the focus groups was a *proper framework to organize the exchange between actors.*

4. Conclusion

The initial stage of thesis was identifying organizational forms and types of university – industry co-creation, drivers and barriers for university – industry co-creation, the relation between University and Industry in different tiers of geographical proximities, and getting deeper understanding on entrepreneurial and engaged universities and their changing role in different periods and modes.

Based on these theoretical foundations, we show that the lower as the distance between University and Industry is, the higher is the level of knowledge exchange and innovation capacity, but even the higher is the level of education the higher are chance to collaborate

with universities. Results even show that industry is more interested in collaboration with universities rather than university with industry, and the possibility of collaboration between university and industry depends on the functionalization of the conceptual frameworks, which means that conceptual frameworks are considered as significant factors *which impact on the performance and development of all actors and stakeholders.* As the final common proposal from the focus groups was a *proper framework for SEEC to organize the exchange between actors which is shown above.*

5. References

1. Siegel, D., Waldman, D., Atwater, L., Link, A., 2003. Commercial knowledge transfers from universities to firms: improving the effectiveness of university-industry collaboration. Journal of High Technology Management Research;

2. Bruneel, J., D'Este, P., Salter, A., 2010. Investigating the factors that diminish the barriers to university-industry collaboration. 7th Triple Helix International Scientific and Organising Committees;

3. Intzesiloglou, G., Kakderi, Ch., Komninos, N, Zaharis N., 2011. Identifying Successful Knowledge Exchange Practices between Academia & Industry in University city Regions: The case of Thessaloniki Greece. International Conference for Entrepreneurship, Innovation and Regional Development;

4. AL-Tabbaa, O., 2015. Universities-industry collaboration: A literature review. Scandinavian Journal of Management. ;

5. Perkmann, M., Walsh, K., 2009. The two faces of collaboration: impacts of university-industry relations on public research. Industrial and Corporate Change;

6. Dooley, L., Kirk, D., 2007. University Industry Collboration - Grafting the entrepreneurial paradigm onto academic structures. European Journal of Innovation Management;

7. Ketikidis, P., Zigiaris, S., Zaharis, N., 2012. Regional Innovation and Competitiveness: Analysis of the Thessaloniki Metropolitan Region. Case Studies in Innovation for Researchers, Teachers and Students;

8. Ranga, M., Etzkowitz, H., 2013. Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. Industry and Higher Education (ingentaconnect);

9. Etzkowitz, H., Leydesdorff L ., 2015. The Endless Transition: A Triple Helix of University-Industry-Government. Springer Publisher;

10. Etzkowitz, H., Webster, A., Gebhardt, Ch., Terra, B., 2000. The future of the university and the University of the Future: evolution of ivory tower to entrepreneurial paradigm; Elsevier Research Policy 29;

11. Schartinger, D., Rammer, Ch., Fischer, M., Frohlich, J., 2002. Knowledge interactions between universities and industry in Austria: sectoral patterns and determinants. Elsevier Research Policy 31;

12. Motohashi, K., 2005. University–industry collaborations in Japan: The role of new technology based firms in transforming the National Innovation System. Elsevier Research Policy 34;

13. Abramo, G., D'Angelo, C., Di Costa, F., Solazzi, M., 2009. University–industry collaboration in Italy: A bibliometric examination. Elsevier Technovation;

14. Watanabe, T., 2009. UIC - Effect of patenting and licensing by university on collaboration research. Special Feature: Public-Private R&D Collaboration;

15. Perkmann, M., Walsh, K., 2007. University-industry relationships and open innovation: towards a research agenda. International Journal of Management Reviews;

16. Etzkowitz H., Leydesdorff., 2000. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university – industry – government relations. Research policy 29 (109 – 123);

17. Abreu M., Grinevich V., Hughes A., Kitson M., 2009. Knowledge Exchange between Academic and the Business, Public and Third Sectors, UK-IRC, UK Innovation Research Centre (35 – 39);

18. Laursen K., 2015. In the know: Exploring the Effect of Geographical Proximity on Industry – University Collaboration in the UK, Research Gate.

Consctructing a Measurement Model of Civic Consciousness

Sonya Msryan

PhD Student, Chair of Applied Sociology, Department of Sociology, Yerevan State University,
sonya.msryan@gmail.com

Abstract. The concept of "Civic Consciousness" has been employed in practical discourses and several empirical researches; however the multidimensional measurement model of the concept has not been constructed. The following article endeavors to introduce predesign of exploration of how civic consciousness can be measured. We propose construction of measurement model of civic consciousness applying two statistical techniques of structural equation modeling: Latent Variable Path Analysis and Confirmatory Factor Analysis and comparison and testing of distinct multidimensional models to capture best understanding to the underlying construct of civic consciousness.

Keywords: *civic consciousness, measurement model, latent variable, structural equation modeling*

Introduction

The quantitative reflection of civic consciousness based on the empirical researches is an important research question since it will directly help the understanding of the development perspectives of a society and formation of civic identity, the basic sentiments and attitudes of society towards democratic and civic values and norms. This is essential especially for the countries experiencing transition from the totalitarian or semi-totalitarian regime to the relatively democratic ones which assumes radical changes in governmental, political, economic and social structures. Measurement of civic consciousness will enable to derive sustainable model constructed on the consistent variables along with the widely spread behavioristic approaches describing the civic behavior of the individuals at the micro-level. The measurement model will enable insight into the core factors underlying the civic behavior of individuals rather than describing the civic behavior itself.

Within the framework of this research work we employ the concept of "civic consciousness" to define a system of particular personal immanence which expresses ones competences, orientations, beliefs and behavior as well as self-reflection towards civic, political and public spheres. Civic consciousness of a group or society is defined as a compound of civic consciousness of individuals of the particular group/society. In this paper we establish multidimensional definition of civic con-

sciousness considering it as a latent construct (endogenous variable) which can be measured through a combination of directly observed variables (exogenous variables). The paper includes literature review on the topic as well as description of brief methodology on construction of measurement model of civic consciousness.

Literature Review

People and institutions are talking about particular level of development of "civic consciousness" among different persons, groups or societies. Rising of "civic consciousness" is one of the general objectives stated by different civic organizations, civic society and movements. Nevertheless, at the academic level the concept of "civic consciousness" has not received its concrete and widely accepted meaning which leads to various interpretations and misinterpretations of the concept.

Sandal calls the concept of civic consciousness "tentative" and meanwhile "viable" emphsizing that it can be used to describe "individual process of orientation in social and political life" [Sandahl, J., 2015]. Among other interpretations of the concept is "citizen's being conscious of duties towards state and home country"[Janowitz, M., 1983], "combining elements of reason, self-criticism and political commitment with themes such as social identity, personal habits, knowledge and values" [Janowitz, M. 1983, Cf. Lange & Onken 2013], "aggregate of attitudes relating to the following: respect for law, support of government, concern for fellow citizens, and the willingness to promote public welfare" [Close, D., 2003], "the initiative knowledge of the relationship between individuals and the state or society; the rational cognition of citizenship, civic rights and liabilities and civic virtues; the internalization and identification of the social behavioral norms and basic values" [Huasheng, T., 2012], "understanding of contemporary political life and political alternatives"[Sandahl, J., 2015]. Most of the definitions of civic consciousness in some sense outline its multidimensionality describing it as an aggregation of particular personal attitudes and characteristics serving as components of the concepts.

As for empirical researches, there are several of them [e.g. Bunzl M., 2012, Pope IV, A. 2014, Sandahl, J., 2015, Cheung Ch., Ty Lee, Chan W., Leung K., 2014, Valeeva A. R., Koroleva E. N. & Sakhapova K. F., 2014, Anisa, M. 2015, Kovalchuk, V. 2015, and etc.]; most of which aiming at the development and strengthening of civic consciousness among youth in the context of educational processes [e.g. Kovalchuk, V. 2015, Valeeva A. R., Koroleva E. N. & Sakhapova K. F., 2014, Valeeva A. R., Koroleva E. N. & Sakhapova K. F., 2015 and etc.]. Generally, the authors try to adopt qualitative approaches while dealing with civic consciousness [e.g. Sandahl, J., 2015, Bunzl M., 2012, Pope IV, A. 2014, Anisa, M. 2015, Kovalchuk, V. 2015, and etc.] rather than bringing it to the sphere of "numbers" [e.g. Huasheng, T., 2012, Cheung Ch., Ty Lee, Chan W., Leung K., 2014 and etc]. One of the attempts to measure civic consciousness is in the context of revealing influence of young people's engagement

in activities in the school, youth center, family and mass media on their civic consciousness [Cheung Ch., Ty Lee, Chan W., Leung K., 2014]. On the other case the authors used three components to describe the level of Technical University Students' civic consciousness, which are cognitive, emotional and personal, practice-effective components [Valeeva A. R., Koroleva E. N. & Sakhapova K. F., 2015].

Within these quantitative empirical researches there are quite limited attempts of constructing measurement models of civic consciousness. Huasheng T. [2012] uses the following dimensions to describe civic consciousness in contemporary China: cognition of own roles, national identity, political participation, legal consciousness, moral consciousness, ecological civilization, global citizenship. These dimensions serve as a base to construct a scale on civic consciousness and to present broad empiric data on the topic in contemporary China. However, the analysis is limited within descriptive interpretation of data and the author does not provide measurement and structural models of civic consciousness based on the identified dimensions. Angelou J. [2015] provides further development to Huasheng's approach introducing underlying structure of the construct being measured based on multidimensional analysis methods. The author identifies five factors underlying the civic consciousness as follows: personal identity and citizenship, national identity, moral consciousness, ecological consciousness and social citizenship. The author recommends "equation modeling" as the next statistical treatment for the further development of the scale - "a technique which will further identify the percentage by which a certain item contributes to the factor it has been loaded" [Angelou J. 2015].

On the whole, the review of key literature reveals limited attempts of constructing measurement model of civic consciousness, however, literature comes with valuable researches aimed at model building on the concepts cohesive to civic consciousness such as civic competence [e.g. Hoshins B., Villalba E., Nijlen D., Barber C., 2008], civic engagement [e.g. Flanagan C., Syvertsen A., & Stout M., 2007, Wray-Lake L., Metzger A., & Syvertsen A., 2016], environmental consciousness [e.g. Sánchez M., 2010] and etc. These examples of model building of cohesive concepts may serve as methodological guidelines while developing measurement model of civic consciousness.

Proposed Methodology

General Principles

The research work aims at the development of measurement model of civic consciousness in the Armenian society. The objective of the research work is construction of a heuristic measurement model of civic consciousness which will enable further measures of the level of civic consciousness in the Armenian society. However, we hope in development of universal scale and measurement model depart of particular social context which will be applicable also to the similar studies carried out in other societies and groups.

As mentioned above, we adopt multidimensional definition of civic consciousness, which considers incorporation of dimensions habitually associated to this notion. Based on the analytical review of approaches found in the literature, these dimensions are identified as follows: civic competence (cognitive dimensions, including items referring to recognition of civic and democratic values and norms, forms of engagement and etc.), civic orientations and beliefs (affective dimensions, including items referring to orientations and believes towards civic values and norms, engagement to civic, political and public life and etc.), deliberate civic behavior[1] (behavioral dimensions, including items referring to the commitment to engagement to civic life, public discussions and etc.) and self-reflection (dimension referring to the orientations and believes towards the "self" as a citizen and civic actor).

"Each action … takes place in a situation consisting of objects, each actor has a system of relations-to-objects" [Parsons, T. & Shils, E., 1951], accordingly we distinguish three broad classes of the objects of orientations: civic sphere, some aspects of public life and political life, simultaneously adopting that the boarders of these spheres are not precisely defined, but rather interweaved. In addition to these three main spheres, we distinguish also "self" as a fourth object of orientations.

Based on the defined dimensions of civic consciousness as well as objects of orientations our proposal to operationalization of the concept is shown in Annex 1. The operationalization scheme has been developed in a way to cover all possible aspects of variables to be associated to the concept of civic consciousness. Based on the results of model construction techniques, the variables having low correlations to the conceptual structure will be eliminated.

There are numerous ways to model multidimensionality of a given construct, and each approach comes with different theoretical assumptions and empirical implications [Wray-Lake L., Metzger A. & Syvertsen A., 2016]. The consctruction of measurement model of civic consciousness implies application of quantitative data which will be collected using structured questionnaire. The latter will include identified endogenous variables (directly observed variables) according to the operationalization of the concept.

The population of the survey is Armenian society, i. e. all adult residents living in Armenia. Represenatative sample will be constructed - selection will be made in nested, random-cluster way, which means that geographical clusters will be selected (cities and rural communities) and individuals within a particular geographical cluster will be selected randomly. The quantitative data will be collected based on face-to-face interviews using structured questionnaire.

---

[1] *"Deliberate behavior" is emphasized here, as the civic behavior is considered to be fully realized and voluntary, which lacks especially in totalitarian or non-totalitarian countries, on the other hand absence of behavior may be recorded (for example one's not participating in elections) being announced as "boycott" which is a realized civic action and should be incorporated into the scale in a proper manner.*

Why Armenia? Historical context

Armenia has passed through the process of transition from Socialism to Capitalism, as well as experienced transition from the totalitarian regime to the relatively democratic one. These assume radical and tricky changes in social, economic and political life. The overcome of the phenomena of "socialist mentality", "socialist spirit" or "planned consciousness" specific to soviet society was and is going to be one of the main difficulties of this transition. For several decades the formulation of human identity has been the object of social institutes and ideological organizations aiming at controlling humans' ideas, attitudes and activities from the "above" and "adjusting" them to meet the standards. After Soviet Union breakdown the promotion of civic values became one of the key components of developmental initiatives, governmental toolkits and civic organizations in Armenia. The discourses of "democracy", "civic society", "citizenship" and development of "civic consciousness" started to spread over throughout Armenia society. Nevertheless, though these broad attempts, in many aspects Armenian society is still post-soviet society: it continues to live with past stereotypes and mentality "by inertia".

The articulation of ideas, beliefs and sentiments of these two controverting social times in Armenian society leads to need to examine the level of development of civic consciousness as an indirect answer to the question of at what level "democratic rules of game" are accepted in Armenian Society. The answer to this question will give insight into the question of what is the current situation of Armenian society in terms of development of civic values and norms. Employment of concept of civic consciousness will lead to understanding of "what is going on in peoples' mind" rather than describing patterns of civic behavior which may be misleading in countries lacking democracy as Armenia is. As a country formerly involved in transition processes from the totalitarian regime to the relatively democratic one and currently experiencing the breakthrough towards deepen democratization as an Eastern Partnership country, Armenia may serve as a sample while studying civic consciousness in other post-soviet countries where historical context is rather similar.

Construction of a Measurement Model

It is recommended to define civic consciousness as a latent variable or emergent variable as it is intangible and not observable in a direct manner, which means we construct combination of directly observable variables which in a particular manner are describing the latent construct. Model construction includes application of multivariate analyze procedures for data structure simplification and reduction which will lead to identification and interpretation of civic consciousness as a latent variable or emergent variable.

Two basic principles of model construction are proposed: application of two distinct statistical techniques for model construction and testing and comparison of three distinct multidimensional models.

Application of two distinct approaches of structural equation modeling (SEM) technique to determine the measurement properties of the scales is suggested: Confirmatory Factor Analysis (CFA) and Latent Variable Path Analysis (LVPA). SEM is used when data consist of multiple indicators for each variable (called latent variables or factors) and specified paths connecting the latent variable [Datallo, P. 2013]. CFA and LVPA bring together individual items to tap larger and abstract meta-concepts as "civic consciousness" is by its definition. CFA is used in testing the measurement model which is specified *a priori* based on theory. LVPA is used for simultaneous test of measurement and structural parameters. It incorporates relationships between observed and latent variable, relationships between latent variables and gives information on errors and disturbances. Measures of reliability of the scales (Cronbach's alpha) along with the SEM and PCA results are also proposed to evaluate internal consistency of the results.

It is proposed to compare distinct multidimensional models to determine which model(s) best capture collected empirical data on civic consciousness including the following models: unidimensional single latent variable model, higher-order factor model, multiple higher-order factors model. Comparison and testing of alternative approaches of model construction will help to more precise understanding and identification of structure of civic consciousness.

Conclusion

In this paper we have defined civic consciousness as a system of particular personal immanence which express competences, orientations, beliefs and behavior as well as self-reflection towards civic sphere and particular aspects of political and public spheres. Civic consciousness of a group or society is defined as an aggregation of civic consciousness of the particular group/society. We establish multi-dimensional definition of civic consciousness proposing an operationalization which includes four basic dimensions comprising it (cognitive, affective, behavioral and self-reflectional). We established objects of orientations as follows: civic shphere, some aspects of public and political life, and "self".

The proposed methodology includes quantitative data collection using structured questionnaire developed according to the theoretical operationalization of the concept of interest. For construction of measurement model of civic consciousness Confirmatory Factor Analysis and Latent Variable Path Analysis measurement methods are proposed for application as well as testing and comparison of unidimensional single latent variable models, higher-order factor models and multiple higher-order factors models to capture best reflection of empirical data.

References

Angelou J., (2015) Scale on Civic Consciousness (SCC) for the National Service Training Program, International Journal of Humanities and Management Sciences (IJHMS) Volume 3, Issue 3

Anisa M., (2015), "Active citizenship, dissent and civic consciousness: young Muslims redefining citizenship on their own terms", Identities: Global Studies in Culture and Power, April

Bunzl M., (2012), "Discovering an integral civic consciousness in a global age: Global problems, global governance, and denial", Journal of Integral Theory and Practice, March

Cheung Ch., Ty Lee, Chan W., Leung K., (2004) "Developing civic consciousness through social engagement among Hong Kong youths", The Social Science Journal 41(4):651-660 · December

Close, D. (2003), Is civic consciousness strengthening in Greece? Evidence in the Historical and Western European Contexts. In E. Close, M. Tsianikas and G. Frazis (Eds.) "Greek Research in Australia: Proceedings of the Fourth Biennial Conference of Greek Studies, Flinders University"

Datallo P. (2013), Analysis of Multiple Dependent Variables, Oxford University Press, New York

Flanagan A., Syvertsen A., and Stout M., (2007), Civic Measurement Models: Tapping Adolescents' Civic Engagement , The Pennsylvania State University, Circle Working Paper 55, May

Hoshins B., Villalba E., Nijlen D., Barber C., (2008), "Measuring Civic Competence in Europe", European Communities

Huasheng T., (2012) A Survey on Civic Consciousness in Contemporary China, International Education Studies; Vol. 5, No. 6

Janowitz, M. (1983). The reconstruction of patriotism: Education for civic consciousness. Chicago: University of Chicago Press

Kovalchuk V. , (2015) "Civic Consciousness Development of Youth in the Context of Educational Reforms", The US Experience, Comparative Professional Pedagogy, 5(2)

Lange, D., & Onken, H. (2013). Political socialization, civic consciousness and political interest of young adults. In M. Print, & D. Lange (Eds.), Civic education and competences for engaging citizens in democracies (pp. 65-76). Rotterdam: Sense Publishers.

Parsons T. and Shils E. (1951) Towars a General Theory of Action, Cambridge, Mass.

Pope IV, A. (2014), "Critical civic consciousness: Exploring the US civic opportunity gap with Giroux and Freire", Citizenship Teaching & Learning 9: 3, pp. 241–256

Sánchez M., (2010) Defining and measuring environmental consciousness, Revista Internacional de Sociología (RIS), Vol.68, nº 3, Septiembre-Diciembre, (pp. 731-755)

Sandahl, J. (2015). Civic consciousness: A viable concept for advancing students' ability to orient themselves to possible futures? Historical Encounters: A journal of historical consciousness, historical cultures, and history education, 2(1),

Valeeva A. R., Koroleva E. N. & Sakhapova K. F., (2014), "Civic Education of the Technical Uni-

versity Students in Foreign Language Classes", Canadian Center of Science and Education

Valeeva A. R., Koroleva E. N. & Sakhapova K. F., (2015), "Development of The Technical University Students' Civic Consciousness", Procedia - Social and Behavioral Sciences, May

Wray-Lake L., Metzger A., & Syvertsen A., (2016), "Testing multidimensional models of youth civic engagement: Model comparisons, measurement invariance, and age differences", Applied Developmental Science

Annex 1. Operationalized Structure of Civic Consciousness
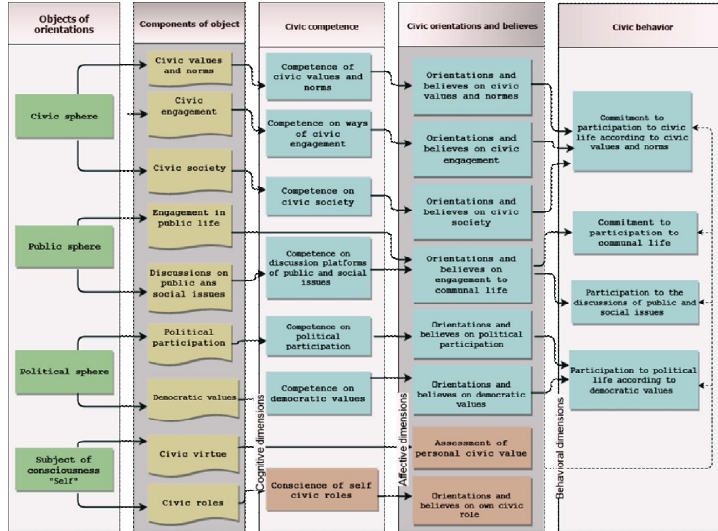
The Great Idea and the Peace of San Stefano.

Stamatia Fotiadou

Democritus university of Thrace, Department of History and Ethnology

matinafwtiadou@hotmail.com

Abstract. The present paper is part of my PhD project which aims to juxtapose the various aspects of the Greek and Bulgarian national idea during the last decades of the 19th century, and more specifically from the end of the Russo-Turkish War in 1877/78 until the unification of Eastern Rumelia and Bulgaria in 1885, in order to draw a meaningful comparison and interpret the multifaceted nature of two opposing Balkan nationalisms. More specifically it examines how the Athenian press reacted against the provisions of the preliminary agreement of San Stefano in the beginning of 1878 in order to present the different flavors that the Greek Great Idea acquired in the time span between the San Stefano peace and the Treaty of Berlin.

Keywords: *Peace of San Stefano, Athenian Press, Nationalism, Greece, Great Idea*

1. Introduction

The Graeco-Bulgarian antagonism over the territorial control of Macedonia and Thrace was an important aspect of the Eastern Question which was temporarily settled by the Treaty of Berlin in July 1878. Before that the preliminary peace of San Stefano[1] which ensued from the Russian victory in the Russo-Turkish of 1877/78 had provided Bulgarians with all they could dare hope for uniting Moesia, Macedonia and Thrace in one state which was to stretch from the Danube and the Black Sea to the Aegean[2]. Obviously this settlement also served Russian expansionist policy in the

---

[1] *Preliminary Treaty of Peace between Russia and Turkey: Signed at San Stefano*, February 9/ March 3, 1878, The American Journal of International Law Vol. 2, No. 4, Supplement: Official Documents 1908, 387-401.
[2] Crampton J. R., (2007), *Bulgaria*, Oxford University Press, Oxford, 93-95.

Balkans[3]. Bulgaria was designed to become the strongest state in the Balkans under Russian influence and patronage[4]. However, Russia's aspirations to establish its hegemony in the Balkans were met with strong reaction by the other European Powers which led to the revision of the San Stefano agreement in the Congress of Berlin.

In the meantime Greece was alarmed by the Russo-Turkish initial arrangements for the establishment of a large Slavic state which would nullify Greek plans for territorial expansion northwards[5]. Greek political elites and public opinion started to realize that the fate of the Ottoman ruled provinces of Macedonia and Thrace was at steak[6]. Moreover, the Athenian press bitterly commented on the disproportionate Greek and Bulgarian gains[7].

2. The Great Idea and the Peace of San Stefano

In the course of the last decades of the 19th century the Greek Great Idea was still shaping and reshaping against an unstable political and diplomatic situation in the

---

[3]Dialla A., (2008/2009), *Russian nationalism and the eastern question: the case of Panslavism (1856-1878), Modern Greek Studies Yearbook, University of Minnesota*, Vol. 24/25, 73-92, 85.

[4] Russia would assume controlling position from the very beginning of the peace implementation. For example, Russians would supervise the organization of the autonomous Bulgarian state in the presence of their army. Jelavich B., (2004), *Russia's Balkan Entanglements 1806-1914*, Cambridge University Press, Cambridge, 175.

[5]Kofos E., (2001), *Η Ελλάδα και το Ανατολικό Ζήτημα*, εκδοτική Αθηνών, Αθήνα, 151.

[6]Dakin D., (2012), *Η Ενοποίηση της Ελλάδας*, ΜΙΕΤ, Αθήνα, 205.

[7]While the Bulgarian state would possess the largest part of Macedonia and Thrace (except Thessaloniki and Chalkidiki) including cities with Greek population such as Kastoria, Serres and Kavala no territorial expansion was provided for Greece. According to the Treaty of San Stefano Turkey was committed to observe the Organic Law in Crete and introduce a system of local administration in Epirus and Thessaly with Christian participation. Divani L., (2000), *Η Εδαφική Ολοκλήρωση της Ελλάδας (1830-1947). Απόπειρα Πατριδογνωσίας, Εκδόσεις Καστανιώτη, Αθήνα,* 232.

Ottoman Balkans, which was complicated by the interference of the Great Powers[8]. Greek society was still frustrated after the Greek political isolation and the concomitant failure to accomplish the Great idea through the Crimean War[9].

At a time that the memories of the Crimean War (1853-1856) were still fresh, the proposal for a Graeco-Turkish approach and the formation of a Greek-Ottoman federation came to the fore[10], although differently understood by different political and intellectual milieux. This stance was also determined by the fact that Constantinople as the cultural capital of Greece still exerted influence over Greek political and intellectual elites[11]. In this context the publications of the Athenian press reveal how Greek society was divided between those who opposed the prospect of a Graeco-Tukish approach looking for Russian support instead, and those who favored the creation of a Greek-Ottoman federation in order to prevent Bulgarian possession of Macedonia and Thrace.

More specifically the terms of the San Stefano peace attracted the immediate attention of the Athenian press. Obviously the views that each newspaper propagated to the Greek public were in line with its overall political and ideological profile[12]. The unique pro-Russian newspaper was the 'Ephimeris', which however expressed conflicting views towards Russian foreign policy. While it refrained from making any comments on the San Stefano provisions for Bulgaria, it criticized Greek governments for not having laid claims to Greek territorial expansion and for being indifferent towards the sufferings of the Greek populations living in the Ottoman Empire[13]. At

---

[8]Skopetea E., (1988), *Το «Πρότυπο Βασίλειο» και η Μεγάλη Ιδέα, όψεις του εθνικού προβλήματος στην Ελλάδα*, Πολύτυπο, Αθήνα, 288.
[9]*«Laos»* (1878), 13/3.
[10]Exertzoglou H., (1996), *Εθνική ταυτότητα στην Κωνσταντινούπολη τον 19ο αιώνα, Ο Ελληνικός Φιλολογικός Σύλλογος Κωνσταντινουπόλεως*, 1861-1912, Νεφέλη, Αθήνα, 23.
[11]Exertzoglou H., (2015), *Εκ δυσμάς τω φως;, Εξελληνισμός και οριενταλισμός στην Οθωμανική Αυτοκρατορία μέσα 19ου - αρχές 20ού αιώνα*, Εκδόσεις του Εικοστού Πρώτου, Αθήνα, 42.
[12]The analysis of the ideological and political profile of the Athenian newspapers is one of the issues of my ongoing research.
[13] *'Διότι τώρα, ως κατηντήσαμεν, δεν έχει διατετυπωμένας η Ελλάς αξιώσεις περί μεγεθύνσεως αυτής, αλλά παράπονα γραώδη κατά της αυξήσεως της Βουλγαρίας... Πώς να διαμαρτυρηθώμεν δια την Καβάλαν, ενώ υπό τα όμματα του ελληνικού στρατού οι*

the same time it opposed the plans for a Greek-Turkish approach the newspaper editor characterizing them as an indication of 'national unconsciousness'[14].

However, most Athenian newspapers belonged to the opposite site of the spectrum such as the newspapers "Laos", "Alitheia", "Dikaion" and "Ora". According to them the inclusion of the allegedly Greek regions of Macedonia and Thrace to Great Bulgaria was a heavy blow to Greek irredentist policy[15]. Being pro-British they published data and statistics in order to show that ethnic Greeks besides their cultural superiority formed the majority of the Christian population in Macedonia and Thrace[16]. They also published lengthy articles on Bulgarian history and culture in order to demonstrate the cultural differences between Greeks and Bulgarians[17]. In addition they proposed that Macedonia be granted autonomous status[18].

Pro-Russian sentiments receded when it was announced that due to British intervention a Greek delegation would be allowed to present the Greek case in the Congress of Berlin[19]. At the same time articles presenting Great Britain as the unique defender of Greek national interests appeared in the pro-British press[20].

3. Conclusions

αιμοβόροι Τούρκοι ατιμάζουν κόρες, καίουν ιερείς και καταστροφήν σπείρουν παντού! Μήπως όμως μόνον εις την Θράκην και Μακεδονίαν υπάρχουν Έλληνες; Η Μικρά Ασία έχει υπέρ του εν και ήμισυ εκατομμύριον Ελλήνων, ως οι πλειότεροι αγνοούν την γλώσσα των! Οποία πρόνοια ελήφθη περί αυτών ποτέ;': "Ephimeris" (1878), 1/3.

[14] *"Ephimeris"* (1878), 1/3.

[15] *'Ο εν Θράκη ελληνικός πληθυσμός πλεονάζει κατά το 1/3 του βουλγάρικου στοιχείου, υπερτερεί προς δε αυτού και πλούτου, και παιδείας, και εμπορίω και βιομηχανία .... Σχολεία αρρένων και θήλεων πανταχού της Θράκης ανέκαθεν ιδρύθησαν': "Laos"* (1878), 11/3.

[16] The newspaper "Ora", for example, often publishes ethnological maps and demographic statistics, regarding the Greek and Bulgarian presence in Macedonia and Thrace: *"Ora"* (1878), 22/3.

[17] *"Laos"* (1878), 15/3.

[18] *"Laos"(* 1878), 20/2.

[19] *"Alitheia"* (1878), 1/3 & 2/3.

[20] *'Ζήτω ο Αλφρέδος και η Αγγλία – Ιδού έργα τα οποία η ελληνική ευφυΐα επιτέλεσε, και δια των οποίων αμαυρωθέντων παρά της παρούσης μάλιστα κυβερνήσεως, προεκλίθη ή την οποίαν σήμερον η Ευρώπη αποδεικνύει ζωηράν υπέρ ημών συμπάθειαν': "Laos"* (1878), 18/3.

In sum, on the eve of the Congress of Berlin two opposing trends are displayed in the Athenian press. On the one hand it was the "Ephimeris" for which any effort at establishing an alliance with the Ottomans equaled national treason; on the other the newspapers who favored a more flexible policy towards Turkey. Although they admitted that long-term Greek and Turkish interests were conflicting, they claimed that under the current circumstances an alliance with Turkey would serve Greek national policies.

It is not strange that for the Greeks the traditional national enemy was the Ottoman Empire at least until 1870. Under the new unfavorable circumstances, they had to readdress the issue of their enemies and allies. Now it was the Bulgarians who became the most hateful enemies within a few months replacing the Turks who had held this position for more than four centuries. The Greek-Bulgarian conflict over the possession of Macedonia and Thrace made any attempt at reaching an understanding impossible. Moreover Greece was confronted with a problem that was not prepared to deal with.

4. References

4.1 Newspapers

"Alitheia" 1/3/1878
"Alitheia" 2/3/1878
"Dikaion" 8/3/1878
"Ephimeris", 1/3/1878
"Laos" 20/2/1878
"Laos" 18/3/1878
"Laos" 11/3/1878
"Laos" 13/3/1878
"Laos" 15/3/1878
"Ora" 22/3/1878

4.2. Bibliography

Crampton J. R., (2007), *Bulgaria*, Oxford University Press, Oxford.

Dakin D., (2012), *Η Ενοποίηση της Ελλάδας*, ΜΙΕΤ, Αθήνα.

Dialla A., (2008/2009), *Russian nationalism and the eastern question: the case of Panslavism (1856-1878)*, Modern Greek Studies Yearbook, University of Minnesota, Vol. 24/25, 73-92.

Divani L., (2000), *Η Εδαφική Ολοκλήρωση της Ελλάδας (1830-1947). Απόπειρα Πατριδογνωσίας*, Εκδόσεις Καστανιώτη, Αθήνα.

Exertzoglou H., (2015), *Εκ δυσμάς τω φως;, Εξελληνισμός και οριενταλισμός στην Οθωμανική Αυτοκρατορία μέσα 19ου - αρχές 20ού αιώνα*, Εκδόσεις του Εικοστού Πρώτου, Αθήνα.

Exertzoglou H., (1996), *Εθνική ταυτότητα στην Κωνσταντινούπολη τον 19ο αιώνα, Ο Ελληνικός Φιλολογικός Σύλλογος Κωνσταντινουπόλεως, 1861-1912,* Νεφέλη, Αθήνα.

Jelavich B., (2004), *Russia's Balkan Entanglements 1806-1914*, Cambridge University Press, Cambridge.

Kofos E., (2001), *Η Ελλάδα και το Ανατολικό Ζήτημα*, εκδοτική Αθηνών, Αθήνα.

Preliminary Treaty of Peace between Russia and Turkey: Signed at San Stefano, February 9/ March 3, 1878, The American Journal of International Law Vol. 2, No. 4, Supplement: Official Documents 1908, 387-401.

Skopetea E., (1988), *Το «Πρότυπο Βασίλειο» και η Μεγάλη Ιδέα, όψεις του εθνικού προβλήματος στην Ελλάδα*, Πολύτυπο, Αθήνα, 288.

CRIMINAL POLICY OF RM FOR COMBATING AND PREVENTING SEXUAL ABUSE OF CHILDREN

Vedije Ratkoceri

PhD Candidate / Assistant in the criminal field - Law Faculty
South East European University – Tetovo – FYROM
v.ratkoceri@seeu.edu.mk

Abstract. This paper aims to present comprehensively the activity of state institutions namely the criminal policy of FYR of Macedonia in combating and preventing child sexual abuse. Firstly, the author will give a legal overview of the criminal legislation where there will be treated the respective articles in the Criminal Code regarding the incrimination of sexual violence against children and the evolution of penalties for perpetrators of such offenses. The subject of the study in this paper will also be the relevant documents adopted by the state institutions for combating and preventing pedophilia and other activities undertaken by these institutions in this regard. Will be analyzed the "Action Plan for the management of child sexual abuse and pedophilia 2009- 2012" adopted by the Government and the "Protocol for cooperation between the competent authorities in cases of child sexual abuse and pedophilia", legal overview of the "Law on Special register of persons convicted with a final judgment for crimes of sexual abuse of minors and pedophilia". There also will be reviewed the content of the online portal with the data of convicted persons for pedophilia in our country and the latest innovation in this field, incorporation of medical-pharmacological treatment as a security measure for child sexual abusers or otherwise known as "chemical castration of pedophiles". In this case, the Criminal Code and the Law on Execution of Criminal Sanctions and relevant articles that regulate the implementation and enforcement of this measure will be reviewed in depth.

Key words: *child sexual abuse, pedophilia, criminal code, criminal policy, security measures*

1. Introduction

Sexual abuse of children represents one of the most serious crimes against children in the contemporary world. This crime brutally violates the freedoms and fundamental rights of the child. The criminal legislation of FYROM considers "children" all the persons under the age of 14. These individuals due to the degree of their psycho-physical development are unable to protect themselves from abuses of a sexual nature, and it is the duty of society and state institutions to protect their physical and psychic integrity. Sexual abuse of children by adults represents a complex crime due to the psychological state of the perpetrator and psychophysical condition of the victim. Even more complicated is the situation when the child will be sexually abused by family members (incest), i.e. where the child should feel safe and

where it is believed that the best protection is offered. Looking at the statistics in our country, we can conclude that we have a significant number of abusers (sexual abuse of children), in some cases recidivist.

Therefore, following modern trends, our country has undertaken a series of legal measures to strengthen the criminal policy to combat and above all to prevent child sexual abuse. In this regard, in 2008 the Government of the RM drafted and adopted the "Action Plan for the prevention and management of child sexual abuse and pedophilia 2009-2012" which preceded the legal changes that followed in the Criminal Code, where new offenses against sexual abuse of children were incriminated and penalties prescribed for these types of offenses were significantly aggravated. Furthermore, a special law for online register of pedophiles was adopted, where the general public can have access to data on persons convicted of pedophilia in the country. "Protocol on Cooperation between the competent authorities in case of sexual abuse of children and pedophilia" was also adopted, which aims to take measures and actions in the most efficient manner by all organs of state that have to intervene in these cases. Definition of pedophilia by contemporary psychological literature, including the World Health Organization, appears as a mental disorder. Therefore, we should have specific approach for treatment of these individuals. Here we are talking about their medical treatment. In this sense, the FYR of Macedonia in 2014 became the first country in the region which incorporated in its criminal legislation the measure of medical-pharmacological treatment, also known as chemical castration and which will be applied in children sexual abusers.

2. Overview of Criminal Code regarding incrimination of child sexual abuse

The Criminal legislation of the FYROM based on the necessity for efficient protection of children from sexual abuse incriminated a number of offenses in the Criminal Code.

Therefore, the Criminal Code of RM in the nineteenth Chapter foresees "Crimes against gender freedom and gender morality," including these crimes: Rape – Article 186 ; Abuse of a disabled person – Article 187; Sexual assault against a child who has not attained 14 years – Article 188; Abuse using abuse of power – Article 189; Satisfaction of sexual desires in front of the other – Article 190; Mediation in conducting prostitution – Article 191; Child prostitution – Article 191-a; Displaying a pornographic material to a child – Article 193; Production and distribution of childrens pornography – Art. 193-a; Enticement on sexual intercourse or other sexual acts of a child who has not attained 14 years – Article 193-b; Incest – Article 194; Publication of court verdict – Article 194-a.

Furthermore, several other acts of this nature are also incriminated outside of this chapter, such as Article 197 - "Life affair with children" as well as Article 418-g - "Child traffiking".

Taking into consideration the social risk of these criminal offenses, the necessity to prevent these serious crimes and to offer an effective protection for the victims on one hand and the necessity of harmonization of the criminal legislation in this area with the international conventions and recommendations on the other hand, this chapter of the Criminal Code was changed and modified several times, but mostly in 2009 and 2014.

The Novel of 2014[1] made significant interventions and changes in the part of the crimes against gender freedom and gender morality where the punishments foreseen in this chapter for the criminal offenses of sexual abuse of children under the age of 14 were significantly harshened.

The offense of "Sexual assault against a child who has not attained 14 years", it is considered that it is done by someone who will perform sexual intercourse or other action against a child who has not attained 14 years and will be sentenced to at least 12 years of imprisonment. Before the changes in 2014, the punishment for this crime was at least 8 years of imprisonment. The second paragraph further provides the most severe form of this offense, stating that if due the action performed as described in paragraph 1 is caused grievous bodily harm, death or other serious consequences or if the offense is committed by several persons or in a cruel and degrading manner, the perpetrator will be sentenced by at least 15 years imprisonment or life imprisonment (Article 188). The object of protection of this crime is the right development of children up to age 14, which means fully protection from various forms of sexual abuse (pedophilia) and by abnormal influences on their formation as healthy individuals. This is why criminal law includes principle prohibition to any sexual relationship with children who have not attained 14 years, regardless of gender. Sexual intercourse or other sexual action either willingly or by force are also incriminated, so the childs agreement to such relationships has no value since the child this age can not form free will[2].

Other aforementioned criminal offenses also aim to protect children from any kind of sexual abuse. To achieve this goal, the penalties prescribed for such offenses are quite high. For instance, for the offence "Satisfaction of sexual desires in front of the others" in the third paragraph it is claimed that whoever commits a sexual act in front of a child who has not attained 14 years or pushes him to conduct a sexual act in front of him or in front of someone else, such an act shall be punished with imprisonment of at least 4 years (Article 190).

As the worst form of committing the criminal offense "Child prostitution" is foreseen committing such acts against a child who has not attained the age of 14 and the punishment prescribed for the perpetrator in this case is at least 10 years of imprisonment (191-a).

---

[1] Law on Amendments and Addendums of the Penal Code of RM, Official Gazette No. 27.2014, 2014

[2] Kambovski, V. (2015). *Komentar na Krivicniot Zakonik na Republika Makedonija* (Vol. II). Skopje: Matica, pg.817

For the criminal offence "Production and distribution of child pornography" the penalty prescribed is imprisonment from 5 to 8 years (193-a).

For the criminal offence "Fraud or other action for sexual abuse against a child who has not attained 14 years" the penalty prescribed is imprisonment from 1 to 5 years (193-b).

For the criminal offence of incest in the cases when it is committed with a child who has not attained 14 years the penalty prescribed is at least 10 years of imprisonment.

The last Article of this Chapter, named "Publication of court verdict" provides that when sentencing for a crime committed against a child who has not attained the age of 14, the Court, upon the request of the public presecutor, will decide that on behalf of the offender the final Court verdict or a certificate from this verdict will be published in the public media, while protecting personal data of the victim (194-a). This Article has a preventive nature, because it is considered that if the public is familiar with the Court verdict and the data of the sexual offender this will protect the children from the perpertrator especially in the area where he lives.

3. Action Plan for the prevention and management of child sexual abuse and pedophilia 2009-2012

Government of FYROM approved the "Action Plan for the prevention and management of child sexual abuse and pedophilia 2009-2012" in 2008. The purpose of this plan was to contribute to the reduction of this phenomenon and its consequences, through increasing awareness, taking preventive measures, ensuring coordinated and effective protection, assistance, rehabilitation and reintegration of child victims of sexual abuse. This plan also aimed to provide the tools and mechanisms for the implementation of the assistance and protection of children from sexual abuse and pedophilia and establishment and promotion of a coordinated system of cooperation between governmental institutions and relations between governmental and non-governmental sector, including all areas that cover this issue .[3]

Within the document in question it is determined that this plan was based on several international documents, namely the Conventions which protect the rights of children such as the Convention of the Council of Europe for protection of children from sexual exploitation and sexual abuse, convention that deals the prohibition of child labor and urgent action to eliminate the worst forms of child labor, Convention on the rights of the child and the optional Protocol on the sale of children, child prostitution and child pornography.

Briefly, these were the specific goals of this plan:

The first goal has to do with the legal reforms, where the Plan determines that by the end of 2009, the Republic of Macedonia needs to harmonize its legislation with the Convention for the protection of children from sexual exploitation and sexual abuse of Council of Europe and also to ratify this Convention. This was expected to be realized through the adoption of relevant laws and amendments to existing laws.

---

[3] Action Plan for the prevention and management of child sexual abuse and pedophilia 2009-2012 retrievd from
www.mtsp.gov.mk/WBStorage/.../akcionen_plan_zloupotreba.doc

Therefore, this goal is achieved and these changes were made with the Law on Amendments and Addendums of the Penal Code of RM[4] on September 2009 where the existing incriminations for the child sexual abuse where modified and there was also introduced a new criminal offense "Enticement on sexual intercourse or other sexual acts of a child who has not attained 14 years" (article 193-b). As I mentioned above, significant changes were made also in 2014.

The second goal has to do with the research and analysis of the situation of child sexual abuse and pedophilia, data that should be obtained through the research of the current situation. On this occasion a study on the state of child sexual abuse and pedophilia in 2010 was prepared by the Institute for Sociological, Political and Juridical Research of the University "St. Cyril and Methodius" in Skopje and the UNICEF Office. The study was called "The abandoned and stigmatized - Analysis of the situation: the sexual abuse of children". We can say that this was the first serious and comprehensive research supported by governmental bodies, regarding the current state of child sexual abuse in our country.

The third goal relates to prevention and hereby are planned a series of activities towards raising public awareness about the problem of child sexual abuse and pedophilia that should be done through: various media campaigns, promotional materials, organizing workshops with the general population; organization of different educational workshops and introduction of the problems of sexual abuse and pedophilia into school curricula in nursery, primary and secondary schools; organization of different educational workshops with children and parents / caregivers; informing and educating parents / guardians and families who are at risk of social problem of child sexual abuse and pedophilia; training for NGOs in the country for the implementation of preventive activities to the problem of child sexual abuse and pedophilia; encouragement denouncement of cases of sexual abuse of children; undertaking measures for involvement of children in the education system and a number of other similar measures of a preventative nature.

Fourth, measures of assistance and protection to victims of child sexual abuse and pedophilia, which include: early detection of child victims of sexual abuse in educational centers-institutions, health care centers, social protection centers and necessary coordinated actions, the opening of the national SOS line for denouncing of child sexual abuse and pedophilia, the provision of effective treatment, assistance and protection of child victims of sexual abuse and pedophilia, prohibition of further victimization of children-victims of sexual abuse, provision of adequate forms of protection and care of child victims of sexual abuse and pedophilia as well as opening of information centers for the treatment of children - victims and their families and their psychosocial support.

The fifth goal was about the perpetrators respectively child sexual abusers and included the measures and treatment program for persons convicted for criminal sexual abuse of children and pedophilia, during and after the period of the sentence. Therefore, in 2014 a new security measure was introduced in our criminal legislation which will be elaborated in depth later in this paper.

The sixth goal, as was putted in this plan, it concerns the coordination of

---

[4] Law on Amendments and Addendums of the Penal Code of RM, Official Gazette No. 114/09-14, 2009

competent authorities with non-governmental organizations for international cooperation and this was expected to be realized through the preparation of a single protocol for operation of institutions in the detection and treatment of cases of sexual abuse children and pedophilia, A key protocol was introduced in 2012 and will be discussed in this paper.

The seventh goal foresees continuing education of staff as continuous education of competent persons as well as inclusion of content related to child sexual abuse and violence into educational curricula in adequate higher education institutions.

The eighth goal, so called Specific evidence provides evidence establishing and reporting system for cases of child sexual abuse and pedophilia. As we shall see in this paper, in accordance with this, legal changes followed and now our country has special criminal records in addition to two records for cases of pedophilia.

And last, monitoring and evaluation that determines the effective and coordinated implementation of the action plan including financial implications, ultimately budget forecasts for all these activities.

4. Protocol for cooperation between the competent institutions in cases of sexual abuse of children and pedophilia

In order to undertake the most efficient measures for the prevention and management of child sexual abuse and pedophilia in the country, it was seen as a necessary action to adopt the Protocol for cooperation between the competent institutions in the cases of child sexual abuse and pedophilia[5]. This protocol was introduced and promoted by the Government in August 2012.

With this protocol is provided effective and successful cooperation of the competent authorities to raise the level of protection and assistance to child victims of sexual abuse and pedophilia, as well as assistance to the perpetrators of these criminal acts towards changing of their behaviour and their integration in society[6].

Also, with this protocol is regulated the cooperation between competent authorities in accordance with the law, bylaws and Action Plan for the prevention and management of child sexual abuse and pedophilia for 2009-2012.

In this Protocol are provided the types of cooperation, the manner and the content of this cooperations between competent authorities and other participants in this process of detection and prevention of sexual abuse of children and pedophilia and in providing protection of child victims of sexual violence and pedophilia, as well as assistance in the integration of the offenders of these criminal society acts and their behaviour changing.

5. Special Register for persons convicted for the offense of child sexual abuse and pedophilia

---

[5] *For more See* Protocol for cooperation between the competent institutions in cases of sexual abuse of children and pedophilia. Retrieved february 20, 2017, from http://mtsp.gov.mk/WBStorage/Files/protokol_zloupotreba_deca.pdf
[6] *Ibid*.

A continuation of the the preventive fight aginst pedophilia and sexual abuse of children in FYR of Macedonia was the publication of data for persons convicted for pedophilia and other offenses related to child sexual abuse.

Therefore, in the Article 106-a of Criminal Code named "Special register" in the second paragraph is defined: "The court will deliver to the state administration body responsible for the affairs in the field of labor and social policy the data on persons convicted by a final judgment for offenses against freedom and gender morality and for the criminal offense under Article 418-g of this Code committed against minors, for which will be led a special register". According to the third paragraph of this article, the purpose for the existence of this registry is to protect the rights of minors, under the terms and procedure determined by law. Meanwhile, the first paragraph of this article specifies keeping a special registry also for people to which is imposed a security measure, wich are registered in medical records. Therefore, with this article there are established two separate registries among criminal records and their purpose is exclusively preventive, ie for the protection of persons to whom a security measure is imposed or the protection of minors[7].

Basing on this article in 2012 the Parliament adopted the "Law on Special register of persons convicted with a final judgment for crimes of sexual abuse of minors and pedophilia"[8]. According to this Law an online register was created with personal data of the persons convicted for the crimes prescribed in the Chapter "Crimes against gender freedom and gender morality" against children under 14 years. This online register has an open access and anyone can see who are the persons convicted for pedophilia in the FYR of Macedonia.

This online register[9] is coordinated by the Ministry of Labor and Social Policy and led by Bureau for Social Welfare –Skopje. Here you can search the informations on persons convicted in the country, the respective town or district, their personal data: name, surname, address and photograph and the type of offense and sentence imposed. Also on this register there is prospect of the search by name and surname, if you wish to verify whether there was or is any appointed person convicted of such offenses. In the data of these persons it is also evident that the person concerned is serving a sentence or he/she is released.

In this portal there are data for a total of 214 persons who have committed 226 criminal offenses and who have served sentence or are serving sentence for crimes related to pedophilia. 5.14% of them or 11 convicted are female perpetrators and the rest 94.86% are males.

The largest number of criminal offenses committed in a total of 143 cases has to do with the offense of "sexual assault against a child who has not reached age 14" from Article 188. Than follows the offense under Article 418-g "Child trafficking" where we have a total of 43 cases, of which 6 are female perpetrators. There are 7 cases of

---

[7] Kambovski, V. (2015). *Komentar na Krivicniot Zakonik na Republika Makedonija* (Vol. II). Skopje: Matica, pg.625

[8] Law on Special register of persons convicted with a final judgment for crimes of sexual abuse of minors and pedophilia - Official Gazette No.11/2012.

[9] Online register of pedophiles - www.registarnapedofili.mk

incest from Article 194, all males. For the criminal offense under Article 189 "Sexual abuse with abuse of position" there are 4 cases, all males.

Male persons also have committed offense under Article 187 "Sexual abuse of disabled people", where there are 2 cases, and from Article 191-a "Child prostitution" a total of 3 cases. For the criminal offense under Article 193 "Exposure of child pornographic material" were convicted total 9 perpetrators, 8 males and 1 female. As a criminal offense where females outperform males, where from a total of 6 cases 4 are female perpetrators, is the one from Article 192 "Push towards and enabling sexual acts". With the changes in 2014 this criminal offense has been deleted from the Criminal Code of the Republic of Macedonia.

Regarding the profile of women as perpetrators in this record, it results that there are additional 11-female perpetrators convicted for offenses related to child sexual assault or criminal offense under Article 418g – child trafficking.

Regarding the geographical scope where perpetrators of these crimes come from, according to the data, majority of them are from the city of Skopje, a total of 15 cases and the Skopje region (the respective municipalities), with a total of 41 persons. Regarding the penalties sentenced to these people, penalties of imprisonment for a term of 4 years lead, with a total of 38 cases, with 8 years of imprisonment were sentenced 24 people, with 5 years - 17 people, with 10 years imprisonment - 15 persons, 1 person is sentenced with 13 years imprisonment, and one person is sentenced to life imprisonment and there are no data for one person.

As mentioned above, one person was sentenced to life imprisonment. It is the person with initials ZK, aged 45 years from Bitola, who was captured in 2013 and according to the media writings at the time, in 2013 ZK raped two minors (aged 8 and 11 years old) in his apartment and also, for a period of time, he had committed shameful acts in front of minors (aged from 8 to 15 years) in schoolyards.

In addition to these information in order prevention and protection of children, the portal contains a range of educational information regarding pedophilia and its prevention. Data of pedophiles will remain in this database (record) for a period of 10 years after the release of the convicted and if the perpetrator doesn't repeat the offense for this period of time, his data will be deleted.

6. Medical-pharmacological treatment for child sexual abusers

Following the trends from other countries, FYR of Macedonia with the Amendments to the Criminal Code[10] in February 2014, introduced a new security measure called "Medical-pharmacological treatment", or known as "chemical castration".

A state can castrate its citizens using one of two methods: surgical castration or chemical castration. Each achieves different physical and psychological results and is

---

[10] Law on Amendments and Addendums of the Penal Code, Official Gazette of RM No. 27.2014

thus only justifiable in certain situations [11]. Today castration is used in certain countries in the form of punishment (sentence) or in the form of medical treatment for offenders mainly of sexual crimes especially sexual abuse against children.

Castration has its origin very early in the ancient world. Thus, Physical castration of males has been known and used in the Ottoman Empire, where in the sultan's harem (the place where lived the Sultan's wives, concubines and maids) where able to serve and work only castreted males (whose genitalia were removed entirety)[12]

It was a punishment for adultery in ancient Egypt, for rape in twelfth century Western Europe, and for homosexuality in thirteenth-century France. In ancient Greece slaves were castrated for commercial purposes. In the USA, it was forced on prisoners of war and slaves. At the beginning of the nineteenth century, the eugenics movement used castration as means of protecting the "welfare of society" by castrating persons with mental deficiencies [13].

The term "chemical castration" describes a medical treatment that uses antihormonal drugs to block the release of hormones, resulting in significantly lower testosterone levels and sex drives in men [14]. Chemical castration consists in giving the medicine on a periodic basis, usually in the form of injection, which quenches the sexual libido.[15] Sweden, Germany and Denmark were among the first countries to allow chemical castration, as an alternative to the surgical form which is also permitted. It is significant that in these countries it is utilized solely as a voluntary treatment [16]. In certain legislations chemical castration is incorporated as a sanction (USA, Poland, Estonia etc), meanwhile in others (Great Britain, Germany etc) is used as a medical treatment for the sex offenders with their their reconciliation[17]

Criminal Code of RM in the Article 65-a states that: To the perpetrator of sexual assault against a child under 14 years old, when there is a risk of further commitment of such offenses, the Court can impose a measure of medical-pharmacological treatment (paragraph 1). So, this measure is provided only for the criminal offense "Sexual assault against a child who has not attained 14 years" (Article 188). The imposition of this measure needs the consent of the perpetrator of

---

[11] Oswald, Z. E. (2013). "Off with His __": Analyzing the Sex Disparity in Chemical Castration Sentences. (A. a. http://repository.law.umich.edu/mjgl/vol19/iss2/5, Ed.) *19 Mich. J. Gender & L. 471*

[12] *For more See* Victor, C. T. (2006). *A Brief history of castration* (Second edition ed.). Bloomington, Indiana, USA

[13] Winslade W. (1998) cited by Koshevaliska, O. (2014). Medical Pharmacologic Treatment (A. K. A. Chemical Castration) in the Macedonian Criminal Code. *Balkan Social Science Review , 4*, 25-45.

[14] Murray. (1998). California's Chemical Castration Law: A Model for Massachusetts? *Criminal and Civil Confinement , [Vol. 24:729.*

[15] Kambovski, V. (2015). *Komentar na Krivicniot Zakonik na Republika Makedonija* (Vol. II). Skopje: Matica.

[16] Wilson, D. (2007). The legal implications of chemical castration of sex offenders in criminal law. *Australasian Law Teachers Association - ALTA 2007 Refereed Conference Papers.* Australasian Law Teachers Association - ALTA

[17] Kambovski, V. (2015). *Komentar na Krivicniot Zakonik na Republika Makedonija* (Vol. II). Skopje: Matica.

the criminal offense, so, it is on a voluntary basis. "Compensation" for voluntary submission to such medical treatment is the reduce of the sentence of imprisonment, respectively, the perpetrator will serve half of the sentence. For instance, if for the criminal act is sentenced life imprisonment, the court may impose to the offender a sentence to imprisonment of 40 years; if for the criminal act imprisonment of 40 years is sentenced, the Court may impose to the offender a sentence of 20 years of imprisonment; and if criminal act is punishable by 20 years of prison, the court may impose the minimum prison sentence prescribed for that criminal act as long as the perpetrator agrees to undergo chemical castration treatment, which will last until the end of his life or until the Court estimates that is necessary to take the treatment (paragraph 2, 3 and 4 of the Article 65-a) .

Unlike the other security measures in our legislation, which are executed before serving the eventual prison sentence, the pharmacological-medical treatment will be executed after the perpetrator serves the prison sentence, meaning after the perpetrator has been released in freedom. The chemical castration will be performed in the specialized medical institutions. Supervision for the implementation of the treatment will be performed by the Directorate on Execution of Sanctions who will inform the court at least once in 6 months regarding the execution of this measure and the need for the continuation or discontinuation of the treatment (paragraph 5 of the Article 65-a).

Whereas, in principle, the application of the chemical castration is on a voluntary basis with the consent of the perpetrator, the application may be converted into mandatory in cases when the perpetrator will not undergo chemical castration or willingly abandons the treatment after giving the consent and serving the sentence. In these cases the court can determine that the measure should be executed by force in the health institution or other specialized institution (paragraph 6).

Whereas, when dealing with recidivism, the court will order the mandatory chemical castration even without the consent of the offender (paragraph 7) but without further specifying whether in this case they will benefit dimidiation or any easements.

The procedure of execution of the security measure of medical-pharmacological treatment is regulated by the Law on the Execution of Criminal Sanctions of the Republic of Macedonia[18] with the changes made to this law in November 2014 where as a novelty was incorporated an entire chapter, Chapter XXI-a titled "Medical-pharmacological treatment of perpetrators of the offense sexual assault against a child who has not attained 14 years".

This law regulates which institutions are responsible for the execution of this measure, who has the obligation to supervise the execution of this measure, how is the procedure of execution and other relevant issues regarding chemical castration.

This law states that the treatment will be done in specialized medical institutions.

A Directive by the Minister of Health, as indicated in law will arrange which are these institutions and the way how this procedure shall be done (Article 257-a).

---

[18] Law on Amendments and Addendums of the Law on Execution of Sanctions, Official Gazette of RM No. 166/2014

The law confirms that the supervision of the execution of the chemical castration should be done by the Directorate on Execution of Sanctions in corporation with Corrective institutions - prisons and specialized medical institutions. Corrective institutions are obligated to send the court decision with which this measure has been imposed to the Directorate for Execution of Criminal Sanctions immediately after the beginning of prison sentence of the convicted person, (Article 257-b). The way how this data will be submitted more closely will be regulated with an additional Act from the Minister of justice (Article 257-b). Furthermore, this Directory send the verdict to the specialized medical institution before commencing the preliminary stage for the release of the convicted person for the purpose of performing the analysis and preparation for the medical-pharmacological treatment (Article 257-b (2)).

For the initiation and the course of the enforcement of the medical-pharmacological treatment, the specialized medical institution has an obligation to inform the Directorate for Execution of Criminal Sanctions every six months, while this Directory may request further information from the medical institution beyond this period about the health condition of the person to whom this measure is applied and the results from the application of the measure, whereas, on the other hand the Directorate for Execution of Criminal Sanctions informs the court at least once in six months about the measure execution or about the need of its extension or termination (Article 257 – v).

In circumstances when the person who has to undergo the treatment does not appear in the treatment for reasonable grounds, it is obliged to justify his absence within three days from the day when it had to undergo this treatment in the specialized medical institution, and for it to notify the institution. After receiving the excuse, the medical institution appoints a new term for the implementation of this measure and notifies the Directorate for Execution of Sanctions.

The specialized medical institution has the option to postpone the medical-pharmacological treatment if the person brings evidence for another hospital treatment or in a case of death occurred to close family member. This delay can last maximum until the end of the hospitalization respectively up to 3 days after the death of a close family member (Article 257-d). In addition, the person who must undergo this treatment, has an obligation to inform the specialized medical institution for any change of address of residence (Article 257 – g).

If the convicted person wont undergo the treatment for unjustified reasons or if exceeds three days from the day when it had to appear to the medical institution, the institution is obliged within 48 hours to inform the Department for execution of criminal sanctions. For this kind of refusal or leaving the treatment, the Directory, without delay will inform the competent court. In order to execute the measure, the Court without delay will order his bringing by force and this order will be submited to the police. If the person is unreached for the authorities, the court will realise a warrant for arrest (Article 256- gj). All expenses for the execution of the medical-pharmacological treatment will be on the burden of the Budget of the Republic of Macedonia (Article 257 –e).

Directorate for Execution of Criminal Sanctions shall establish and maintain separate records of convicted persons to whom is pronounced the measure of medical-pharmacological treatment. Minister of Justice determines the form, content and manner of these data (Article 257 – zh).

With the incorporation of the chemical castration in its criminal legislation, Macedonia became the first country in the region that fights pedophilia with a medical treatment. The relevant articles that were analysed in this paper satisfactorily regulate the issue of chemical castration of pedophiles, but also show us some deficiencies.

For example, the specialized medical institutions are not assigned yet, as well as the chemical castration procedure in unknown, including the medicament that will be used for this procedure, since there isn't issued yet a Directive by the Minister of Health. Also a high concern remains whether this measure is consistent with the fundamental human rights and dignity.

Until today, the measure of chemical castration is not yet imposed in the courts of FYR of Macedonia.

7. Conclusions

As noted in this paper FYR of Macedonia has undertaken a series of measures and actions to combat and prevent child sexual abuse. Action Plan which regulated in details the actions who needed to be undertaken by the competent authorities for its implementation, in a large measure is considered as implemented, therefore there have been a significant legal changes, The Protocol was approved, it was published online the special register of pedophiles and is was incorporated the medical-pharmacological treatment for pedophiles as a security measure.

Therefore, the recent amendments to the Criminal Code and the involvement of many incriminations of criminal acts against children brings us to conclusion that our country provides a solid legal protection for children- victims of sexual abuse and incriminates all the forms of child sexual abuse. Also, our criminal code has harshened the penalties for sex offenders and this will contribute to a more efficient fight against these crimes.

It remains to work further on raising awareness about child sexual abuse, also in the area of the support of the children victims after victimization and offering assistance for their fast and successful rehabilitation. In this regard, therefore, in practical terms, unfortunately, it was not done enough until now.

References

1. Law on Amendments and Addendums of the Penal Code, Official Gazette of RM No. 27.2014

2. Law on Amendments and Addendums of the Penal Code of RM, Official Gazette No. 114/09-14, 2009

3. Law on Amendments and Addendums of the Law on Execution of Sanctions, Official Gazette of FYROM No. 166/2014

4. Law on Special register of persons convicted with a final judgment for crimes of sexual abuse of minors and pedophilia, Official Gazette of FYROM No. 11/2012

5. Action Plan for the prevention and management of child sexual abuse and pedophilia 2009-2012 retrieved from www.mtsp.gov.mk/WBStorage/.../akcionen_plan_zloupotreba.doc

6. Ministry of Labor and Social Policy (n.d.). Protocol for cooperation between the competent institutions in cases of sexual abuse of children and pedophilia. Retrieved february 20, 2017, from http://mtsp.gov.mk/WBStorage/Files/protokol_zloupotreba_deca.pdf

7. Online register of pedophiles - www.registarnapedofili.mk

8. Ratkoceri V. (2017) Chemical Castration as a security measure in the criminal legislation of the Republic of Macedonia. *International Journal of Social Sciences and Education Research, Volume 3 (2), pp. 356-360.* ISSN: 2149-5939.

9. Victor, C. T. (2006). *A Brief history of castration* (Second edition ed.). Bloomington, Indiana, USA

10. Koshevaliska, O. (2014). Medical Pharmacologic Treatment (A. K. A. Chemical Castration) in the Macedonian Criminal Code. *Balkan Social Science Review , 4*, 25-45.

11. Oswald, Z. E. (2013). "Off with His __": Analyzing the Sex Disparity in Chemical Castration Sentences. (A. a. http://repository.law.umich.edu/mjgl/vol19/iss2/5, Ed.) *19 Mich. J. Gender & L. 471* .

12. Murray. (1998). California's Chemical Castration Law: A Model for Massachusetts? *Criminal and Civil Confinement , [Vol. 24:729]* .

13. Kambovski, V. (2015). *Komentar na Krivicniot Zakonik na Republika Makedonija* (Vol. II). Skopje: Matica.

14. Wilson, D. (2007). The legal implications of chemical castration of sex offenders in criminal law. *Australasian Law Teachers Association - ALTA 2007 Refereed Conference Papers.* Australasian Law Teachers Association - ALTA.

15. PERPETRATORS OF CRIMINAL OFFENCES IN 2015 – State Statistical Office of Republic of Macedonia, Skopje, July 2016,

Available on: http://www.stat.gov.mk/PrikaziPublikacija.aspx?id=43&rbr=635

16. Maletzky B. -Sexual abuse and the sexual offender,Karnac Books Ltd,2016,ISBN:978-1-78220-389-6

A Comparative View on the Legal Protection of Family Home and the Current Situation in FYR Macedonia

Albana Metaj-Stojanova

Faculty of Law, South East European University
a.metaj@seeu.edu.mk

Abstract. Family home is a central hub that connects spouses, parents and children in the exercise of family rights and duties. The importance of family home is incontestable not only in terms of daily life and existence of family members, but also in terms of exercising family's main social functions. In recent decades, modern European legislations have acknowledged the significance of family home, thus giving it a special legal status and legal protection, reflected in limited ownership rights of spouses and greater protection of interests of children, especially needed in cases of divorce. Despite the importance of family home, it is still classified under the same set of rules that apply to other marital assets and does not enjoy special legal protection under Macedonian law. General provisions concerning the management, disposal and use of this property apply, depending on whether the family home is joint property of spouses, acquired during marriage, or separate property of one of them. This article aims to answer the question whether family home needs special regulation and protection under Macedonian law by analyzing the concept of family home and the legal provisions given by the Italian and French Civil Code concerning this matter. The methodology applied is qualitative research and use of the analytical and comparative methods. The article concludes that special legal protection of the family home would be in the best interest of the children.

Keywords: *family home, joint property of spouses, separate property of spouses, division of property, best interest of the child*

1   Introduction

When we think of family home, we do not necessarily think of property rights and legal provisions, but instead, the first thing that comes to mind is a feeling of emotional connectedness that derives from close personal and affective relations that are created and developed within the household. This is so, because there is a very close connection between family relations and family home, thus one could not even imagine the very existence of the family and the development of familial relationships

outside, or in absence of a family home. Family and marriage are pre-legal and pre-state natural structures that have accompanied mankind from its beginnings to the present day. The social and state interest in regulating and disciplining marital and family relationships has been high throughout all stages of human evolution. The legal doctrine broadly recognizes that the social interest in family relations' legal regulation and protection is closely related to the social functions of the family. The nuclear family carries out some important social functions such as the reproductive function, the economic cooperation function, the educational function [1]. The numerous transformations that the family structure has undergone, especially during the second half of the 20th century, enabled the emergence of other functions of postmodern families such as the function of family to provide protection, affection as well as emotional support for its members [2], [3], [4], [5]. All these family functions are carried out within the family home. Because of its central role in the family life, family home is considered to be an integral part of the family unit itself [6].

Even though the notions of "family" and "family relations" are among the oldest in human nature, they have evolved and undergone considerable transformations in the past decades, such as the shift in the legal treatment of women, the dramatic increase of the number of divorces and the increase of the percentage of children born out of wedlock. These transformations are mainly connected to the women's liberation movement of the late 1960s and '70s. The increase of the divorce rate generates many legal issues, among which, one of the most important is the reallocation of family property upon divorce.

One of the signals of transformation of family law in the last decades is the economic relationship between husband and wife, transformation that has generally resulted in joint management of family economic affairs by the husband and the wife [7]. Since the 1960's, a new generation of social historians has identified and historically traced the concept of "the new family". [8] Family is changing and transforming itself in relation to wider social trends and sometimes it is seen as a source of change itself which prompts changes to occur in public policy and provisions [9]. Hence, European countries have amended their legislation in order to adapt to these transformations. In the last decades many legal changes had to take place in order to ensure equal rights of both spouses and to implement the principle of the best interests of the child [10], not only within marriage, but also in cases of divorce. In 1980, the English Law Commission regarding lawsuits that involve minor children stated: "In such cases it may well be thought the primary concern must be for a broken family rather than a broken marriage; and the welfare of the children, social, psychological and economic, should take precedence over the adjustment of financial rights and duties of former spouses toward each other." [11]

This article will analyze the legal regulation of the family home by the Italian and French legislation in terms of property rights of spouses over family home during marriage, as well as in cases of dissolution of the marital relationship. The general rule is that dealings concerning the family home during marriage are effective only if the other spouse consents, regardless of the ownership. In cases of separation or divorce the family home is awarded to the spouse who has greatest need for it, including particularly a spouse with custody over minor children [12]. The aim is to explore legal solutions that could be adapted and applied in the Macedonian context, bearing in mind the fact that Macedonian law does not provide a special treatment of family

home. Thus, as it is the case with any other marital asset, the family home can either be joint property of spouses, acquired during marriage, or separate property of one of them. The regime of ownership is the only factor that affects the management and use of the family home during marriage and the division of it in cases of dissolution of marriage. In cases when family home is separate property of one of the spouses, he can freely dispose with it. No consent from the other spouse is needed [13]. In cases when family home is joint property, it will be divided equally between them by the court [14]. This is why in most cases of divorce, children who are entrusted to the custody and education of one spouse, and it is usually the mother, are forced to move out of the family home, which negatively affects their development [15].

2   Methodology

In this paper qualitative and comparative methods, commonly used in research in the field of social sciences will be applied. The qualitative method will be applied through the analysis of books, articles and papers related to the subject-matter, in order to get a clearer picture about the role, importance and legal regulation of family home. Legal solutions offered by the French and Italian Civil Code will be explored and an analysis of the current regulation of the family home by the internal law will be provided. The comparative method will be used in order to make comparisons and draw parallels between different legal regulations of the research topic. Based on the analysis of the existing Macedonian law and through comparison with other legal solutions, the need for special legal treatment of family home will be emphasized. It is expected that this paper contributes to the explanation of the special nature and importance of family home, as well as to the debate on the need for improvement of the internal legal framework concerning the research topic.

3   Literature review

"Family home" means primarily a dwelling (building, structure, vehicle or vessel) in which a married couple ordinarily resides [16], but not only. The notion of "family home" is broader as it encompasses the set of assets, movable and immovable, that serve to the domestic existence of the family and to the preservation of the interests in which family life expresses and articulates itself [17]. Family home is a special type of property, different from any other marital asset because it plays such a central role in our everyday lives.

Family is the natural and fundamental group unit of society [18] and it exercises multiple functions of great importance to society. The importance of family unit is best explained through the functionalist theory, which examines a part of society, such as the family in terms of its contribution to the society as a whole [19]. One of the first well-known functionalists is the American anthropologist George Murdock. In his work entitled "Social Structure", he examined a total of 250 societies of various kinds, both from hunters and gatherers category, as well as pastoral, agrarian or indus-

trialized. He concludes that despite the variety of forms, family is a universal social institution and gives this definition of the nuclear family: "a social group characterized by common residence, economic cooperation, and reproduction. It includes adults of both sexes, at least two of whom maintain a socially approved sexual relationship, and one or more children, own or adopted, of the sexually cohabiting adults" [1]. Hence, Murdock suggested that there were four essential social functions of the family: satisfaction of the sex drive within monogamous relationships, biological reproduction of the next generation; meeting its members economic needs; teaching basic norms and values to the young. Another important functionalist is Parsons, which has identified two other basic functions of the family unit: the primary socialization of children and the stabilization of adult personalities of the population of the society [19]. Families carry out all these functions within the family home therefore its importance is undeniable.

Family home as a legal concept, is closely related to a person's right to family life [20], as well as to the fundamental human right to adequate housing. In fact, the right to housing is considered to be a cornerstone of the right to an adequate standard of living [21], [22]. The right of housing and the right to family life are closely linked and their protection could well justify *ad hoc* proprietary rules, given the recessive nature of the property right, which the legislature could limit, in order to have full enjoyment of these fundamental human rights [23]. Property on the other hand is not a natural right, but a much needed construction of society. After the industrial revolution the idea that property is the basis of liberty prevailed. But the strengthening of private property was accompanied by abuses resulting from it and conflicts between property rights and personal rights have arisen [24].

A special legal treatment of family home would limit the property rights of the owner and would prioritize the needs and best interests of children in cases of separation or divorce. Children's best interests are served and protected by remaining in the family home, near their friends and school, rather than by moving to other unfamiliar surroundings [25]. The need for a special protection and a special status of the family home in FYR Macedonia was identified in a paper published in 2016 [12]. This article will go further and analyze the current situation of family home and its distribution upon divorce as regulated by the internal legislation, as well as the regulation of family home by Italian and French legislation. Apart from the legal provisions of the abovementioned Civil Codes, different authors will be brought to attention.

4 Family home in the existing legal framework of FYR Macedonia

The legislation of FYR Macedonia does not recognize or use the term "family home". Only one provision of the Law on Family refers to the family home, without however mentioning it explicitly. Thus, "the spouses decide by mutual consent about their mutual place of living and about the managing of the mutual household." [26] The property of spouses is regulated by the Law on Ownership and Other Real Rights, according to which "the property of spouses can be common and separate" [27]. Hence, the status of the family home during marriage and its distribution upon di-

vorce depends on whether it is common property of both spouses or separate property of one of them. If the family home is common property of spouses, they will jointly and in agreement manage and dispose it during marriage and none of them can independently dispose or burden its part in the common property [28]. This is so, because the share of each of the spouses in the joint property is undefined and until an eventual division and determination of the shares in the common property, a spouse cannot independently dispose of it or burden it [2]. In case of sale of a certain part of the common property, the spouses have the right of pre-emption [29]. This is also the stance of the Supreme Court of FYR Macedonia, according to which, a contract by which one of the spouses without the consent of the other spouse, has alienated and burdened a property acquired in marriage before its division between the spouses, is void [30]. When carrying out tasks beyond the framework of regular management and disposal of the property, the consent of the other spouse, expressed in the appropriate form is required [31]. If the spouses cannot agree on the management of the common property, the court decides [32].

In determining the shares of each spouse in the common property, the court starts from the fact that the common property must be divided into equal parts [33]. However, as a subsidiary rule, the division of common property according to the spouses' contribution is applied. The law gives the court the possibility to award a larger part of the common property, at the request of one of the spouses, if he or she proves that his or her contribution in the common property is obviously and significantly larger than the contribution of the other spouse [34]. In a decision of the Basic Court of Tetovo, the petition of the claimant (the wife), was accepted only partially since she could not argue the alleged contribution. In the petition the claimant requests from the court to confirm the right to ownership over half of the house, claiming that it was constructed from means earned through joint efforts during the marriage. The court ruled that only 1/10th of the building belonged to the claimant. The court does not doubt the fact that she has been caring for the children's upbringing and education, as well as for the housework, however, even though she had a hairdresser license, she had practiced this profession for a very short time, so there was no opportunity to generate income, with which she would contribute to the construction of the house. On the other hand, the defendant (the husband) managed to argue that the financial means needed for constructing the house, where generated by his 13 year of work abroad. Thereby, the defendant argued that his financial contribution to the construction of the house was 10 times greater than the contribution of the wife [35].

After the divorce, it happens frequently that one of the spouses is unable to pay the other one for his part of the joint property, on the basis of the pre-emption right, and the family home, which is often the most valuable asset of the couple will have to be sold.

Regarding the separate property of spouses, each one manages and disposes freely of it, unless they have agreed otherwise in written form [36]. This means, that the non-owner spouse will be forced to leave the family home, even if he or she has gained custody over minor children.

It is clear that the legal solutions offered by the Macedonian law regarding family home do not support the principle of the best interest of the child, enshrined in the CRC. Thus, the domestic law is not compatible with the convention, to which FYR Macedonia is a member country. Given the fact that in the period 2005-2015 the

number of divorces rose by 41.8% [37], the special legal regulation of family home by the domestic law becomes a necessity.

5   Legal status of family home in the Italian Civil Code

According to the Italian legislation "the spouses agree with each other about the address of family life and set the family residence according to the needs of both and the preeminent ones of the family itself." [38] Following the marriage there arises between the spouses the duty of cohabitation. The legal regime of property adopted in cases where the spouses have not entered into a specific agreement is the common property of spouses. If the family home is common property of the spouses, each of them can use the family home, as long as they do not alter its destination and do not prevent other family members from using it in accordance with their rights [39]. Each spouse enjoys a right *uti dominus* over the family home [23]. The management of common property is incumbent on both spouses, while acts exceeding the ordinary management, as well as the stipulation of contracts with which they grant or acquire personal enjoyment rights are jointly granted to both spouses [40]. In relation to third parties, obligations may be imposed on the common property, only if they are contracted jointly by the spouses [41]. As regards the family home in common property of spouses, full protection is provided by law, both with respect to the internal relations between them and also in relation to third parties.

In cases when family home is separate property of one of the spouses, the owner cannot perform acts that prevent or make the enjoyment of the family home more difficult for the other family members. The non-owner spouse acquires the basic right to inhabit the home and to use its furnishing as a personal servitude [23].

Prior to the so called filiation reform [42], in cases of divorce or separation the family home was awarded to the spouse to whom the minor children were entrusted [43]. With the entry into force of the Law no. 154, December 28th 2013, the situation changed. The new law gives priority to joint custody instead of sole custody of minor children. Accordingly, the amended Civil Code states that the enjoyment of the family home is attributed primarily, with regard to the interests of the children [44]. Main criticisms that have to do with this legal solution relate to the idea that the best interest of the child should be assessed case-by-case by the court. The court must verify in each case which is the housing modality that most closely matches the development of the child's personality: prevalent placement with one parent, turnaround residence at both of the parents, or the alternation of the latter at the family home where the child keeps his residence. In this perspective, it is worth reviewing the position of the Italian jurisprudence, which tends to reproduce the old patterns of sole custody and considers as the only means of achieving the moral and material interest of the offspring, the fixing of the habitual residence of one of the parents and the assignment to them of the right to enjoy the family home [45].

6 Legal status of family home in the French Civil Code

According to the French legislation, spouses are allowed to have separate domiciles, but only if this does not undermine the legal provisions concerning the community of living [46]. Spouses mutually oblige themselves to a community of living and they jointly determine the family residence [47]. According to French law the right to dispose of the family home during marriage is limited by the consent of the other spouse, even in cases when it is a separate property [48]. After divorce, the family home belongs to the person who owns it, but the court may grant it on lease to the other spouse when parental authority is exercised by the latter or in cases of joint custody, when the children have their usual residence in this family home. This right ceases with the coming of age of the youngest of the children, in case of remarriage of the one to whom it was granted or when the latter lives in a state of notorious concubinage. In all cases, the judge may terminate the lease in the event of new circumstances [49].

The Act no. 305-2002 of March 4th, 2002, brought about changes regarding the custody of minor children upon divorce. Thus, separation of the parents has no influence on the rules of devolution of the exercise of the parental authority [50]. A judge in charge of family causes (*juge aux affaires familiales)* shall settle issues watching in particular over the safeguarding of the welfare of minor children [51]. The residence of a child may be fixed alternately at the domicile of each of the parents or at the domicile of one of them. On request of one of the parents or in case of disagreement between them about the mode of residence of the child, the judge may order provisionally an alternate residence of which he shall determine the duration. On the expiry of it, the judge shall rule finally on the residence of the child alternately at the domicile of each of the parents or at the domicile of one of them [52]. It is noteworthy, that the French legislation is much more flexible and adaptable to the needs and welfare of the children, that the Italian one.

7 Conclusions

Based upon the analysis of the national legal system and the solutions offered by the Italian and French Civil Codes, we can conclude that a special treatment and protection of family home within the legislation of FYR Macedonia is necessary. It is important for the family home to enjoy special protection, both during marriage and upon divorce. Regarding the family home status during marriage, it is important that the right to dispose of the owner is limited by the consent of the other spouse. In cases of dissolution of marriage the legislation should provide a solution that is in the best interest of the minor children. For this purpose, the legislation may allow the court to establish a personal servitude in the form of *habitatio* or to establish a lease in favor of the spouse to whom the children are entrusted in custody. These solutions are guided by the principle of the best interest of the child. The children must be able to enjoy the opportunity to continue living in the house where they spent their years of life; a

choice which aims to avoid, in addition to the discomfort of the separation of the parents, the further trauma of a forcible departure from what, until a few days ago, represented their own family environment.

8   References

1. Murdock, G. (1967), *Social Structure*, Third Printing, The Free Press, New York

2. Trpenovska et al. (2013), *Semejno Pravo*, Kulturna ustanova Blesok, Skopje

3. Podvorica H. (2005), *E Drejta Familjare*, Prishtine

4. Omari, S. (2007), *E Drejte Familjare,* Tirane

5. Aliu, A, Gashi, H. (2007), *E Drejta Familjare,* Universiteti i Prishtines, Fakulteti Juridik, Prishtine

6. Withnall, C. S., (1990), Negligence and the House that Jack Built, *Otago Law Review,* Vol. 7, no. 2, 189-201

7. Hafen, J. O. (1991), Review of M. Glendon: The Transformation of the Family Law: State, Law and Family in the United States and Western Europe, *BYU Law Review,* Vol. 1991, no. 1, 719-735

8. Lewin, L. (1983), The New Family and the New Property by Mary Ann Glendon, *Boston College International and Comparative Law Review,* Vol. 6, no. 1, 361-367

9. Silva, E. B., Smart, C. (1992) *The New Family?,* SAGE Publications Ltd., London

10. Article 3 of the Convention on the Rights of the Child

11. The Law Commission, (1980), *The Financial Consequences of Divorce: The Basic Policy, English Law Commission Report*

12. Article 337 sexies cc, Article 155 quarter cc of the Italian Civil Code

13. Article 68 of the Law on Ownership and Other Real Rights of Republic of Macedonia (2001)

14. Article 75 of the Law on Ownership and Other Real Rights of Republic of Macedonia (2001)

15. Mickovik, D., Ristov, A., (2016), Family Law in the Civil Code of the Republic of Macedonia, *Journal of Civil and Legal Sciences*, Vol. 5, no. 1, 1-6

16. Section 2 (1) of the Irish Family Home Protection Act (1976)

17. Frezza, G, (2011), *Casa familiare in Trattato di diritto di famiglia,* Zatti, Milano

18. Article 16 (3) of the Universal Declaration on Human Rights (1948)

19. Haralambos & Holborn, (2013), *Sociology: Themes and Perspectives, 8th Edition,* Harper Collins Publishers Limited, London

20. Article 12 of the European Convention on Human Rights (1950)

21. Article 25 of the Universal Declaration of Human Rights (1948)

22. Article 11 (1) of the International Covenant on Economic, Social and Cultural Rights (1966)

23. Sesta, M., (2013), Comunione di Vita e "Diritti" sulla Casa Familiare in *Famiglia e Diritto,* Vol.5/2013, pages 511-520

24. Reich, C. A., (1964), The New Property, *The Yale Law Journal,* Vol. 73, no. 5, pages 733-787

25. Davis, M. F., (1983), Comment: The Marital Home, Equal or Equitable Distribution?, *University of Chicago law Review,* Vol. 50, No. 3, 1089-1115

26. Article 32, paragraph 2 of the Law on Family

27. Article 66 of the Law on Ownership and Other Real Rights

28. Article 70, paragraph 1, 2 of the Law on Ownership and Other Real Rights

29. Article 70, paragraph 3 of the Law on Ownership and Other Real Rights

30. Supreme Court of FYR Macedonia decision, in "Collection of Court Decisions", book 4, page 62, decision no. 3 ("*Zbirka na Sudski Odluki",* kniga 4, p. 62)

31. Article 72 of the Law on Ownership and Other Real Rights

32. Article 73 of the Law on Ownership and Other Real Rights

33. Article 75, paragraph 2 of the Law on Ownership and Other Real Rights

34. Article 75, paragraph 3 the Law on Ownership and Other Real Rights

35. Decision of the Basic Court of Tetovo, no. 423/1997 (15.10.1997)

36. Article 68, paragraph 3 of the Law on Ownership and Other Real Rights

37. State Statistical Office, (2016), *Macedonia in Figures,* page 13, found on: http://www.stat.gov.mk/Publikacii/MakedonijaVoBrojki2016_en.pdf

38. Article 144 of the Italian Civil Code

39. Article 1102, paragraph 1 of the Italian Civil Code

40. Article 180 of the Italian Civil Code

41. Article 186/d of the Italian Civile Code

42. Law no. 154 of December 28th, 2013

43. Ex Article 155, paragraph 4 of the Italian Civil Code

44. Article 337, paragraph 6 of the Italian Civil Code

45. Figlia G.C., (2015), Assegnazione della Casa Familiare e Interessi in Conflitto. Ricercando un "Ragionevole Bilanciamento" nel Dialogo con la Giurisprudenza, *Actualidad Juridica Iberoamericana,* no. 3 bis, 347-370

46. Article 108, 108-1 of the French Civil Code

47. Article 215, paragraph 1, 2 of the French Civil Code

48. Article 215, paragraph 3 of the French Civil Code

49. Article 285-1 of the French Civil Code

50. Article 373-2, paragraph 1 of the French Civil Code

51. Article 373-2-6, paragraph 1 of the French Civil Code

52. Article 373-2-9 of the French Civil Law

Information and Communication Technologies

Towards Assembling Photo Lineup Identification via Convolutional Neural Networks

Hana Trojanová[1], and Ladislav Peška[2],

[1] Department of Psychology, Faculty of Arts, Charles University, Prague, Czech republic
`trojhanka@gmail.com`
[2] Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic
`peska@ksi.mff.cuni.cz`

Abstract. Lineups may be used as key evidence in the investigation process, especially in cases where eyewitness testimony is the only evidence. This project focuses specifically on creating lineups based on photographs – a photo lineup. The main goals of the project are to create practical tools, data sets, and guidelines that will contribute to a simpler, more accurate administration of photo lineups and their subsequent verifications. We intend to achieve this goal with machine learning methods, which are based on learning the similarity of different objects through their pictures. Outputs of the machine learning methods will be compared with photo lineups created by experts in terms of lineup fairness.

Keywords: *Machine learning, Convolutional Neural Networks, Photo lineup, Lineup fairness*

1   Introduction

Evidence from eyewitnesses usually plays a significant role in criminal proceedings. A very important part is the lineup - eyewitness identification of the perpetrator. This forensic method consists of the recognition of persons or things and thus is linked with a wide range of psychological processes such as: perception, memory, and decision making. These processes can be influenced, and therefore many researchers try to identify variables that enter into the identification process.

Lineups may lead to the prosecution and subsequent conviction of the perpetrator. Yet there are cases where lineups can play a role in the conviction of an innocent suspect. This points to the importance of studying the issue of lineup procedure at a general level (studying patterns of processes involved in the formation of mistakes) as well as within the local, social, and legal conditions, which are also involved in the whole issue. Sources of error in eyewitness identifications are numerous. They can be found mostly in memory processes and the process of obtaining testimony through an interaction with investigators. One of the recommendations for inhibiting errors

caused by the interaction with investigators is a double-blind administration of lineup, which may be provided by computational methods (Douglass, Smith and Fraser-Thill, 2005). Lineup filling in general is based on searching in large datasets of persons, which is a difficult task, however, machine learning methods can be used to significantly simplify the process.

2 Literature Review

Variables entering the photo lineup procedure
Decades of research into the problems of eyewitness testimony has shown several variables that are more or less entering the process of identifying and affect its quality. According to Fulero (2009), these variables can be divided into estimator variables and system variables. Estimator variables include characteristics of the witness (eg. personal characteristics, level of attention, ethnicity; Meissner and Brigham, 2001), the characteristics of the event (distance or lighting, time of day or the duration of crime; Shapiro and Penrod, 1986) and testimony characteristics (its credibility and accuracy). These variables interfere with the accuracy of the witness, but are not under the control of the justice and the investigative authorities. System variables include the time interval between crime and testimony, the method of questioning, clarity and understandability of instructions in the lineup, the presence of other people, process conditions, etc. Those variables can be controlled by the system (judiciary, police, etc.) and it is possible to influence the effect (Fulero, 2009; Shapiro and Penrod, 1986). One of the ways to control the quality of assembled lineups for experiments is to measure its fairness.

Lineup fairness
Lineup fairness is a research variable usually assessed on the basis of data obtained from "mock witnesses" - people who have not seen the offender. Lineup fairness basically measures bias against the suspect. This task assures that recognition in the assembly is fair if the mock witness is unable to identify a suspect after only obtaining a brief description. An optimally fair lineup is when the mock witnesses identify the suspect as often as the fillers (Brigham, Ready and Spier, 1990; Mansour et al., 2017).

Machine learning and photo lineup
Promoting computer programs for identification by eyewitnesses is one way to ensure that the identification procedures will be double-blind for all witnesses (Douglass, Smith and Fraser-Thill, 2005). Searching for suitable lineup candidates is especially difficult in case of minority ethnics or specific age groups (Rhodes, Anastasi, 2012; Sporer, 2001). Sources which forensic technicians can use in such cases are, e.g., in the Czech Republic, very limited and can greatly affect the quality of created lineups. However, if properly assembled, this issue could be alleviated by applying some of the machine learning methods.

   Machine learning is a sub-area of artificial intelligence and includes algorithms and techniques that help computer systems adapt to the required changes. Variety of ma-

chine learning methods have been successfully applied to problems in the areas of economics, biology, medicine, computer science, and others. The aim of this project is to propose a system that would be able to create a set of photos for a lineup based on specified conditions. One of the key conditions is the degree of similarity of the people in the photos. This challenge is closely related to the problem of identifying persons which was successfully resolved by applying deep learning methods, namely convolution neural networks (CNN; Hu et al., 2015; Parkhi et al., 2015). Although machine learning methods have been used in a number of similar problems, we are not aware of its application in composing photo lineups.

3   Proposed Methodology

The nature of this project is primarily experimental. The first step would ensure the creation and preparation of background materials (database of candidates for photo lineups and machine learning methods for the selection of candidates), the implementation of pilot research, and to start collecting interaction data. The output of the initial research will be used to create tools (software, data sets, and guidelines based on real experiments), which in practice simplify the creation and administration of photo lineups.

To be specific, the steps of this project are:
1. Using machine learning techniques, especially CNN to compose photo lineups (including the creation of data sets of candidates).
2. Experimental evaluation of the fairness of the proposed photo lineups and comparing them with the outputs from practitioners.
3. Experimental verification of output quality with regard to the specific characteristics of the suspect (different ethnicity or ages).

Machine learning will be formulated to find potential candidates based on a plurality of characteristics derived from the profile of the suspect so that the resulted lineup set was fair. As a basic profile, photos and content-based attributes such as age, race, gender, etc. will be used. Lineup fairness will be approximated as the degree of similarity between the suspect and the group of candidates using a reference set of people in the early stages of the project. Later on, notion of fairness will be further refined by the collected interactions. In order to obtain the inter-person similarities, we plan to primarily use CNN. First, we will focus on the use of pre-trained CNN for facial recognition (Parkhi et al., 2015). The core idea of the project is to utilize CNN not to identify a specific person, but to compare the vector of similarities to the train set objects (photos) of suspect and other candidates of photo lineup. We hypothesize that the candidates with similar vectors (e.g., w.r.t. cosine distance) to suspect are good candidates for fair lineup. The arrangement and recommendation of candidates can use also other vector similarity measures, or take into account further characteristics (diversity, Radlinski et. al., 2008; individual user preferences, Fürnkranz and Hüllermeier 2010, etc.). Using already trained networks significantly reduces the time

to develop the first iteration of methods, then we plan to gradually adjust the networks according to the results of experiments.

For evaluating the fairness of CNN-based lineups we plan to use specific experiments similar to those used by Mansour et al. (2017). Respondents who do not have direct knowledge of the perpetrator will be given a verbal description and later will be asked to identify the suspect or determine that a target object is not present in the lineup. Subsequently, three sets of photo lineups will be made for each offender with varying degrees of similarity. We expect that the increasing similarity of members in a lineup will reduce the likelihood that the suspect will be guessed by the respondent on the basis of knowledge of a brief verbal description.

Upon the verification of the initial experiments, we plan to compare CNN-based lineups and lineups made by forensic technicians. In these experiments we focus on comparing both approaches w.r.t. specific suspect's characteristics (e.g., age and ethnicity) and lastly to combine both approaches. We suppose that the lineups made by software will generally receive higher fairness due to the ability to effectively explore larger data set, but may contain specific errors caused by machine learning generalization approach as well as inherently insufficient data representation, which can be however easily alleviated by forensic technicians.

4   Conclusions

The main objective of our work is to improve the process of photo lineups by employing machine learning methods, especially convolutional neural networks. CNN should address the problem of assembling lineups from the perspective of inter-person similarity by using the suspect's photo as the base for similarity estimation. The proposed method is able to quickly explore large databases of candidates and propose the most suitable ones. Lineups made by both practitioners and computer methods will be evaluated with respect to the lineup's fairness with consideration towards age and ethnicity. We believe that the practical benefit of this work will be both the decrease of workload for the practitioners assembling lineups as well as an increase of lineup fairness. In addition, the computer program can reduce the possibility of influencing a witness with the lineup's administrator.

Acknowledgement

References

Brigham, J. C., Ready, D. J., & Spier, S. A. (1990). Standards for Evaluating the Fairness of Photograph Lineups. *Basic And Applied Social Psychology*, 11, 2, 149-163.

Douglass, A., Smith, C., & Fraser-Thill, R. (2005). A problem with double-blind photospread procedures: Photospread administrators use one eyewitness's confidence to influence the identification of another eyewitness. *Law and Human Behavior*, 29, 5, 543-562.

Fulero, S. (c2009). System and estimator variables in eyewitness identification: A review, in Krauss, D., & Lieberman, J. *Psychological expertise in court: psychology in the courtroom*, *Volume II.,* Burlington, VT: Ashgate, 57-78.

Fürnkranz, J., & Hüllermeier, E. (2010). Preference Learning. In *Encyclopedia of Machine Learning*, Springer US, 789-795.

Hu, G., Yang, Y., Yi, D., Kittler, J., Christmas, W., Li, S. Z., & Hospedales, T. (2015). When Face Recognition Meets with Deep Learning: an Evaluation of Convolutional Neural Networks for Face Recognition. Computer Vision And Pattern Recognition. In *Proceedings of the IEEE International Conference on Computer Vision Workshops,* 142-150.

Mansour, J. K., Beaudry, J. L., Kalmet, N., Bertrand, M. I., & Lindsay, R. C. L. (2017). Evaluating lineup fairness: Variations across methods and measures. *Law And Human Behavior*, 41, 1, 103-115.

Meissner, C., & Brigham, J. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law*, 7, 1, 3-35.

Parkhi, O. M., Vedaldi, A., & Zisserman, A. (2015). Deep Face Recognition. *British Machine Vision Conference,* 1-12.

Radlinski, F., Kleinberg, R., & Joachims, T. (2008). Learning diverse rankings with multi-armed bandits. In *Proceedings Of The 25Th International Conference On Machine Learning (Icml '08)*. Acm, New York, Usa, 784-791.

Rhodes, M. G., & Anastasi, J. S. (2012). The own-age bias in face recognition: A meta-analytic and theoretical review. *Psychological Bulletin*, 138, 1, 146–174.

Shapiro, P., & Penrod, S. (1986). Meta-analysis of facial identification studies. *Psychological Bulletin,* 100, 2, 139-156.

Sporer, S. (2001). The cross-race effect: Beyond recognition of faces in the laboratory. *Psychology, Public Policy, and Law*, 7, 1, 170-200.

Towards a Sensor-Based Architecture for Remote Monitoring of Patients in Developing Regions: Review and Qualitative Research Methodology

Adelina Basholli[1], Thomas Lagkas[2], Peter A. Bath[3], and George Eleftherakis[2],

[1]South-East European Research Centre, University of Sheffield, Thessaloniki, Greece
[2]CITY College- International Faculty of the University of Sheffield, Thessaloniki, Greece
[3]Information School, University of Sheffield, Sheffield, U.K.
adbasholli@seerc.org, {tlagkas, eleftherakis}@city.academic.gr, p.a.bath@sheffield.ac.uk

Abstract. The healthcare sector has increased pressure towards improving the quality of care delivered to patients, especially considering new technological advances. The application of digital technology, like sensor-based applications, can help to monitor patients diagnosed with diseases who need constant treatment and management. Developing regions present suitable case studies where the number of people diagnosed with diseases that need continuous monitoring, more specifically chronic diseases, is increasing. In many developing countries, such as in Kosovo, the application of sensor technology for remote and real-time monitoring of chronic disease is not applicable in healthcare centres. Hence, this study presents a brief evaluation of the existing sensor-based applications, their applicability in developing regions, and identifies the research questions that may lead to a successful and cost-effective proposal of a sensor-based architecture. Qualitative Research is proposed as primary research method that will help in addressing the emerging research questions from the literature review.

Keywords: Sensor-based networks, continuous monitoring, chronic diseases, research methodologies, qualitative research, developing countries

1 Introduction

The term digital technology incorporates new technological advancements that are used for communication and sharing of information between parties. These trends are applicable also in healthcare domain. For example, many academic researchers and people from industry are working to apply digital technology for remote monitoring of patients' living parameters [1, 2]. Hence, sensor-based networks are proposed as a new and advanced technology that can be used to monitor patients' conditions continuously. The increasing number of people diagnosed with chronic diseases and the highest number of deaths caused by them, presents a serious threat to population health and to health service planning and delivery. These statistics are critical especially for developing countries, where it is expected that they will increase further [3, 4].

There are several arguments that support the decision for proposing sensor-based architecture to help developing regions treat and manage chronic illnesses. Moreover, in developing regions, the number of healthcare centres is low compared to the population and their needs [5]. Therefore, there are cases where the patients need to travel long distances to the nearest healthcare centre. Another fact, which enforces the research towards application of sensor-based platforms in developing countries, is related with the increased number of ageing population there [6]. It is worth to mention also that the highest number of elderly persons diagnosed with chronic conditions live in developing regions.

The idea of sensor-based applications in healthcare is closely related with user perception, because at the end the user will determine if sensor applications are worth using or not. Therefore, among some other facts, the successful implementation of a sensor-based application will highly depend on users' adoption and perception. Issues like application accuracy, data security and integrity, patient privacy and control over its data, are some of the aims that e-health products should comply with.

The aim of this research study is to evaluate existing sensor-based applications, critically analyse them and compare their applicability in a developing country. After a thorough analysis, this study identified the emerging research gap and set the research questions in order to address the identified gap. In order to answer the research questions, a research methodology section briefly presents possible research methods and the decision on the most appropriate one for this study.

2   Setting the Context

In order to be able to help in treating and managing chronic illnesses in developing regions, in this research we have considered Kosovo as a case study. Kosovo is a developing country and the poorest one in Europe [7]. It has a population of 1,771,604 [8], where 61% of them live in rural areas, and 50% of the population is under 25 years old. However, the ageing population is increasing year-by-year. For example, in 1981 the percentage of people above 65 years old was 4.5% of the total number of population and in 2011 this had reached 6.7% [9]. Below are summarized some of the arguments which make Kosovo a suitable case study for this research work. A detailed explanation of them can be found also in Basholli [10].

- Kosovo is a newly created Balkan country that has recently experienced war
  This means that the current healthcare infrastructure is under development. The public health system still operates with old technological trends and equipment [11].
- Sensor-based applications are not used for treatment or management of chronic diseases
  Most of the health providers, especially public healthcare centres, still use old techniques of health offering tools.
- Increasing number of ageing population
  According to Kosovo Agency of Statistics [12] this number will decrease further from 2.0 children per woman as it was in 2011, to

1.7 children per woman in year 2031, and 1.5 in year 2061. This is closely related with the increasing ageing population. Hence, considering the year 2011, the percentage of Kosovo population over 65 years old was 6.9% of the total population. This number is expected to become 40.6% by year 2061 [13].

- Increasing number of chronic ill patients

In the period of war, years 1998-1999, chronic diseases where the second leading factor of death after the deaths caused from war trauma [14]. The number of population affected from chronic conditions continued increasing, thus, from the total number of deaths in years 2010-2011, 59.27% of them were caused by conditions that were related with chronic diseases [15]. The situation was similar during years 2012-2013 [12]. Jerliu [7], in their investigation with elderly Kosovar population, found that 83% of the total number of participants (N=1890) reported at least one chronic condition, and cardiovascular diseases were dominating by 63% out of 83%.

- Limited access to medical services

Almost 90% of the chronically ill interviewees in the study conducted by Jerliu, Toçi, Burazeri, Ramadani, and Brand [9], reported that they had difficulties to access medical services. They also indicated that one of the reasons for this was their economical situations, where 87.7% stated that they could not afford the cost of health services.

- Limited number of medical staff especially in rural areas

According to Percival and Sondorp [11], there are around 13 doctors for every 10,000 inhabitants whereas in other developed European countries there are 35 doctors per 10,000 inhabitants. Another recent report from the Health Policy Institute [16] shows that the total number of medical staff is around 2003 doctors and 1059 nurses. Compared to the total number of population in Kosovo, this means that there are around 1.15 doctors and 3.84 nurses per 1,000 inhabitants respectively.

- Network infrastructure is developing and is comparable with other developed countries

The Kosovo Association of Information and Communication Technology [17] reported that Internet penetration in Kosovo is comparable with other European developed countries. This is due to the improved network infrastructure and technologies applied in the telecommunication industry in Kosovo.

All above mentioned facts present 'favourable' conditions for future investigations that are related with the aim of this research study. The cost, on the other hand, may be reduced. This was suggested also in the study by Basholli, et al. [18]. The paper compares living expenses in Kosovo and available commercial prices of sensor-based applications. Therefore, an affordable remote monitoring application will enable patients to record their chronic parameters, for example heart rate, blood pressure, oxygen saturation and similar; and send them wirelessly to the medical staff. This may enable quick reactions on emergency situations.

In the next section, similar sensor-based applications are evaluated. However, while considering these applications, we always had in mind the characteristics of a developing country addressed above.

3   Evaluation of the Existing Sensor-based Applications for Chronic Disease Related Parameters

In the literature, there are many studies related with the application of sensor-based networks in healthcare. However, the basic idea is almost the same; provision of healthcare in distance and monitoring of living parameters. Various studies, such as Darwish and Hassanien [19], or Appelboom [1], concluded the benefits of applying sensor technology for monitoring chronic ill patients or elderly people. Appelboom [1] investigated various sensor applications that are proposed for monitoring health conditions. Most of the analysed sensor applications were used for blood pressure (Ultrasound, AMON), heart rate, temperature, blood glucose, and blood oxygen. There were included also other, similar applications, proposed by researchers that are used for rhythm monitoring, or tissue glucose, waking activity, seizure activity, etc.

However, before proposing a sensor-based application a researcher should consider some very important aspects of such architecture that may dictate the successful implementation and application of it in practice. Hence, according to Milošević, Shrove and Jovanov [20], most of the presented similar sensor applications have limitations in the system integrations or the possibility of scalability; channel interference while using wireless communication links for exchange of the gathered information; no, or undefined, support for large amount of data coming from different sensor nodes and knowledge discovery; high costs; no continuous data exchange between the device and the medical centre; and unwieldy connections/wires between the sensors and their processing unit.

We also did a thorough analysis of the existing sensor-based applications for monitoring chronic diseases, as summarized in Table 1. To the best of our knowledge while investigating the literature and considering the studies presented in Table 1, it is noticeable that they have not used a user acceptance model to understand users' acceptance or evaluate their attitudes prior to proposing a sensor-based application. Or some of them have performed studies after they proposed the prototype and then they found some of the users' concerns, opinions or attitudes on using the specific system.

Table 1. Existing healthcare sensor-based applications

Project/Appli cation name	Tracked parameters	System highlights	Disadvantages	Comparing with our idea of the sensor based application
Smart Vest [21]	Heart rate (can record electrocardiograms-ECG), blood pressure, body temperature, record photo plethysmographs-PPG and galvanic skin response.	Washable shirt that is able to continuously record physiological signals. Can monitor several parameters through a single device without user interaction. The prototype was tested in a clinical environment using 25 males. The system had different accuracy levels compared to traditional models.	Still a prototype system. Wearable data acquisition and processing hardware are too big and impracticable to wear it. Battery of the hardware processing unit can last only 4.5h when it is fully charged.	Authors have not considered user acceptance or attitude to wear such shirt or get monitored by it, prior to proposing it.
AMON [22, 23]	Heart rate, blood pressure, oxygen saturation - SpO2, temperature, activity and a one lead ECG.	Presents a wrist-worn enclosure or monitoring system that is aimed for high-risk cardiac/respiratory patients. It can perform analysis of gathered data online and present them in appropriate form. Can monitor several parameters through a single device (which weights the half of grams that does Smart Vest's hardware processing unit). Performance of the AMON was tested by a medical study of 33 participants. The system had different accuracy levels compared to traditional models.	Gathered data are not transmitted continuously. Pandian [21] reports inconsistency in the reported medical data while using AMON.	This product is part of the project FP5 within the frame of European Union project; however the authors have not used a validation mean of their architecture. Even though they have tested it using medical study the results at the end showed that some patient had

				insecurities, complains which were not considered at the beginning.
HealthGear [24]	Blood oxygen and pulse levels while the user is sleeping.	HealthGear presents a set of sensors that use Bluetooth technology to send sensed data to a cell phone. The gathered data are stored, transmitted, analysed and presented to the user in appropriate form. The system was tested using 20 volunteers.	It uses Bluetooth technology which imposes interference caused by various factors. The data rate of this application is low (9600 bps). Batteries (two AAA) of the HealthGear can last 12 hours.	Authors in this study have not collaborated with medical doctors to test their application.
LifeShirt [25]	ECG and oxygen saturation.	LifeShirt presents a wearable monitoring system that is able to record ECG and oxygen saturation. It can record these data and store them for later access. It was tested by 10 normal participants and 10 hospital patients.	LifeShirt is designed to monitor patients in the operating room but not in real-time. It uses conventional electrodes and it does not provide online analysis of data. According to [21] the ECG recording of the outdoor participants was affected by the baseline wander, which created difficulties in analysing ECG. Furthermore, authors report that they had the biggest problem with monitoring respiratory function.	Authors have not considered user acceptance or attitude to wear such shirt or get monitored by it, prior to proposing it.
AliveCor's integrated phone case [26]	Heart monitoring.	AliveCor presents a smart-phone ECG reader that is able to monitor and record users' cardiac rhythms, as well as send their information to healthcare providers. It is a limited for sale product and is available only to medical	It does not provide continuous recoding of patient physiological data. AliveCor is available for a set of smart-phones and not compatible for all of them.	It is a limited for sale product in the United States-developed country. There are no information regarding

		professionals and patients that have prescriptions.		the user acceptance of such product.
ZIO patch [27]	Heart monitoring.	It presents a heart monitoring patch that is able to record continuously patient data for up to 14 days. Patient can use it during exercise, while sleeping, bathing (under certain conditions).	Gathered data are not transmitted in real-time.	Zio Patch presents a commercial product which is available in USA market-developed country.
Holter monitors [28]	Heart monitoring.	Holter monitors use web platform for presenting patients' data, and wired electrodes attached to the patients' chest to record medical data. It enables continuous monitoring of heat rate.	It presents wired architecture with electrodes which cause discomfort for the user and difficulty to wear for longer distances. Holter monitors do not transmit gathered data in real-time. According to Higgins [27], Holter monitors present slow communication system.	Present a commercial product available in market over the 60 years. However due to technology advances, and wireless communication links; its usage is decreasing.
Cardionet MCOT [29]	Heart rate.	MCOT enables continuous recording of heat rate and real-time transmission of gathered results. It has a similar architecture to Holter monitors as it uses electrodes and wires, as well as a mobile phone to process gathered data.	Similarly to Holter monitors, it uses wires connected to the processing unit.	It costs around 900 dollars [27] which is considered to be expensive for developing countries.
SensiumVitals [30]	Heart rate, respiratory rate and axillary temperature.	SensiumVitals presents another device in the form of patch used to monitor heart rate, respiratory rate and axillary temperature. This device has 5 days battery life.	This device is used within the hospital area to send wirelessly data signals to the nurses.	It does not provide distance-remote monitoring.

Wrist blood pressure measurement device [31]	Blood pressure.	It presents a wrist blood pressure device which is able to record continuously blood pressure values using DOPPLER ultrasound sensor, and a voice coil actuator which is used to change the pressure in a balloon.	Tested using a simulator, not real data.	Still prototype which is not tested using real-patient data.
Microwaves that irritate the human body techniques [32]	Respiratory rate, oxygen saturation, and coughing activity.	A system architecture that can detect the microwaves that irritate the human body. Such architecture is suitable to monitor respiratory rate, oxygen saturation, or coughing activity.	Tested using experimental data not real-time data.	Still prototype which is not tested using real-patient data.
UAHealth [20]	Weight, physical activity and heart activity.	UAHealth presents a mobile health integrating mobile application (iOS based), used for monitoring patients' weight, physical activity and heart activity. Gathered data are uploaded in the server were can be accessed further from the health professionals.	Does not use real-time communication. Thus gathered data are transmitted when the device is connected to the Internet.	No real-time communication. There are no information regarding the user acceptance of such product.
Zephry [33]	Heart Rate, R-R Interval, speed and distance.	Zephry presents a commercial product that is able to record heart data, r-r interval, speed and distance.	As it uses Bluetooth, it imposes much more interference caused by different factors and the data rate is lower.	Users need to have a smart phone in order to use this sensor-based application.
Kito [34]	Heartbeat, blood oxygen, body temperature, and takes an ECG reading.	Similarly to AliveCor's integrated phone case, Kito presents a smart-phone case that is able to monitor patients' heartbeat, blood oxygen, respiratory rate, body temperature, and takes an ECG. Gathered data from this application are	As it uses Bluetooth, it imposes much more interference caused by different factors and the data rate is lower.	In order to use Kito, users need to have a smart phone.

		displayed in the phone screen and are saved in the phone memory.		
A Real-Time Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors [35]	Heart monitoring	The proposed system comprises of the already proposed wearable sensor applications like Zephry, however the authors have designes a real-time monitoring system that uses the Bluetooth technology to transmit the data from wearable device to an Android phone. Then the data from Android device are transmitted using GPRS, 3G, or other Wi-Fi networks to MySQL database which presents collected data to an online web-based portal. The communication link is designed for the patient and doctor to have access there too.	The proposed system uses Bluetooth as communication technology or for sending the data from the wearable sensor device to mobile phone. Therefore, as it uses Bluetooth, it imposes much more interference caused by different factors and the data rate is lower. Moreover, the system was evaluated for 40 individuals after its proposal.	The proposed system consists of already proposed sensor-based applications. However, the contribution is the combination of such wearable sensors in designing a real-time communication system. Moreover, there is no information about user acceptance prior to proposal of such system.
HRM [36]	Heart monitoring	Real time Health monitoring application proposed in [36] consist of a wearable sensor that is mainly designed to monitor people that have problems with heart. Collected data are then transmitted using wireless internet connection to a database.	The proposed system needs to have wireless connection all the time in order to transmit gathered data from the sensors. Moreover, from the experimental results which were conducted after the proposal of the wearable device, it is shown that the proposed sensor-based application is not fully wireless.	There is no information about user acceptance prior to proposal of such system.
NovioSense	Blood sugar.	It provides a non-invasive tear	Still a proposal.	In the market there

[37]		glucose sensor which is combined with a metal coil coated with hydrophilic gel which is dropped into the eyelid.		is not a real-time and non-invasive solution for monitoring blood sugar levels [37].
Google proposed a lenses prototype [38]	Blood sugar.	It presents an idea under development that will help patients to monitor their glucose levels via their tears.	Still a prototype.	In the market there is not a real-time and non-invasive solution for monitoring blood sugar levels [37].
GlucoWise [39]	Blood sugar.	Sensor based device that will be able to measure blood sugar by transmitting low-power radio waves.	A proposal that is under development.	A proposal that is under development.
Glucosense [40]	Blood sugar.	Presents a wearable device that consists of a sensor head which will be able to collect data and measure them. Gathered data will be transmitted wirelessly to a smart phone or PC.	A proposal that is under development.	A proposal that is under development.

As presented in Table 1, various sensor-based applications have already been proposed for developed regions. However, if we consider developing regions, where economical and infrastructural conditions differ from developed countries, it is hard to implement and use such applications. This was another research gap which was identified, together with the limited number of similar studies that have considered users' attitude in developing regions, or remote-sensor applications that provide affordable solutions for population living in low- and- middle income countries.

4   Research Questions

Taking into account the detailed analysis and research related with the need for sensor-based applications for remote monitoring of patients with chronic diseases, as well as the brief evaluation of the existing applications, we have identified these research questions:

1. In what context, will the application of sensor-based platforms help developing regions to treat and manage chronic diseases?
2. How can the application of sensor networks address the needs of healthcare centres in developing regions?
3. What may be the factors leading to successful application of Sensor-Based Networks (SBN) in a developing country?
4. What may be the factors that can challenge the implementation of SBN in health system of a developing country?
5. Do the users need an application for managing and monitoring chronic diseases?
6. To what extent will the application of sensor-based networks lower the healthcare cost?
7. Is there an existing network infrastructure for implementing sensor networks in developing countries?
8. What should be the characteristics of an efficient sensor-based framework for healthcare in developing countries?

These research questions will serve as a primary resource for continuing with the research methodology. Therefore, in the next section we discuss research methods that will help us answer the identified research questions.

5   Research Methodology

Methodology is a group of methods, schemes, and procedures that lead the researcher to understanding, describing and exploring a phenomenon. Therefore, methodology is a broad term that defines the methods that are used in research, as well as specific steps that the researcher needs to follow to apply those research

methods. The application of research methods consists of gathering samples, data, documents, or related facts that help the researcher solve the problem. In order to have a well-defined methodology, the researchers need to explore possible methods that will help them answer their research questions, get familiar with a phenomenon, and determine frequencies of occurrence or test researchers' hypotheses. There are two basic research approaches, the quantitative approach and the qualitative one. Quantitative approach mainly deals with the situations where the researcher investigates how much or how frequently a phenomenon is happening. Therefore, if a research question consists of "how often" or "how many", it is recommended to use quantitative methods [41].

Qualitative research is concerned with subjective assessment of behaviours, opinions, attitudes, or gestures [41]. In this way, qualitative approach tries to explore peoples' experiences, interactions or communication within a group. More specifically, it tends to understand how things are happening; how they came to a specific point; what are the opinions of the interviewees; explore new research area where little investigation is done, etc. Qualitative approach is a research method which most of the time tries to transcript words into text or writing. Therefore, words and text are used as data instead of numbers that quantitative research uses [42]. Hence, qualitative research tends to investigate the social phenomenon and explain why things are the way they are, or why people do a specific behaviour; it tries to understand and explain peoples' opinions, and explore their concepts or views.

Based on the literature review it was concluded that most of clinical centres in developing countries still work with old and traditional health offering tools and equipment. Considering this fact, and the limited number of previous works for investigating the users' perceptions towards application of sensor platforms (specifically) in healthcare system, this study decided to use a qualitative approach primarily. As Flick [43] suggested, in cases where the phenomenon under investigation lacks previous research, the researcher needs to first elaborate and analyse the area. Hence, this study will first investigate the opinions of chronic ill patients and health professionals, attitudes, concerns and perception towards application of sensor-based platforms for continuous monitoring of their chronic conditions in developing regions. The qualitative approach will help to answer predefined research questions.

Another argument that supports the decision on the qualitative method, as a primary research method, is related with a previous research presented in [18] regarding user adoption of digital technology. The study found a very limited number of research studies that have investigated user perceptions towards the application of sensor networks for continuous monitoring of chronic diseases. According to that study, most of the literature focused on information technology in general, from the patient's or health professional's points of view.

6   Conclusions and Future Work

This study has presented possible approaches to the research and processes related with the research methodologies. Taking into account the overall aim of this study, which is the proposal of a unique, flexible and cost-effective sensor-based architecture, quantitative and especially qualitative methods were further elaborated. In this way, we were able to decide on the primary method to begin the investigation process.

The idea of using qualitative approach as a primary research method has to do with the lack of previous research in understanding patients' and medical staff attitudes, perceptions, and opinions on using sensor-based technology (this is also one of the general reasons for using qualitative research proposed by Flick [43]). Moreover, in Kosovo, sensor technology is not applied in healthcare centres to treat and manage remotely the chronic illnesses. Therefore, the application of a qualitative approach will help to identify users' willingness, experience, and attitudes and understand their opinions regarding application of sensor-based networks for continuous treatment and monitoring of chronic conditions.

The results of this qualitative study will lead the research towards proposal of a sensor-based architecture that will help developing regions in treating and managing chronic diseases.

References

1. Appelboom, G., Camacho, E., Abraham, M.E., Bruce, S.S., Dumont, E, Zacharia, B.E. et al.:Smart wearable body sensors for patient self-assessment and monitoring. Archives of Public Health 2014, 72:28, doi:10.1186/2049-3258-72-28 (2014)
2. Custodio, V., Herrera, F.J., López, G., and Moreno, J.I.: A Review on Architectures and Communications Technologies for Wearable Health-Monitoring Systems. Sensors. 13907-13946. doi:10.3390/s121013907(2012)
3. Minaie, A., Sanati-Mehrizy, A., Sanati-Mehrizy, P. & Sanati-Mehrizy, R.: Application of Wireless Sensor Networks in Health Care System. Proceeding of the 120th ASEE Annual Conference & Exposition. Paper ID #6904: American Society for Engineering Education (2013)
4. Suhrcke, M., Nugent, R.A., Stuckler, D., & Rocco, L.: Chronic disease: an economic perspective.   The   Oxford   Health   Alliance.   Retrieved   from http://www.sehn.org/tccpdf/Chronic%20disease%20economic%20perspective.pdf (2006)
5. Vo, A., Brooks, G.B., Farr, R. & Raime, B.: Benefits of Telemedicine in Remote Communities & Use of Mobile and Wireless Platforms in Healthcare. Research study made by the University of Texas Medical Branch (UTMB Health). Retrieved from http://internetinnovation.org/files/special-reports/91311_Vo_Telehealth_Paper.pdf (2011)
6. Virone, G., Wood, A., Selavo, L., Cao, Q., Fang, L., Doan, T., et al.: An Advanced Wireless Sensor Network for Health Monitoring. Transdisciplinary Conference on Distributed Diagnosis and Home Healthcare (D2H2), Arlington, VA (2006)
7. Jerliu, N., Ramadani, N. , Mone, I. & Brand, H.: Public health in Kosovo after five difficult years of independence. SEEJPH 2013. doi: 10.12908/SEEJPH- 2013-02

8. Kosovo Agency of Statistics: Population, candidate places, and potential candidates. Yearly statistical report by Kosovo Agency of Statistics. Retrieved from https://ask.rks-gov.net/ (2016)

9. Jerliu, N., Toçi, E., Burazeri, G., Ramadani, N. & Brand, H.: Prevalence and socioeconomic correlates of chronic morbidity among elderly people in Kosovo: a population-based survey. BMC geriatrics, vol. 13, no. 1. pp. 22. doi:10.1186/1471-2318-13-22 (2013)

10. Basholli A, Lagkas Th, Bath P A, Eleftherakis G. Towards a Wireless Monitoring System in Developing Regions The Case of Kosovo. Proceedings of the 9th Annual South-East European Doctoral Student Conference. ISBN 978-960-9416-07-8 (2014)

11. Percival, V. & Sondorp, E.: A case study of health sector reform in Kosovo. Conference of Health, PMC2864221, doi: 10.1186/1752-1505-4-7 (2010)

12. Kosovo Agency of Statistics.: Causes of deaths in Kosovo during 2012-2013. Yearly statistical report by Kosovo Agency of Statistics. Retrieved from https://ask.rks-gov.net/ (2015)

13. Kosovo Agency of Statistics.: Forecast of Kosovo population 2011-2061. Report of the Project funded by Census Project Multi-Donor Trust Fund. Retrieved from https://ask.rks-gov.net/ (2013)

14. Spiegel, P. & Salama, P.: War and Mortality in Kosovo, 1998-99: An Epidemiological Testimony. The Lancet, 355. pp. 2204–2209. doi: 10.1016/S0140-6736(00)02404-1 (2000)

15. Kosovo Agency of Statistics.: Causes of deaths in Kosovo during 2010-2011. Yearly statistical report by Kosovo Agency of Statistics. Retrieved from https://ask.rks-gov.net/ (2012)

16. Health Policy Institute.: Kosovo: Brief health system review. Retrieved May 17, 2015 from http://www.hpi.sk/en/2013/11/kosovo-brief-health-system-review/ (2013)

17. The Kosovo Association of Information and Communication Technology (STIKK).: Internet Penetration and Usage in Kosovo. Article published by STIKK. Retrieved from http://stikk.org/publikimet/ (2013)

18. Basholli A, Lagkas T, Bath P A, Eleftherakis G. Feasibility of sensor-based technology for monitoring health in developing countries - cost analysis and user perceptions. Proceedings of the 17th International Symposium on Health Information Management Research – ISHIMR (2015)

19. Darwish, A. & Hassanien, A.E.: Wearable and Implantable Wireless Sensor Network Solutions for Healthcare Monitoring. Sensors (Basel). 11(6). pp. 5561–5595. doi: 10.3390/s110605561 (2011)

20. Milošević, M., Shrove, M.T. & Jovanov, E.: Applications of smartphones for ubiquitous health monitoring and wellbeing management. Journal of Information Technology and Application. pp. 7-15.Retrieved from http://doisrpska.nub.rs/index.php/jita/article/viewFile/357/31121 (2011)

22. Anliker U, Ward JA, Lukowicz P, Troster G, Dolveck F, Baer M, et al. (2004). AMON: a wearable multiparameter medical monitoring and alert system. IEEE Trans Inform Tech Biomed 2004; 8(December (4)):415–27.

23. Lukowicz, P., Anliker, U., Ward, J., Troster, G., Hirt, E. & Neufelt, C.: AMON: a wearable medical computer for high risk patients. Proceedings Sixth Int Symp Wearable Comput. pp. 133–134. Retrieved from http://www.computer.org/csdl/proceedings/iswc/2002/1816/00/18160133.pdf (2002)

24. Oliver, N. & Mangas, F.F.: HealthGear: A Real-time Wearable System for Monitoring and Analyzing Physiological Signals. Proceedings of the International Workshop on Wearable and Implantable Body Sensor Networks (BSN'06). 0-7695-2547-4/06 (2006)

25. Halin, N., Junnila, M., Loula, P., Aarnio, P.: The LifeShirt system for wireless patient monitoring in the operating room. J Telemed Telecare. 11:41–3 (2005)

26. Paul, G., David, A., Dwight Reynolds, A.: Accuracy and novelty of an inexpensive iPhone-based event recorder [abstract]. Heart Rhythm 2012, sp23. (2012)

27. Higgins, S.L.: A Novel Patch for Heart Rhythm Monitoring. Future Cardiology 9(3). pp. 325-333. Retrieved from http://www.medscape.com/viewarticle/804459 (2013)
28. Barrett, P., Komatireddy, R., Haaser, S. et al.: Comparison of 24 hour Holter monitoring versus 14 day novel adhesive patch electrocardiographic monitoring. Am J Med. doi:10.1016/j.amjmed.2013.10.003 (2014)
29. Cardionet: CardioNet MCOT. Retrived August 11, 2014 from https://www.cardionetcom/government_03.htm (2014)
30. Atkinso, S.: SensiumVitals, Wearable, Wireless Patient Monitoring System. Presentation of Sensium Healthcare. Retrieved from http://www.sehta.co.uk/wp-content/uploads/2014/02/Steve-Atkinson.pdf (2014)
31. Weber, S., Scharfschwerdt, P., Seel, T., Kertzscher, U. & Affeld, K.: Continuous wrist blood pressure measurement with ultrasound. Biomed Tech, 58:1–2. doi: 10.1515/bmt-2013-4124 (2013)
32. Nagae, D. & Mase, A.: Measurement of heart rate variability and stress evaluation by using microwave reflectometric vital signal sensing. Rev Sci Instrum, 81:094301. doi: 10.1063/1.3478017 (2010)
33. Zephry broschure: Zephry HxM BT. Retrieved from http://zephyranywhere.com/products/hxm-bluetooth-heart-rate-monitor/ (2010)
34. Azoi: Kito application. Retrieved January 20, 2015 from https://azoi.com/ (2015)
35. Kakria, P., Tripathi, N. K. and Kitipawang, P.: A Real-Time Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors. International Journal of Telemedicine and Applications. Volume 2015 (2015), Article ID 373474, 11 pages, http://dx.doi.org/10.1155/2015/373474
36. Farin, N.J., Sharif, S. M. A., and Mobin, I.: An Intelligent Sensor Based System for Real Time Heart Rate Monitoring (HRM). Intelligent Control and Automation, 2016, 7, 55-62, http://dx.doi.org/10.4236/ica.2016.72006
37. NovioSense: Tear Glucose Sensor.Retrieved from http://noviosense.com/wp-content/uploads/2014/08/Teaser-NovioSense.pdf (2014)
38. Forbes: Google Contacts Will Help Diabetics Monitor Blood Sugar Via Tears. Retrieved from http://www.forbes.com/sites/ptc/2014/02/12/google-contacts-willhelp-diabetics-monitor-blood-sugar-via-tears/ (2014)
39. Glucosence.: Non-invasive, continouse glucose monitoring. Retrieved 21 February, 2016 from http://www.glucosense.net/
40. GlucoWise: Imagine living a healthier life with GlucoWise. Retrieved 21 February, 2016 from http://www.gluco-wise.com/
41. Hancock, B., Ockleford, E. & Windridge, K.: An Introduction to Qualitative Research. The NIHR RDS for the East Midlands/Yorkshire & the Humber. Retrieved from http://www.rds-yh.nihr.ac.uk/wp-content/uploads/2013/05/5_Introduction-to-qualitative-research-2009.pdf (2007)
42. Braun, V. & Clarke, V.: Successful Qualitative Research a practical guide for beginners. London: Sage. ISBN 9781847875815 (2013)
43. Flick, U.: Designing Qualitative Research. London: Sage publication, Library of Congress Control Number: 2006938283, ISBN 978-0-7619-4976-3 (2007)

A Review of Data Representation Standards for M2M Communications in Wireless Networks

Fesal Baxhaku[1] and George Eleftherakis[2]

[1] South-East European Research Centre, University of Sheffield, Thessaloniki, Greece
[2] CITY College - International Faculty of the University of Sheffield, Thessaloniki, Greece
febaxhaku@seerc.org, eleftherakis@city.academic.gr

Abstract. Massive amount of data is generated on daily basis by a huge number of deployed sensors in sites for monitoring features of interests in the domains of interest. A lot of work is accomplished in wireless sensor networking (WSN) providing the data as services to the end users. The focus over the last years shifted in providing semantics to these immense amount of generated data considering limited resources of WSN. To achieve the advanced analytical processing and interpretation demanded from modern applications, techniques for data exchange and semantic enrichment should consider the limited resources and challenges imposed when using WSN. This manuscript is a review of sensor data standards related to syntax and semantics, trends, and ontologies for enriching raw data semantically that later are used for more sophisticated data exchange between the connected machines. This will enable extraction of knowledge from these data and better exploitation of these data by emergent applications and end-users.

Keywords: Sensor Data Standards, Semantics, Ontologies for Sensor Semantic Enrichment, Data Annotation, Machine to Machine communication.

1   Introduction

The Wireless Sensor Network is a forthcoming technological revolution in which everyday objects are equipped with sensors and identification capabilities. These capabilities when connected to the Internet can provide significant benefits, real-time and remote monitoring, which enables the development of sophisticated applications

for assisting humans in their daily activities. The number of everyday connected objects is expected to become 50 billion until 2020 which consist of 6.58 connected devices per person (7.6 billion people in total) [30] with 14.1 ZB[3] generated data per year. As this number continuously grows, the domain of sensors still needs attention for standardization. Standards for physical and electrical feature representation, data processing and message parsing procedures, and the possibility for offering Plug & Play capabilities [8].

Data processing [3,32], quality of data [32] and storage [3,32] becomes a big challenge with the enormous increase of connected sensory devices attached to daily objects. The data will play a significant role in every field of interest when they are exploited in the right way. Machines need the collected data provided by various sensors to be understandable. In fact, the need for structured data that would enable machine interpretability and reasoning is essential [17]. This requires attaching further semantics to the actual raw data.

Certainly, the ultimate goal of WSN as the main enabling factor for Internet of Things (IoT), requires not just connected objects to the Internet but also these observable objects to be found, accessed, managed and possibly connect with other objects to achieve a common goal at a global level. For instance, in automobile driving scenario, two cars equipped with sensors can communicate to each other, take the necessary responsibilities for

[3] https://www.forbes.com/sites/joemckendrick/2016/11/13/with-internet-of-things-and-big-data-92-of-everything-we- do-will-be-in-the-cloud/#231f5d154ed5

avoiding a possible collision on a winding road or when there are view difficulties. All these require a proper way of machine-to-machine communication and understanding.

Ontologies as a means for providing machine-to-machine processing and interpretability including human understanding are the main enabling factors for this [18]. Thus, a common global Ontological representation standard for modeling sensory information is crucial for overcoming misinterpretation, heterogeneity, and different levels of interoperability concerning the data. A challenging aspect is to transform these data from sensor devices manufactured by different vendors, with different data formats into homogeneous, discoverable, machine readable and interpretable format.

In this paper we review data standardization efforts considering limitations of sensor platforms and their capabilities, and standardization efforts for semantic enrichment of sensor data together with the enabling technologies for semantic enrichment. At the same time, we provide a comparative study between these standards. The remaining paper is organized as following: Section 2 introduces characteristics and requirements for sensory devices and data standards for sensor networks. In Section 3 we discuss current efforts on ontologies as main enabling factor for sensor networks semantic data annotation and their characteristics. Finally, we conclude the paper with a discussion.

2 Describing Sensor Data: Standards and Trends

Wireless sensor nodes are composed of a number of sensors, transceiver, a radio, power source and the memory. They are small devices with limitations in memory, communication, processing, energy consumption [45,16]. Further, sensor nodes are sensitive and prone to physical damages that will produce unrelated values or often fail when they are deployed in harsh environments. Taking into account that the sensory devices are used to measure physical properties of the objects being observed, several research challenges need to be addressed. An emerging research field of these challenges is associated with data: lightweight format to be used, quality of data, syntactic and semantic interoperability, redundancy, scalability. Certainly, these challenges become more difficult to deal when there are plenty of manufacturers who produce these kind of devices and each of them has their own way of describing things.

Accordingly, there is a need for data standards that are able to describe physical and electrical features, measurements, enabling plug & play capabilities [8], providing syntactic and semantic interoperability, offering data scalability by always taking into consideration resource limitations. Providing such a standard allows to easily filter unnecessary data or detect erroneous ones which yields to better decision making. This also important for energy saving by not transferring inaccurate data to other nodes. In

the case of the minimum energy or outside noise directly influencing sensors, wrong data will be generated that easily could be detected.

As long as sensor node energy lifetime is critical in a WSN, demands for low packet size, and less frequency of packet delivery is necessary. The fewer data are transmitted the more energy efficient would be the node. Sending 100 bits of data from node to node consumes 5 μJ [44]. Since the data needs to be transmitted from node to node until it reaches the sink node, the energy will be wasted in the whole network.

2.1   Sensor Data Standards

Having open data standardizations for describing sensors and their capabilities in the domain of WSN provide a mean for interoperable systems, stimulate market competition, prevents parties from controlling a standard and avoid the need to stuck in a specific architecture for solving problems which will results in innovation and differentiation with the provision of better services. A goal of this section is to present sensor data standards, discuss them according to the specific layer categorization and then represent what they have done for data interoperability.

SensorML [2] provides an XML schema for describing sensor meta-data, and its processes, while O & M is a standard that describes the observations. Both present standards under the umbrella of SWE group. A combination of SensorML and O & M [9] gives good modeling to describe the sensory information and thus create syntactic interoperability.

The IEEE 1451 is a set of standards able to interconnects smart transducers with the systems. It provides numerous functionalities [36] (like self-identification, self-description, self-diagnosis, location-awareness, time- awareness, data processing, etc.), and thus (semi)automation could be achieved. Here, the transducer electronic data sheet (TEDS) is introduced as a specification for sensory information, able to be attached to memory in EEPROM of smart transducers.

Amon [1] is a general purpose open data format for describing and exchanging sensor/metering/monitoring devices data. It describes the data capabilities of devices, metering point, and entities.

SenML is lightweight media type for representing sensor measurements and related data, with the focus devices with limited capabilities [23]. It is designed to carry multiple measurements, and possibility that the packet size could remain under 80 bytes. The supported protocols are Constraint Application Protocol (CoAP) and HTTP.

Echonet [28] is an open standard supporting heterogeneity of home appliances and the sensors integrated into such types of equipment. Many vendors are already using Echonet in the Japanese market in the domain of smart homes .

Device Kit is an OSGi technology that serves as a data model for devices. It also simplifies the development process for future applications when hardware characteristics are unknown [14].

Device Description Language (DDL) [8] provides an XML schema for describing sensors and related devices by exposing them as services. It is a reference for Service Oriented Device Architecture (SODA).

2.2   Scope of the Standards.

In the world full of different type of sensors, ensuring the heterogeneity of the devices and making them fully functional is not quite easy. The applicability and the scope of each previously mentioned data formats in the prior section are different. Table 5 presents functionalities they provide in different layers starting from physical to application layer. Indeed, these functionalities are represented for some of the standards in [8], and we are extending with additional data formats.

Operating environment cover the description of physical characteristics of the devices (form factor) and operating environment. These informations even though are

not highly important for the developer, they can serve as a form to check whether the device works properly under specific conditions.

Physical layer describes the elecrical characteristics, mechanical interfaces and other form factor of physical devices (size, shape etc.).

Units and block layer (Pins and ports) describes pin wiring, pinout, and timing of signals. This will allow to describe the pins and ports of the sensors with the platform. These three layers are less important for the developer and consequently for the application point of view since there is not much that could be done using such information.

Events and Protocol Layer is the one that describes the parsing procedures of the signal being processed. These procedures needs analog-to-digital converter (ADC) for analog voltage port or a string for digital-port. Most of the standards that need to tackle the issue of the Plug & Play capability needs to be able to provide specifications of the receiving signal. Whenever a sensor is connected to the platform, it generates a timed pulse that is translated into a unique identifier. This identifier maps to an address space that will causes the platform to download the driver for the specific sensor and automatically start receiving measurements for the monitoring

object. To enable the Plug & Play capabilities, only TEDS, DDL, and Device Kit are the standards fulfilling such requirements.

Functional layer provide descriptions for the semantics of the receiving signal. For instance whenever a signal is send by a sensor, this is converted by ADC to the apropriate value (i.e. 30 degree Celius). These semantics are the most important features for developers and thus a target of all the standards described above. In this layer, the measurements and units are described, time, location and other important features of the monitoring objects.

Network layer describes interfaces for wireless communication and protocol stack. Since majority of the sensors do not have wireless communication capabilities, most of the standards do not include descriptions for this layer. This is rather handled by platform itself.

Data service layer expose the device interfaces to the outside world as a service over the network. This layer is supposed to manage the communication protocol, and data format together with the semantics where it is possible to access the devices data over the network. This layer has not been part of the abovementioned standards.

Table 1: Sensor descriptions of standards in different layers (Y=Yes, N=No)

Description	IEEE 1451	DDL	Device Kit	Sensor ML	Echonet	Amon	SenML
Operating environment layer	N	Y	N	N	N	N	N
Physical layer	N	Y	N	N	N	N	N
Units and block layer	N	Y	N	N	N	N	N
Event and protocol layer	Y	Y	Y	N	N	N	N
Functional layer	Y	Y	Y	Y	Y	Y	Y
Network configuration and protocol layer	Y	N	Y	N	N	N	N
Interoperable data service layer	N	N	N	N	N	N	N

We see in Table 1 that the only standard able to describe how environmental variables affects the results of the device is DDL. In IEEE 1451 and Device Kit, the lower layer is Event and protocol layer. We also know that the data carried by sensing devices are just raw reading, and if no parsing procedure exist, there is no practicable way to understand such readings.

Although, under the assumption that parsing procedures are implemented by vendors for each sensor node, almost all the standard choose the lower bound layer the

functional one which is also considered mandatory. In this layer, the semantics of the receiving signal are described (i.e. 30 degree Celsius). Some standards like IEE 1451 and device kit define networking capabilities, while the last layer is not the scope of any standard. In fact, the networking layer is the discussed topic among researchers whether should be included in the standards [8], since most of the sensors do not have networking capabilities. Nodes themselves are responsible for data transmission.

Majority of manufacturers describe the devices capabilities (error rate, max. and min. values, device operation condition mode, parsing procedures, sensor features etc.) using their specific model and often they do not follow a particular standard already mentioned in this paper. Hence, the scope of majority of the presented standards is to model the observed sensor data and their values (i.e room temperature, it's value, timestamp etc.). Basically, the choosen standard should allow to model the data where the packet length remains small, provide simple semantics to enable later to increase the knowledge with an alternative format with expressive power.

2.3 From Plaintext to Data Interoperability.

The increasing number of sensors continually produce vast amount of raw data. To properly exploit the resources and extract new knowledge from the raw data, more than values are needed. Machines require formats that easily could be processed, understand and even interpret. The desired format needs to scale well and carry enough information but always considers constraints of the sensor nodes. For instance in a home automation scenario, the home temperature is required to automatically maintain cooling and air conditioning. Further, to create intelligent homes, several parameters could be gathered such as humidity, moisture and temperature and based on these observed parameters it is possible to reason and get more insights that could adapt to user preferences. Nevertheless, all these information requires to have small packet size that could easily travels from node to node until it reaches the sink node. Except the need to measure real-time values and communicate these data to other machines, the data need to be machine processable and interpretable. It is insufficient to have just temperature value but there is a need to get more insights from that value (whether the value is in Celsius or Fahrenheit degree, whether is room, outside or body temperature).

To enable machine processing and provoke syntactic data interoperability encoding formats such as XML and JSON are well-formed with a standardized structure. They allow us to model observed raw data in a structure way such that machines could easily process such informations. The XML is the common encoding basis for SenML, SensorML, Device Kit, and Echonet. In fact, Echonet device specification is a logical model of the information or essentially a dictionary of devices where each devices represented in XML is transformed to an Echonet object. Different encoding formats are supported by SenML (XML, JSON, EXI and CBOR[4] or textual modeling formats) depending on device constraints and the developer preferences. DDL uses plain text which is not the appropriate form for enabling machine processing and enhancing interoperability among machines.

Table 2: Features os Sensor Description Standards

Standard Name	Data Format	Semantic Support	Units	Data types	Design perspective	Constraint devices	Supported devices	Good for
SensorML	XML	Yes (if integrated with O & M)	Yes	CDT	Data Oriented	No	Intelligent Sensors	Describing complex devices
IEEE 1451 (TEDS)	IDL	No	Yes	CDT	Modular	Yes	Intelligent Sensors	Manufacturing the design devices interface

| Amon	JSON	No	Yes	PDT	Data Oriented	No	Devices	Industry (metering/ moni- toring)
SenML	XML, EXI, JSON, CBOR,	Very limited	Yes	PDT	Data Oriented	Yes	Sensors, Actuators	Very constraint devices
Echonet	XML (Object - dictionary of devices)	Limited	Yes	PDT	Class	Yes	Home Appliances	Home automation
Device Kit	DKML	No	Yes	PDT	Modular	No	Sensors, Actuators	Exposing devices as services (Eclipse plugin)
DDL	Plain text	N/A	Yes	PDT	Data Oriented	Yes	Sensor and Devices Communication	Manufacturing and process industries (Plug & Play)
*PDT = Primitive Data Types *CDT = Complex Data Types								

[4] Concise Binary Object Representation: http://cbor.io/

The possibility to send several measurements in a single packet without exceeding bandwidth is really important. In a single device, several sensors measurements could be equipped, and this will need all the observed properties to be delivered to the end node. Choosing a lightweight format, that could easily be extended with semantics into it and carry all the measurements at the same time within its boundaries is essential.

In terms of syntactic Interoperability, the efforts have been focused on employing SensorML from OWC group and recently many middleware make use of SenML as lightweight format to their Wireless Sensor Network architectures. The former consist of a set of model languages that defines sensors and their services by exposing them in the web. However, additional effort is required to automate the process which sometimes it is hard to implement the proposed technologies.

Regarding scalability, implementing XML as a data format for real-time application development promises extensibility and flexibility. While managing information as XML raises three issues related to enterprise scalability and robustness. The first is that XML is not designed for fast information retrieval. The second is that XML is a verbose method for exchanging data over a network which is highly constrained and this becomes a problem when exchanging a large amount of data in daily basis. The third issue is that XML elements are not defined as native data types. The steps required for converting XML-tagged data into predefined data types degrade the performance of a real-time WSN application system. On the other hand JSON is a lightweight format with simple syntax, easy for processing that easily could be extended with other data.

Dealing with node constraints and energy efficiency, EXI and CBOR are the preferred formats for transmission of the data in binary form due to small packet size. EXI format allows to deliver packets easily from node to node, but processing the data locally and making decisions requires a lot of CPU resources which is not convenient for the CPU constrained platform. This creates difficulties in detecting erroneous data from quality data and it will break hard constraints of real-time monitoring. On another hand, it is possible to model the data in JSON format that will include a small amount of data, including basic semantics into it, that later these data easily could be transformed into a more sophisticated knowledge, that will allow machines to interpret. XML is another alternative as most of the standards have proposed, but XML is considered heavyweight compared to JSON [34,19]. Xiang et al. ([38]) evaluate the formats through experiments with for the formats XML, JSON, EXI, RDF, Entity Notation. Since the performances are getting better for these sensory platforms, the more semantics we will provide to the next node the better exploitation and usage of these data will be possible.
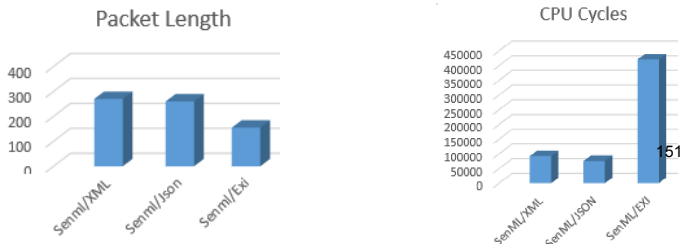
(a) Packet length extracted from [38]

Number of Cycles [38]

In Figure 1a, the Exi format has the lowest packet length, followed by JSON and XML. In contrast, the number of cycles to process the same information (Figure 1b) is lower in JSON format compared to XML [38] and EXI. The last data format requires high processing power.

As a conclusion, the future application requires quite a standardization that could easily integrate the sensing devices into the system and make use of it. Echonet has attracted the Japanese market for home automation. To enable Plug & Play capabilities of the sensors, the IEEE 1451 standard is the most appropriate. This standard allows specifying configuration information in the memory of the sensor. Specifically, using TEDS it is possible to identify the current sensor attached to the devices, its interface and other relevant information that the sensor detects. Later, all these information can automatically be detected and received when the software interface is written. SenML utilizes constraint resources with minimal energy harvesting, low processing power and when the packet length matters. To utilize the resources with limited bandwidth, SenML structures the data as a single object, while this object contains an array of entries. Further, when the bandwidth is highly constrained, this protocol allows to model the data using EXI format and send minimal data over a mesh network. This could also help in minimizing the energy consumption when we know that most of the energy is spent during transmission. However, EXI requires more processing power to process the carrying information. Considering the popularity of JSON format, it is possible to model the data with 80 byte important observations. Amon is created more with the purpose to be human-readable, while Device Kit and DDL even though young in the market, they have a chance to enter in the industry of Wireless Sensor Network. SensorML on the other side is popular in industry [8], but it's complexity and design nature limits the applicability in small, constraint devices [31].

3   Enabling M2M Communication with Semantic Annotation

The already mentioned standards are not widely accepted and thus are not enough for provoking semantic data interoperability because sensors and platforms are strongly dependent on the sensor manufacturer and industry. Data annotation and semantics are valuable properties for today real-time systems to overcome issues of heterogeneity, machine understanding and interpretation and discovery of the resources as well as extraction of new knowledge from the output of multiple sensor measurements. While sensors consist of common characteristics across applications, metadata are those characteristics that make a difference and achieve common understanding for both: humans and machines.

Utilizing semantic presentation and the common standard ontologies would help to achieve an interoperability at higher levels and understand the proper meaning of the data. For instance, machines would be able to distinguish the room temperature and body temperature and apply different reasoning techniques. Therefore, through the literature review, sensor ontologies should include a number of concepts and relations between them. The general required attributes for sensors as proposed by National Institute of Standards and Technology (NIST)

[13] are summarized in Table 3. We are categorizing these concepts as follows: a) Sensors / Actuators: identity, manufacturer, configuration c) Physical features: location, power supply, energy, actual consumption energy, operating conditions, force, speed d) Observations: observation, accuracy, frequency and e) Data: data types, latency, units of measurements, quality of data, time.

A shared ontology (or, multiple shared ontologies) describing the above concepts and relations, provokes semantic interoperability among the applications. This shared ontology allows to exchange information in such a way that the meaning of the observed properties of the objects will be automatically processed and interpreted by the receiver. Deriving new semantic knowledge could be achieved on the basis of the observed facts through reasoning.

Table 3: Sensor Required Attributes as proposed by NIST

Attributed	Comments
Physical	Power, weight, size
Operating environment	Conditions for device operation
Immediate data	Time, spatial data, latency, frame rate and other important data
Derived data	Results after computing raw data
Algorithms	Algorithms for producing outcomes (derived data)
Integration/fusion	Data aggregation and fusion combining data from multiple sensors
Capabilities	Functional applications from the data
Communication	Physical and logical protocols, interoperability
Processing	On-board processing power of sensors and sensor nodes
Calibration	Calibration algorithms
Provenance	Maintaining the records of raw data and derived data
Confidence	Level of confidence in raw data

3.1 Technologies and Languages for Semantic Data Interoperability for Wireless Sensor Networks.

Semantic [5] is the study of understanding and interpreting the true meaning of a word, or a sentence. Such words, to be understandable by computers need a semantic representation using symbols or markup languages.

We already know that the most intriguing and successful artefact is the current Web [12], but still, explicit exploitation of the resources need semantic technologies. Hence, the semantic web allows humans and agents to cooperate with each other, reason over the available resources and accomplish sophisticated tasks [5]. The core concept of this semantic representation is Ontology that enables knowledge discovery of a shared resources. It can be used for knowledge representation [24], natural language processing and knowledge engineering [39], semantic representation and building expert systems [24].

Most of the research attention is given to the true meaning of the receiving values from sensors. Several studies are addressing the importance of annotating sensed data and powerful utility that could be derived [40,42,35]. When the (semi)automatic annotation of sensed data is achieved, it will have significant impact in real-time monitoring system and enable real-time machine processing.

To make this happen, several ontological languages are created with the purpose of facilitating the annotation process which will help to achieve semantic interoperability and make the data accessible on the web, as well as expose these as services to third parties. A set of core semantic technologies are already developed, and most of them

are de facto standards [26]. Languages like Ontology Inference Layer (OIL)[12], DAML+OIL [22], RDF [6], Web Ontology Language (OWL)[29], Json-ld [6], enable to describe sensor information with semantics attached to it. Standard ontologies are important for achieving semantic interoperability using the core semantic languages and technologies.

3.2   Ontologies for Sensor Data.

The community has developed several ontologies for describing important information of sensors data. These include measurements, observations, features of interest, location, time etc. In what follows we present Ontologies

[5] Semantic according to: http://www.thefreedictionary.com/semantic
[6] http://json-ld.org/

(even though none of them is a standard) that could possibly provide interoperability at a global level of the system and become de facto standards.

Semantic Sensor Network (SSN) Ontology [11] describes sensors, observations, and related concepts. These concepts in SSN ontology, are divided into four different perspectives: a) Sensors can semantically describe device capabilities of the sensed object b) Observations represents the sensing values c) Systems consisting of subsystems and d) Feature and Property for phenomena properties.

An important aspect of this Ontology is the possibility to add external domain-specific ontologies and extend its capabilities (i.e. Time, Location, or domain-specific ontologies: i.e. Health ontologies). Further, we can have a better level of interoperability in SSN ontology since it aligns SSN ontology concepts with the DOLCE Ultra Lite (DUL [7]) upper ontology.

Sensor Web for Autonomous Mission Operations (SWAMO) [43] is a framework and ontology able to create interoperable sensor web products and services within sensor web. It models components, systems, and processes as physical or logical representation. It consists of agents able to maintain operations as well as make decisions. It is compatible with SWE, specifically SensorML.

OntoSensor [20] presents another ontology for describing sensors, capabilities and it's measurements. This ontology presents overly a general, knowledge base of sensors (humidity, GPS, Accelerometer etc.) for query and inference. To express sensor properties, SensorML is used to derive its terms. The Ontology seems not updated and complex to implement[8].

Universal Plug and Play (UPnP) [41]. Presents an Ontology with the aim of enabling Plug & Play capabilities by describing devices and services they provide. This follows the UpnP device architecture specification and presents instances of devices, services, actions, arguments and state variables. The Ontology is not updated and no new features are added (not actively maintained).

Foundation for Intelligent Physical Agents (FIPA) [15]. Fipa ontology describes devices and their characteristics aiming to exchange and create data interoperability between software agents. The main class of this ontology is Device which has descriptions and this allows to describe hardware and software properties. Since its introduction, there are not updates or added features to this ontology.

OpenIoT Ontology [37]. presents an extension of the SSN ontology with additional concepts relevant to cloud integration, utilizing unit metrics and point of interests (POI) at some level of granularity. It enables to collect the data virtually. It also offers tools for development and deployment of IoT applications. There are extension regarding the client authentication, Client credentials and other concepts related to services.

Semantics in Detecting Indoor Location. Ontologies are very useful in the

process of the discovery of the available resources, and specifically detecting the position of the resources in the environment. Apart from recognizing the latitude and longitude, knowing the exact location, specifically in an indoor environment is significant (third floor, room nr. 15, particular bed)

One of the earliest attempt to maintain and detect the location in indoor environments is presented in [21]. This technique allows to intelligently compute the location in an indoor environment by using ultrasonic techniques. Another attempt to provide a semantic description of the current location of an object is presented in [33]. This infrastructure uses the GPS (global positioning system) to get the information of specific object but hides the details of implementation. When the location is detected, the DNS (Domain name system) maps the position with semantic data.

One approach in providing semantic data for indoor location is defined in [10]. This ontology provides semantics based on RFID tags or Wireless position of the devices. It is possible to detect rooms, hallway, kitchen using the tags detected by nearby devices.

---

[7] DUL - is an upper ontology for presenting concepts understandable among all knowledge domains

[8] http://www.w3.org/2005/Incubator/ssn/wiki/Incubator_Report#OntoSensor

Table 4: Sensor Ontology Features

	Name	SSN	OntoSensor	SWAMO	UPnP	FIPA	CSiro	OpenIoT
Sensors	Physical characteristics	Y	Y	N	N	Y	Y	N
	Identity/ manufacturer	N	N	N	Y	Y	Y	N
	Configuration	Y	Y	N	Y	N	Y	Y
	Hierarchy	Y	Y	N	N	N	Y	Y
	Deployment	Y	N	N	Y	N	Y	Y
Physical features	Location	N	Y	Y	N	N	Y	Y
	Power supply	N	Y	N	N	N	Y	N
	Energy	N	N	N	N	N	N	Y
	Current consumption	N	N	N	N	N	N	N
	Operating conditions	Y	N	N	Y	N	Y	Y
Observations	Input/Output	Y	Y	N	N		N	Y
	Observation	Y	Y	Y	Y	N	N	Y
	Accuracy	Y	Y	N	N	N	Y	Y
	Frequency	Y	Y	N	N	N	Y	Y
	Response model	Y	Y	N	N	N	Y	Y
	Communication process	Y	Y	N	N	N	Y	Y
Data	Latency	Y	N	N	N	N	Y	Y
	Units of measurements	N	Y	Y	N	N	Y	Y
	Data types	N	Y	Y	N	N	Y	Y
	Data quality	N	Y	Y	N	N	Y	Y
	Time	N	Y	Y	N	N	N	Y
Y = Supported, N = Not Supported								

DogOnt [7] - The Ontology Modelling for Intelligent Demotic Environments provides an XML schema[9] and models indoor environment, specifically home automation. It allows to semantically describe various devices located within the home environment.

indoorGML [25]- represent a data model and XML schema for modelling indoor spatial information. It is a framework for defining the position of the objects in indoor spaces. The ontology consist of a) cellular space (the smallest organizational units in indoor space), b)Semantic representation (Defining cells and its connections), c) Geometric representation (representation of an object with geometric substructures), d)

Topological structure (objects connectivity in indoor environment) and e) Multi-Layered Representation (topographic spaces, Wifi coverage cells, and RFID coverage cells).

The most relevant ontologies offering semantics for describing features of sensing devices are reviewed. One of the ontologies from SWE group was O & M. To make a distinction with SSN ontology, the O & M describes the observations as events while in SSN ontology the observations are described as a process. SSN differentiate the domain specific concepts and those devices specific while in O & M everything is presented as a whole.

[9] http://elite.polito.it/ontologies/dogont.owl

Table 5: Number of Concepts, Axioms and Properties

Name	SSN	OntoSensor	SWAMO	UPnP	FIPA	CSiro	OpenIoT
Classes	52	289	No info	9	15	71	74
Axioms	599	1970	No info	310	203	503	383
Object Property	55	125	No info	11	14	61	27
Data Property	0	108	No info	23	18	11	15

The SWAMO ontology is very complex and hard to implement. Even more, this ontology is useful for exposing components/processes as web products. The OntoSensor is not actively maintained and hard to implement. OpenIoT ontology presents an extension of SSN attempting to capture important information about sensor, their units and domain specific informations. However, additional work need to be addressed by OpenIoT in order to address sensor capabilities, performance, and usage conditions. The most relevant ontology to describe semantically the sensed information, and the object being observed seems SSN ontology. This Ontology together with other domain specific ontologies allows to achieve semantic interoperability and prevent the misconception of the data coming from sensors. It means machines are able to process the information in a meaningful manner. Another important feature of SSN is to make use only parts of it (i.e. measurements). This is very beneficial   in transmitting just the right information to other parties for further processing using low-cost technologies. However, transmitting the right information requires some higher intelligence in the nodes and this cannot be achieved just by semantically annotating the sensed data. Using SSN ontology, we are able to attach other ontologies like location (indoor or outdoor location) ontology that is among the research challenges. All these information could enhances the discovery process of the resources using exact location and respond to user queries with higher precision. In other words, SSN enhance the data and device discovery process by semantically describing available resources and observations and offers a great possibility to achieve semantic interoperability.

4   Discussion and Conclusion

We have divided sensor standards in two categories: a) sensor data formats dedicated for simple sensor descriptions and b) standard ontologies for utilizing semantics when describing sensor data, capable of overcoming issues already mentioned in section 2.3.

Certainly, in the first category fall sensor standards with the aim to help

manufacturers with the standardized structured format to describe features of sensory devices and their capabilities. Due to restrictions in memory, bandwidth, and CPU, the possibility to fully describe all the features of each sensory device and enable automatic discovery of the resources is left out from several standards. Manufacturers most of the time have their own approach to describe information and presented standards describe observations and measurements that are essential for exploitation of these resources by taking into account the restrictions.

In this category, majority of the standards are not able to describe complex features such as quality of the information, allowing to discover anomalies in the data that will later allow performing the cleansing procedure. With the increasing volume of data, data inconsistency become issue. Highly dynamic environments require temporal consistency which needs small packet size and efficiency in transmission. It is known that most of the energy is spent during transmission and idle mode, and sending large packet size requires a lot of energy. Utilizing XML as data format, creates larger packet size, requires more processing power, hard to query and less scalable compared to JSON. EXI format is a better alternative when very constraint devices are present, while JSON seems better alternative compared to XML. Future attempt needs to be addressed by each standard,

to reduce packet size, add more semantics and improve the accuracy of information. From the point of view   of resource discovery, employing simple standards provides difficulties in automatic discovery, as well as less efficiency in answering sophisticated questions. It is difficult to enhance query answering using simple formats, with no semantics into it. Also, spatial information presents important features in the domain of WSN, the sensor standards are limited to only latitude and longitude which most often is not enough.

On the other hand, the second category tries to overcome issues of semantics, heterogeneity, sophisticate query answering, enabling automatic discovery and inference new knowledge from the output of several related measurements. Even though there is no standard presented here that describes all the features and capabilities of sensory devices, some are becoming de facto standards. One widely adopted standard is the proposition of W3C group with SSN which follows upper ontology guidelines for modeling concepts and this will result in a more general semantic interoperability within systems. Other ontologies seem not updated, neither maintained. Due to constraints of sensory devices, these ontologies could help to annotate sensed data, in more powerful devices. First, the data travels using a simple, non-semantic format, with a low packet size and later these data are semantically enhanced using techniques that would enable automatic conversion. However, automatic semantic enrichment of sensor data that effectively could be connected with event processing to enhance the expressiveness in event processing demands a lot of effort [32]. What can be seen in the second category, is the possibility to combine several ontologies, relate common concepts and add the features that are missing. Most of the Ontologies leave out the performance concepts, energy level and the capabilities which are exposed at some level of granularity. The key role in the reviewed Ontologies is being played by the SSN ontology. It has inspired other projects, most relevant one the OpenIoT project. We can take this as a base ontology, use the features already presented, make use concepts from domain specific to enrich with semantics already missing in the base
ontology.

Automatic semantic annotation process utilizing Ontologies could overcome heterogeneity and interoperability by possibly modeling all the concepts and attributes of WSN. Even though none of the presented Ontologies overcome heterogeneity/interoperability issues since they cover only parts of the required information model, they are good indicator to be extended with additional features and properties to fully address such requirements. Inferencing new knowledge and transforming the raw data into sophisticated data could be achieved by utilizing semantic representation of the observed raw data from sensors. By observing several related parameters, applying rules over the real time values, new knowledge will be

deduced. For instance, in a driving car scenario there is possible to predict, take the right directions and be on a specific location for the least time possible. By gathering values of car speed (velocity), location, and directions and applying specific rules could be predicted which side has less traffic jam and best route to go. In similar manner, by measuring the distance between cars, rain level, or if the weather is foggy, then it would recommend the best speed to drive the car and avoid possible accidents.

A significant role when processing and reasoning over the semantic data is the modeling language that is used. This requires to be lightweight, scalable enough due to the large amount of generated data and easily processable that would consider the hard real-time constraints of Sensor Networks. Maarala and Su [27] evaluate the performance of different semantic ontological languages in processing in different scenarios (centralized systems, distributed, mobile). Short Entity Format (EN) outperforms in its experiments, having the lowest latency and minimal resource usage. Performing reasoning in centralized system there is a high difference among the standards, where XML based format messages and latency increases higher compared to others formats.

Over the last years, semantic annotation of WSN data, and semantic enrichment utilizing ontologies has gained momentum and is becoming an expanding area of research. Many researchers, institutions, private companies are integrating sensor networks into the web and developing emerging applications exploiting semantic web technologies. More research issues should be addressed to the continuous data generated by sensor networks by taking into account the constraints of these devices and addressing all the features of Wireless Sensor Networks.

References

1. AMEE UK Limited, "AMON v3.1", http://amee.github.io/AMON/
2. Botts, M., et al. "OGCQ_R SensorML: Model and XML Encoding Standard." Technical Standard 2 (2014).
3. Lee, In, and Kyoochun Lee. "The Internet of Things (IoT): Applications, investments, and challenges for enterprises." Business Horizons 58.4 (2015): 431-440. DOI: 10.1016/j.bushor.2015.03.008
4. Blackstock, Michael, and Rodger Lea. "IoT interoperability: A hub-based approach." Internet of Things (IOT), 2014 International Conference on the. IEEE, 2014. DOI: 10.1109/IOT.2014.7030119
5. Berners-Lee, T., James H., and Ora L. "The semantic web." Scientific american 284.5 (2001): 28-37.
6. Beckett, D., and Brian M. "RDF/XML syntax specification (revised)." W3C recommendation 10 (2004).
7. Bonino, D., and Fulvio C. "Dogont-ontology modeling for intelligent domotic environments." The Semantic Web-ISWC 2008 (2008): 790-803. DOI: 10.1007/978-3-540-88564-1_51
8. Chen, Ch., and Sumi H. "Sifting through the jungle of sensor standards." IEEE Pervasive Computing 7.4 (2008).DOI: 10.1109/MPRV.2008.81.
9. Cox, S. "Observations and measurements-xml implementation." OGC document (2011).
10. Coronato, A., Massimo E., and Giuseppe D. P. "A multimodal semantic location service for intelligent environments: an application for Smart Hospitals." Personal and Ubiquitous Computing 13.7 (2009): 527-538.DOI: 10.1007/s00779- 009-0223-x
11. Compton, M., et al. "The SSN ontology of the W3C semantic sensor network incubator group." Web semantics: sci- ence, services and agents on the World Wide Web 17 (2012): 25-32.DOI: https://doi.org/10.1016/j.websem.2012.05.003
12. Domingue, J., Dieter F., and James A. H. "Introduction to the semantic web technologies." Handbook of Semantic Web Technologies. Springer Berlin Heidelberg, 2011. 1-41.DOI: 10.1007/978-3-319-41490-4_3
13. Eastman, Roger, et al. "A Sensor Ontology Literature." (2013). DOI: http://dx.doi.org/10.6028/NIST.IR.7908
14. Eisma, A. "Data Capture in IBM WebSphere Premises Server[TM]." OSGi Alliance 28 (2008): 2011.
15. FIPA. "FIPA Device Ontology Specification", http://www.fipa.org/specs/fipa00091/, 2002.
16. Fouad, M. M., Vaclav S., and Aboul E. H. "Energy-Aware sink node localization algorithm for wireless sensor networks." International Journal of Distributed Sensor Networks (2017). DOI: http://dx.doi.org/10.1155/2015/810356
17. Ganz, Frieder, Payam Barnaghi, and Francois Carrez. "Automated semantic knowledge acquisition from sensor data." IEEE Systems Journal 10.3 (2016): 1214-1225. DOI: 10.1109/JSYST.2014.2345843.
18. Ganzha, Maria, et al. "Semantic interoperability in the Internet of Things: An overview from the INTER-IoT perspec- tive." Journal of Network and Computer Applications 81 (2016): 111-124. https://doi.org/10.1016/j.jnca.2016.08.007

19. Geoff B. "XML vsJSON Based Web Services: Which is the Best Choice?"
20. Goodwin, C., and David J. R. "An ontology-based sensor network prototype environment." Proceedings of the 5th international conference on information processing in sensor networks. 2006.
21. Harter, Andy, et al. "The anatomy of a context-aware application." Wireless Networks 8.2/3 (2002): 187-197. DOI:10.1023/A:1013767926256.
22. Horrocks, I., Van Harmelen F. , and Patel-Schneider, P. F. Reference description of the daml+ oil (march 2001) ontology markup language. Technical report, 2001. http://www. daml. org/2001/03/reference. html, 2001.
23. Jennings C. et. al., "Media Types for Sensor Measurement Lists (SenML) " https://tools.ietf.org/html/draft-ietf- core-senml-05. March, 2017
24. Jurisica, I., John M., and Eric Y. "Ontologies for knowledge management: an information systems perspective." Knowledge and Information systems 6.4 (2004): 380-401.DOI: 10.1007/s10115-003-0135-4
25. Ki-Joune Li, "IndoorGML". http://indoorgml.net/, Accessed: Februar, 2017.
26. Machado, C. M., et al. "The semantic web in translational medicine: current applications and future directions." Briefings in bioinformatics 16.1 (2015): 89-103. DOI: 10.1093/bib/bbt079
27. Maarala, Altti Ilari, Xiang Su, and Jukka Riekki. "Semantic Reasoning for Context-aware Internet of Things Appli- cations." IEEE Internet of Things Journal 4.2 (2017): 461-473.
28. Matsumoto, S. "Echonet: A home network standard." IEEE Pervasive computing 9.3 (2010): 88-92. DOI: http://doi.ieeecomputersociety.org/10.1109/MPRV.2010.57

29. McGuinness, D. L., and Frank V. H. "OWL web ontology language overview." W3C recommendation 10.10 (2004): 2004. DOI: 10.1007/978-3-662-43796-4 5.

30. Mukhopadhyay, S. Ch., and N. K. S. "Internet of Things: Challenges and opportunities." Internet of Things. Springer International Publishing, 2014. 1-17. DOI: 10.1007/978-3-319-04223-7 1.

31. Nappey, P., et al. "Migration of a legacy plant lubrication system to SOA." Industrial Cloud-Based Cyber-Physical Systems. Springer International Publishing, 2014. 167-182. DOI: 10.1007/978-3-319-05624-1 7.

32. Qin, Y., et al. "When things matter: A survey on data-centric internet of things." Journal of Network and Computer Applications 64 (2016): 137-153. DOI: http://dx.doi.org/10.1016/j.jnca.2015.12.016

33. Roth, J. "Flexible positioning for location-based services." coordinates 51 (1929): 169m.

34. Sean L. "XML VS. JSON - A PRIMER", http://www.programmableweb.com/news/xml-vs.-json-primer/how- to/2013/11/07, accessed: November, 2016.

35. Sheth, A. "Citizen sensing, social signals, and enriching human experience." IEEE Internet Computing 13.4 (2009). DOI: 10.1109/MIC.2009.77.

36. Song, E. Y., and Kang L. "Understanding IEEE 1451-Networked smart transducer interface standard-What is a smart transducer?." IEEE Instrumentation & Measurement Magazine 11.2 (2008). DOI: 10.1109/MIM.2008.4483728.

37. Soldatos, John, et al. "Openiot: Open source internet-of-things in the cloud." Interoperability and open-source solu- tions for the internet of things. Springer International Publishing, 2015. 13-25. DOI : 10.1007/978-3-319-16546-2 3.

38. Su, Xiang et. al., Adding semantics to internet of things. Doi: 10.1002/cpe.3203, 2014.

39. Studer, R., V. Richard B., and Dieter F. "Knowledge engineering: principles and methods." Data & knowledge engineering 25.1-2 (1998): 161-197. DOI: https://doi.org/10.1016/S0169-023X(97)00056-6.

40. Szewcyzk, S., et al. "Annotating smart environment sensor data for activity learning." Technology and Health Care 17.3 (2009): 161-169. DOI: 10.3233/THC-2009-0546.

41. Togias, K. Christos G., and Kameas, A. "Ontology-Based Representation of UPnP Devices and Services for Dynamic Context-Aware Ubiquitous Computing Applications," 2010 Third International Conference on Communication Theory, Reliability, and Quality of Service, Athens, TBD, Greece, 2010, pp. 220-225. DOI: 10.1109/CTRQ.2010.44

42. Wei, W., and Payam B. "Semantic annotation and reasoning for sensor data." European Conference on Smart Sensing and Context. Springer Berlin Heidelberg, 2009. DOI : 10.1007/978-3-642-04471-7 6.

43. Witt, K. J., et al. "Enabling Sensor Webs by utilizing SWAMO for autonomous operations." 8th NASA Earth Science Technology Conference. 2008. DOI:10.1.1.532.5495

44. Vermesan, O., and Peter F. "Internet of things-from research and innovation to market deployment". Aalborg: River Publishers, 2014.

45. Yang, Geng, et al. "Precision-enhanced and encryption-mixed privacy-preserving data aggregation in wireless sensor networks." International Journal of Distributed Sensor Networks (2017).

A review on current research in Question Answering Systems and future trends

Lorena Kodra[1], Elinda Kajo Meçe[2],

[1,2] Department of Computer Engineering, Polytechnic University of Tirana, Albania
[1]lorena.kodra@gmail.com, [2]ekajo@fti.edu.al

Abstract. Question Answering Systems (QAS) are becoming a model for the future of web search. In this paper we present a study of the current research in this area. We collected publications from top conferences and journals on information retrieval, knowledge management, artificial intelligence, web intelligence, natural language processing and the semantic web. We identified and classified the current research areas and the newest trends to help researches gain an insight on the latest developments and trends of the research being done on QAS.

Keywords: Question Answering Systems, Community Question Answering Systems, Information Retrieval

1 Introduction

In this paper we present a study of the current research being done on question answering systems. We attempt to give an answer to questions like: What are the characteristics of QAS being given most attention to? What are the areas of the research being given most attention to? What are the newest features being applied? What are possible trends of the research in this area? We collected publications from top conferences and journals on information retrieval, knowledge management, artificial intelligence, web intelligence, natural language processing and the semantic web in the last three years and made a quantitative and topic-based analysis of these publications. Our work can be used to help researchers gain an insight on the present state and latest trends of the research being done in the area of question answering systems.

Unlike related work [6], [7] that classify and report the state of the art of question answering systems, our study makes a quantitative analysis on the amount of research being done on question answering as well as research areas classification and research trend identification. To the best of our knowledge this is the first review of QAS from this perspective.

The rest of this paper is organized as follows: In section 2 we describe the methodology used in our study and define objectives and research questions. Section 3 classifies and analyzes QAS from different points of view. In Section 4 we identify current research areas. Section 5 presents new research trends identified. Section 6

discusses the results and conclusions from the analysis. Finally we list the selected papers in Appendix A.

2 Methodology

2.1 Research questions

We define the following research questions:
RQ1: What are current QAS types?
RQ2: What are the current research areas?
RQ3: What are the future research trends?

2.2 Search keywords and source selection

In order to extract the most relevant information for our review we used the following keywords and their combination and synonyms. The search string below was used as a query to search for publications in different online digital libraries:
("question answering" OR "question answer" OR "question answering system" OR "question answering systems"). The search for these keywords was done on the title of the publication, as well as the abstract.

We selected three of the top scientific digital libraries that store computer science research publications. We did not search on Google Scholar and arXiv because these libraries index content from other libraries. The sources are shown in Table 1.

Table 1. Sources selected for the search process..

Source	URL
IEEExplore	http://ieeexplore.ieee.org
ACM Digital Library	http://dl.acm.org
Springer Link	http://link.springer.com

2.3 Inclusion criteria

Table 2 lists the inclusion and exclusion criteria that we used to collect papers.

Table 2. Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Relevant to the topic of our review	Review papers
Papers that have been published in the last three years (2014 - 2016)	Reports
Published in top conferences and journals on information retrieval, web intelligence, artificial intelligence, natural language processing and the semantic web	
Papers written in English	

We did not collect review papers and reports because our aim is to analyze the existing implementations and developments of QAS.

The selected conferences are: *SIGIR* - Special Interest Group on Information Retrieval, *CIKM* - Conference on Information and Knowledge Management, *AAAI* - Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence, *WWW* - World Wide Web Conference, *WI* - International Conference on Web Intelligence, *ECIR* - European Conference on Information Retrieval, *WSDM* - International Conference on Web Search and Web Data Mining, *ICML* - International Conference on Machine Learning, *ISWC* - International Semantic Web Conference, *ESWC* - European Semantic Web Conference, *EMNLP* - Empirical Methods in Natural Language Processing, *COLING* - International Conference on Computational Linguistics, *ACL* - Association for Computational Linguistics, ECAI – European Conference on Artificial Intelligence , ECML - European Conference on Machine Learning. The selected journals are: NLE – Natural Language Engineering, LRE – Language Resources and Evaluation, TACL - Transactions of the Association for Computational Linguistics, COLI - Journal of Computational Linguistics, JML - Journal of Machine Learning, JMLR - Journal of Machine Learning Research, IRJ - Information Retrieval Journal, Journal of Web Semantics.

We collected 129 papers from the above sources. The results of the analysis are presented in the following sections.

3   Question Answering Systems Classification

We classified the systems presented in the selected publications from three points of view: (1) domain type (open domain vs closed domain), (2) information source type (unstructured vs. structured), (3) collaborative aspect (community vs non-community).

3.1   Domain Type

From this point of view, QAS can be classified into two types: *open domain* and *closed domain*. In open domain QAS, the knowledge base can be as big as possible and not limited to a specific domain and questions can be asked about anything. In closed domain QAS the information is limited to a specific domain (e.g. medical, sports, etc.) and the system responds to questions that are made only under the specified domain. This kind of system is simpler compared to the open domain QAS because less information is processed and the knowledge base is smaller. They typically have high accuracy but can require extensive language processing. On the other hand, open domain QAS have a lower accuracy (especially in cross-lingual settings).

From our study we identified 117 open domain and 12 closed domain QAS translating to a ratio of 90.6% open domain to 9.4% closed domain QAS.

3.2 Information Source Type

We identified two kind of information source type: *unstructured* and *structured*.

Unstructured information QAS: In this kind of system the source of information is the Web or document collections contained inside the system. The answering process is information retrieval (IR) based. That means that the system finds short segments of text on the Web or inside the document collections and analyzes them in order to retrieve candidate answers. The candidate answers are then ranked and processed in order to find the most relevant answer.

Structured information QAS: In such systems the information is organized in a form of structured knowledge base (KB) where the data are linked by semantics. The information in the knowledge base is organized in the form of *triples* composed of *subject*, *predicate*, and *object*. An example of a triple is (Mount Everest, height, 8.848 m). The predicate is a characteristic of the subject, while the object is the value of that characteristic. In question answering over a knowledge base, the question is on subject and predicate, while the answer is from object. Natural language questions are translated into formal language queries that simply extract the information from the structured knowledge base. This process involves linguistic techniques like parsing the syntactic structure of the question, POS tagging [1], tokenization, semantic symmetry detection and ambiguity resolution.

From the systems we studied, 71 of them were structured information QAS and 56 unstructured information QAS, translating to a ratio of 56.6% structured information to 43.4% unstructured information QAS.

3.3 Collaborative Aspect

From this point of view we identified two types of QAS: (1) *community* QAS and (2) *non-community* QAS.

Community QA (CQA) systems are modern collaborative systems where users rely on expertise from the community to get an answer for their questions. New questions are routed to possible answerers based on their expertise level relevant to

the question. Such systems are used for information needs that are not satisfied simply by viewing a Web page [5]. Questions and their corresponding answers are frequently presented as top search results for search queries. They are typically ranked by relevance to the user questions and can be viewed by all searchers. This can also act as a mechanism to decrease the number of duplicate questions.

Non-community QAS, on the other hand rely only on system knowledge and there is no collaboration between users.

We identified 73 non-CQA systems and 56 CQA systems, translating to a percentage of 56.6% non-CQA to 43.4% CQA.

4   Research Areas

From our study we identified three research areas: (1) question processing, (2) information source and organization, (3) answer processing.

Question processing: This area deals with the whole process of question transformation, from user query analysis to finding matches between the given question and candidate answers. The goal is to extract pieces of information from user question formulated in a natural language form in order to identify subject entity and find possible matches between question entity and entities in the knowledge base. The process starts with the identification of query intent, generating of possible candidate questions from user query and selection of the most relevant question. It continues with question routing in order to find possible answerers for a given question, based on other users' expertise. This is relevant in CQAS where routing a question to the right users improves overall system accuracy. In the end, question-answer matching deals with finding possible matches between user question and document text or KB entries in the information source.

We identified 80 publications in this research area dealing with various steps of question processing, making it the most frequent with 62% of the total number of publications.

Information source and organization: This area deals with the way the information is organized in the QAS and its sources. It involves the process of KB creation which organizes information in a semantic way by creating KB triples. This research area also involves QAS that use multiple information sources for retrieving and validating the answers.

We identified 13 publications in this area, translating to a percentage of 16.25% of the total number of publications.

Answer processing: This area deals with the process of detecting candidate answers and analyzing them in order to select the most relevant one. The process starts with detecting candidate answers that might be in the form of document text or KB triples. The candidate answers are then filtered out by validating them according to question relevance. After the validating process is complete, the answers are ranked according to question relevance and the most relevant one(s) are selected from the list. In systems that use multiple information sources, sometimes the answer might be fragmented, meaning that parts of it might be found on different information sources. In such systems there is an extra step that takes care of answer aggregation

and summarization that joins the fragment answers and produces complete candidate answers.

We identified 65 publications in this research this area that is equivalent to 50.3% of the total number of publications.

We find worth mentioning that a considerate amount of publications dealt with multiple areas of research such as question processing and answer processing. The same occurs for publications that deal with the three areas from question processing to information source organization, as well as answer processing. The area overlapping occurs for 26% distinct publications, translating to a percentage of 20% of the total number of publications.

5 Future Research Trends

In order to answer RQ3, we analyzed new characteristics that are being integrated into QAS and tried to identify future research trends.

5.1 Multiple KB QAS

It is common that a natural language question involves many aspects and it may become unpractical using a single knowledge base to cover all aspects of the question. With the continued growth of the semantic web and knowledge bases, each covering different domains, it becomes increasingly important to develop methods to access information over multiple knowledge bases [2]. We noticed a growing number of contributions on multiple knowledge base QAS described in (P3), (P13), (P33), (P62), (P82), (P105) and (P129), with 75% of them during the year 2016. This indicates increased research interest in this type of systems and a future research trend. This trend is justified by the need to create more flexible systems that obtain and validate answers from multiple sources when a single KB is not.

5.2 Non-factoid QAS

A factoid QAS is a system that provides concise facts like "Who is the father of Luke Skywalker?" or "What is the population on Mars?". The limitation of factoid QAS is that many questions that people want answers for, are not factoid questions. In contrast in a non-factoid QAS the system can be asked to provide an answer to a math question, how to change the oil of the car, etc. and the answer can be more of a descriptive nature. Frequently, for non-factoid questions, the answers cannot be readily found by simply using a good search engine because answering the question requires knowledge about the application domain. Thus there is a need to organize knowledge in a different way. We identified 18 non-factoid QAS described in (P15), (P30), (P35), (P36), (P44), (P54), (P55), (P62), (P64), (P69 - P73), (P78), (P111), (P116) and (P123) and noticed a constant increase in the amount of contributions on non-factoid QAS. We can identify this as an increased research interest and future

research trend driven by a need to create intelligent systems that actually "understand" the question.

5.3 Visual QAS

Visual question answering systems (VQAS) are systems that deal with answering questions about an image. The information source is either a hybrid between text and image or entirely image-based. With recent advancement in natural language processing (NLP) and computer vision, visual question answering (VQA) is gaining increased research attention [3] to help solving one of the ultimate goals in computer vision: holistic scene understanding [4]. We identified five systems described in (P34), (P68), (P84), (P87) and (P90), published during 2016 that deal with VQA. The system described in (P68) has both text and image-based information source, while the others are entirely image-based. We consider worth mentioning that this kind of system is not present during the years 2014 and 2015 in the list of publications that we collected. Based on these facts, we can identify this as a research trend, motivated by the need to create intelligent QAS that combine image understanding and natural language interaction.

6   Discussion and Conclusions

In this paper we presented a study on the current research on question answering systems. We can answer RQ1 from three different points of view: domain type, information source type and collaborative aspect. From the domain type point of view, we identified *open domain* and *closed* domain QAS. The need for modern systems to be inclusive of all areas of knowledge has made open domain QAS more popular and gain a greater interest from the research community.

From the information source type point of view, we identified *structured* and *unstructured* information source, with the latter being more popular. The advent of the *semantic web* is making possible the semantic decoration of information and the creation of structured KBs. This has transformed the process of answer retrieval into a database query. Furthermore the answer is specific and straight to the point, unlike traditional IR-based QAS that return an answer as part of a text in a natural language document.

From the collaborative aspect, we identified *community* QAS and *non-community* QAS, with the latter being more popular. However we noticed that a great amount of research is being done on CQAS and the difference in publications for the two systems is not very big. This reflects the increasing role that social networking and online communities have in the acquisition of knowledge.

As regards RQ2, we can say that most of the research is being done on issues regarding question processing. This is justified by the need to improve natural language processing to understand user questions better in order to provide a more accurate answer and create better systems. We also find worth mentioning that a considerate amount of research is being done on issues involving all the answering

process from information source organization to question analysis and answer generation.

To answer RQ3 we identified three future research trends: *multiple KB*, *non-factoid* and *visual QAS*. These trends are driven by the need to create more robust, flexible, inclusive and intelligent systems towards a complete artificial intelligence.

Appendix: Collected Publications

P1. Omari, A., Carmel, D., Rokhlenko, O., Szpektor, I.: Novelty based Ranking of Human Answers for Community Questions. Special Interest Group on Information Retrieval (2016)

P2. Petersil, B., Mejer, A., Szpektor, I., Crammer, K.: That's Not My Question: Learning to Weight Unmatched Terms in CQA Vertical Search. Special Interest Group on Information Retrieval (2016)

P3. Savenkov, D., Agichtein, E.: When a Knowledge Base Is Not Enough: Question Answering over Knowledge Bases with External Text Data. Special Interest Group on Information Retrieval (2016)

P4. Ture, F., Jojic, O.: Ask Your TV: Real-Time Question Answering with Recurrent Neural Networks. Special Interest Group on Information Retrieval (2016)

P5. Boguraev, B., Patwardhan, S., Kalyanpur, J Ch-C., Lally, A.: Parallel and nested decomposition for factoid questions, NLE (2014)

P6. van Dijk, D., Tsagkias, M., de Rijke, M.: Early Detection of Topical Expertise in Community Question Answering. Special Interest Group on Information Retrieval (2015)

P7. Viet Hung, N.Q., Chi Thang, D., Weidlich, M., Aberer, K.: ERICA: Expert Guidance in Validating Crowd Answers. Special Interest Group on Information Retrieval (2015)

P8. Bagdouri, M.: Cross-Platform Question Routing for Better Question Answering. Special Interest Group on Information Retrieval (2015)

P9. Yang, Z., Li, Y., Cai, J., Nyberg, E.: QUADS Question Answering for Decision Support. Special Interest Group on Information Retrieval (2014)

P10. Yeniterzi, R., Callan, J.: Analyzing bias in CQA-based expert finding test sets. Special Interest Group on Information Retrieval (2014)

P11. Keikha, M., Hyun Park, J., Bruce Croft, W.: Evaluating answer passages using summarization measures. Special Interest Group on Information Retrieval (2014)

P12. Araki, J., Callan, J.: An annotation similarity model in passage ranking for historical fact validation. Special Interest Group on Information Retrieval (2014)

P13. Nie, L., Li, T., Akbari, M., Shen, J., Chua, T-S.: WenZher: comprehensive vertical search for healthcare domain. Special Interest Group on Information Retrieval (2014)

P14. Bidoit, N., Herschel, M., Tzompanaki, A.: Efficient Computation of Polynomial Explanations of Why-Not Questions. Conference on Information and Knowledge Management (2015)

P15. Yin, P., Duan, N., Kao, B., Bao, J., Zhou, M.: Answering Questions with Complex Semantic Constraints on Open Knowledge Bases. Conference on Information and Knowledge Management (2015)

P16. Bast, H., Haussmann, E.: More Accurate Question Answering on Freebase. Conference on Information and Knowledge Management (2015)

P17. Tymoshenko, K., Moschitti, A.: Assessing the Impact of Syntactic and Semantic Structures for Answer Passages Reranking. Conference on Information and Knowledge Management (2015)

P18. Völske, M., Braslavski, P., Hagen, M., Lezina, G., Stein, B.: What Users Ask a Search Engine: Analyzing One Billion Russian Question Queries. Conference on Information and Knowledge Management (2015)

P19. Wang, Zh., Yan, Sh., Wang, H., Huang, X.: Large-Scale Question Answering with Joint Embedding and Proof Tree Decoding. Conference on Information and Knowledge Management (2015)

P20. Chan, W., Du, J., Yang, W., Tang, J., Zhou, X.: Term Selection and Result Reranking for Question Retrieval by Exploiting Hierarchical Classification. Conference on Information and Knowledge Management (2014)

P21. Sondhi, P., Zhai, C.: Mining Semi-Structured Online Knowledge Bases to Answer Natural Language Questions on Community QA Websites. Conference on Information and Knowledge Management (2014)

P22. Carmel, D., Mejer, A., Pinter, Y., Szpektor, I.: Improving Term Weighting for Community Question Answering Search Using Syntactic Analysis. Conference on Information and Knowledge Management (2014)

P23. Zhang, K., Wu, W., Wu, H., Li, Zh., Zhou, M.: Question Retrieval with High Quality Answers in Community Question Answering. Conference on Information and Knowledge Management (2014)

P24. Zhang, J., Kong, X., Jie, L., Chang, Y., Yu, P.S.: NCR: A Scalable Network-Based Approach to Co-Ranking in Question-and-Answer Sites. Conference on Information and Knowledge Management (2014)

P25. Mukherjee, S., Ajmera, J., Joshi, S.: Domain Cartridge: Unsupervised Framework for Shallow Domain Ontology Construction from Corpus. Conference on Information and Knowledge Management (2014)

P26. Bagdouri, M., Oard, D.W., Castelli, V.: CLIR for Informal Content in Arabic Forum Posts. Conference on Information and Knowledge Management (2014)

P27. Hasanain, M., Elsayed, T., Magdy, W.: Identification of Answer-Seeking Questions in Arabic Microblogs. Conference on Information and Knowledge Management (2014)

P28. Fang, H., Wu, F., Zhao, Zh., Duan, X., Zhuang, Y.: Community-Based Question Answering via Heterogeneous Social Network Learning. AAAI Conference on Artificial Intelligence (2016)

P29. Mitra, A., Baral, C.: Addressing a Question Answering Challenge by Combining Statistical Methods with Inductive Rule Learning and Reasoning. AAAI Conference on Artificial Intelligence (2016)

P30. Clark, P., Etzioni, O., Khot, T., Sabharwal, A., Tafjord, O., Turney, P.: Combining Retrieval, Statistics, and Inference to Answer Elementary Science Questions. AAAI Conference on Artificial Intelligence (2016)

P31. Oh, J-H., Torisawa, K., Hashimoto, Ch., Iida, R., Tanaka, M., Kloetzer, J. A: Semi-Supervised Learning Approach to Why-Question Answering. AAAI Conference on Artificial Intelligence (2016)

P32. Wu, Y., Wu, W., Zhang, X., Li, Zh., Zhou, M.: Improving Recommendation of Tail Tags for Questions in Community Question Answering. AAAI Conference on Artificial Intelligence (2016)

P33. Zhang, Y., He, Sh., Liu, K., Zhao, J.: A Joint Model for Question Answering over Multiple Knowledge Bases. AAAI Conference on Artificial Intelligence (2016)

P34. Ma, L., Lu, Zh., Li, H.: Learning to Answer Questions from Image Using Convolutional Neural Network. AAAI Conference on Artificial Intelligence (2016)

P35. Pang, L., Lan, Y., Guo, J., Xu, J., Cheng, X.: SPAN: Understanding a Question with Its Support Answers. AAAI Conference on Artificial Intelligence (2016)

P36. Ma, Z., Sun, A., Yuan, Q., Cong, G.: A Tri-Role Topic Model for Domain-Specific Question Answering. AAAI Conference on Artificial Intelligence (2015)

P37. Shen, Y., Rong, W., Sun, Zh., Ouyang, Y., Xiong, Zh.: Question/Answer Matching for CQA System via Combining Lexical and Sequential Information. AAAI Conference on Artificial Intelligence (2015)

P38. Wu, Y., Wu, W., Li, Zh., Zhou, M.: Mining Query Subtopics from Questions in Community Question Answering. AAAI Conference on Artificial Intelligence (2015)

P39. Boteanu, A., Chernova, S.: Solving and Explaining Analogy Questions Using Semantic Networks. AAAI Conference on Artificial Intelligence (2015)

P40. Xu, K., Zhang, Sh., Feng, Y., Huang, S., Zhao, D.: What Is the Longest River in the USA? Semantic Parsing for Aggregation Questions. AAAI Conference on Artificial Intelligence (2015)

P41. Zhang, W-N., Ming, Zh-Y., Zhang, Y., Liu, T., Chua, T-S.: Exploring Key Concept Paraphrasing Based on Pivot Language Translation for Question Retrieval. AAAI Conference on Artificial Intelligence (2015)

P42. Aydin, B. I., Yilmaz, Y. S., Li, Y., Li, Q., Gao, J.: Demirbas, M. Crowdsourcing for Multiple-Choice Question Answering. AAAI Conference on Artificial Intelligence (2014)

P43. Sun, H., Ma, H., He, X., Yih, W-T., Su, Y., Yan, X.: Table Cell Search for Question Answering. World Wide Web Conference (2016)

P44. Tsur, G., Pinter, Y., Szpektor, I., Carmel, D.: Identifying Web Queries with Question Intent. World Wide Web Conference (2016)

P45. Shi, H., Maly, K., Chong, D., Yan, G., He, W.: Backward Chaining Ontology Reasoning Systems with Custom Rules. World Wide Web Conference (2016)

P46. Boudaer, G., Loeckx, J.: Enriching Topic Modelling with Users' Histories for Improving Tag Prediction in Q&A Systems. World Wide Web Conference (2016)

P47. Burel, G., Mulholland, P., Alani, H.: Structural Normalisation Methods for Improving Best Answer Identification in Question Answering Communities. World Wide Web Conference (2016)

P48. Shekarpour, S., Marx, E., Ngonga Ngomo, A-C., Auer, S.: SINA: Semantic interpretation of user queries for question answering on interlinked data, Journal of Web Semantics (2015)

P49. Singh, P., Simperl, E.: Using Semantics to Search Answers for Unanswered Questions in Q&A Forums. World Wide Web Conference (2016)

P50. Kayes, I., Kourtellis, N., Quercia, D., Iamnitchi, A., Bonchi, F.: The Social World of Content Abusers in Community Question Answering. World Wide Web Conference (2015)

P51. Sun, H., Ma, H., Yih, W-T., Tsai, Ch-T., Liu, J., Chang, M-W: Open Domain Question Answering Via Semantic Enrichment. World Wide Web Conference (2015)

P52. Burel, G., Mulholland, P., He, Y., Alani, H.: Modelling Question Selection Behaviour in Online Communities. World Wide Web Conference (2015)

P53. Feng, G., Xiong, K., Tang, Y., Cui, A., Bai, J., Li, H., Yang, Q., Li, M.: Question Classification by Approximating Semantics. World Wide Web Conference (2015)

P54. Raghavi, K. C., Chinnakotla, M., Shrivastava, M.: "Answer ka type kya he?": Learning to Classify Questions in Code-Mixed Language. World Wide Web Conference (2015)

P55. Chaturvedi, S., Castelli, V., Florian, R., Nallapati, R. M., Raghavan, H.: Joint question clustering and relevance prediction for open domain non-factoid question answering. World Wide Web Conference (2014)

P56. West, R., Gabrilovich, E., Murphy, K., Sun, Sh., Gupta, R., Lin, D.: Knowledge base completion via search-based question answering. World Wide Web Conference (2014)

P57. Kim, K., Lee, S., Son, J., Cha, M.: Finding informative Q&As on twitter. World Wide Web Conference (2014)

P58. Peng, B., Rong, W., Ouyang, Y., Li, Ch., Xiong, Zh.: Learning joint representation for community question answering with tri-modal DBM. World Wide Web Conference (2014)

P59. Pudipeddi, J., Akoglu, L., Tong, H.: User churn in focused question answering sites: characterizations and prediction. World Wide Web Conference (2014)

P60. Meng, Z., Gandon, F., Zucker, C. F.: Joint Model of Topics, Expertises, Activities and Trends for Question Answering Web Applications. International Conference on Web Intelligence (2016)

P61. Ruan, H., Li, Y., Wang, Q., Liu, Y.: A Research on Sentence Similarity for Question Answering System Based on Multi-feature Fusion. International Conference on Web Intelligence (2016)

P62. Gallagher, S., Zadrożny, W.: Leveraging Large Corpora Using Internet Search for Question Answering. International Conference on Web Intelligence (2016)

P63. Razzaghi, F., Minaee, H., Ghorbani, A. A.: Context Free Frequently Asked Questions Detection Using Machine Learning Techniques. International Conference on Web Intelligence (2016)

P64. Zheng, S., Bao, H., Zhao, J., Zhang, J., Qi, Zh., Hao, H.: A Novel Hierarchical Convolutional Neural Network for Question Answering over Paragraphs. International Conference on Web Intelligence (2015)

P65. Cabrio, E., Faron-Zucker, C., Gandon, F., Hallili, A., Tettamanzi, A.: Answering N-Relation Natural Language Questions in the Commercial Domain. International Conference on Web Intelligence (2015)

P66. Meng, Z., Gandon, F., Faron-Zucker, C.: Simplified Detection and Labeling of Overlapping Communities of Interest in Question-and-Answer Sites. International Conference on Web Intelligence (2015)

P67. Chiang, Ch-L., Chen, Sh-Y., Cheng, P-J.: Summarizing Search Results with Community-Based Question Answering. International Conference on Web Intelligence (2014)

P68. Xiong, C., Merity, S., Socher, R.: Dynamic Memory Networks for Visual and Textual Question Answering. International Conference on Machine Learning (2016)

P69. Chen, L., Jose, J. M., Yu, H., Yuan, F., Zhang, D.: A Semantic Graph based Topic Model for Question Retrieval in Community Question Answering. International Conference on Web Search and Web Data Mining (2016)

P70. Zhang, K., Wu, W., Wang, F., Zhou, M., Li, Zh.: Learning Distributed Representations of Data in Community Question Answering for Question Retrieval. International Conference on Web Search and Web Data Mining (2016)

P71. Wu, H., Wu, W., Zhou, M., Chen, E., Duan, L., Shum, H-Y.: Improving search relevance for short queries in community question answering. International Conference on Web Search and Web Data Mining (2014)

P72. Yang, L., Ai, Q., Spina, D., Chen, R-Ch., Pang, L., Croft, W.B., Guo, J., Scholer, F.: Beyond Factoid QA: Effective Methods for Non-factoid Answer Sentence Retrieval. European Conference on Information Retrieval (2016)

P73. Braunstain, L., Kurland, O., Carmel, D., Szpektor, I., Shtok, A.: Supporting Human Answers for Advice-Seeking Questions in CQA Sites. European Conference on Information Retrieval (2016).

P74. Höffner, K., Lehmann, J., Usbeck, Ricardo.: CubeQA - Question Answering on RDF Data Cubes, International Semantic Web Conference ISWC (2016)

P75. Zhang, W. E., Abebe, E., Z. Sheng, Q., Taylor, K.: Towards Building Open Knowledge Base From Programming Question-Answering Communities, ISWC (2016)

P76. Lee, J., Ham, Y., Lee, T.: XB; A Large-scale Korean Knowledge Base for Question Answering Systems, ISWC (2016)

P77. Song, D., Schilder, F., Smiley, C., Brew, C., Zielund, T., Bretz, H., Martin, R., Dale, C., Duprey, J., Miller, T., Harrison, J.: TR Discover, A Natural Language Question Answering System for Interlinked Datasets, ISWC (2015)

P78. Yao, S., Liu, J., Wang, M., Wei, B., Chen, X.: ANNA: Answering Why-Not Questions for SPARQL, ISWC (2015)

P79. Cabrio, E., Aprosio, A. P., Villata, S.: Reconciling Information in DBpedia through a Question Answering System, ISWC (2014)

P80. Hamon, T., Grabar, N., Mougin, F.: Natural Language Question Analysis for Querying Biomedical Linked Data, ISWC (2014)

P81. Both, A., Diefenbach, D., Shekarpour, S., Lange, C.: Qanary -- An Extensible Vocabulary for Open Question Answering Systems, ESWC (2016)

P82. Usbeck, R., Ngonga Ngomo, A-C., Bühmann, L., & Unger, C.: HAWK – Hybrid Question Answering using Linked Data, ESWC (2015)

P83. Cabrio, E., Sachidananda, V., Troncy, R.: Boosting QAKiS with multimedia answer visualization, ESWC (2014)

P84. Fukui, A., Huk Park, D., Yang, D., Rohrbach, A., Darrell, T., Rohrbach M.: Multimodal Compact Bilinear Pooling for Visual Question Answering and Visual Grounding, Empirical Methods in Natural Language Processing EMNLP (2016)

P85. Sharp, R., Surdeanu, M., Jansen, P., Clark, P., Hammond, M.: Creating Causal Embeddings for Question Answering with Minimal Supervision, EMNLP (2016)

P86. Ture, F., Boschee, E.: Learning to Translate for Multilingual Question Answering, EMNLP (2016)

P87. Krishnamurthy, J., Tafjord, O., Kembhavi, A.: Semantic Parsing to Probabilistic Programs for Situated Question Answering, EMNLP (2016)

P88. Nakov, P., Màrquez, L., Guzmán, F.: It Takes Three to Tango: Triangulation Approach to Answer Ranking in Community Question Answering, EMNLP (2016)

P89. Golub, D., He, X.: Character-Level Question Answering with Attention, EMNLP (2016)

P90. Ray, A., Christie, G., Bansal, M., Batra, D., Parikh, D.: Question Relevance in VQA: Identifying Non-Visual And False-Premise Questions, EMNLP (2016)

P91. Khot, T., Balasubramanian, N., Gribkoff, E., Sabharwal, A., Clark, P., Etzioni, O.: Exploring Markov Logic Networks for Question Answering, EMNLP (2015)

P92. Li, Y., Clark, P.: Answering Elementary Science Questions by Constructing Coherent Scenes using Background Knowledge, EMNLP (2015)

P93. Joty, S., Barrón-Cedeño, A., Da San Martino, G., Filice, S., Màrquez, L., Moschitti, A., Nakov, P.: Global Thread-level Inference for Comment Classification in Community Question Answering, EMNLP (2015)

P94. Iyyer, M., Boyd-Graber, J., Claudino, L., Socher, R., Daumé III, H.: A Neural Network for Factoid Question Answering over Paragraphs, EMNLP (2014)

P95. He, S., Liu, K., Zhang, Y., Xu, L., Zhao, J.: Question Answering over Linked Data Using First-order Logic, EMNLP (2014)

P96. Wang, Q., Liu, J., Wang, B., Guo, L.: A Regularized Competition Model for Question Difficulty Estimation in Community Question Answering Services, EMNLP (2014)

P97. Bordes, A., Chopra, S., Weston, J.: Question Answering with Subgraph Embeddings, EMNLP (2014)

P98. Yang, M-C., Duan, N., Zhou, M., Rim, H-C.: Joint Relational Embeddings for Knowledge-based Question Answering, EMNLP (2014)

P99. Madabushi, H. T., Lee, M.: High Accuracy Rule - based Question Classification using Question Syntax and Semantics, International Conference on Computational Linguistics COLING (2016)

P100. Xiang, Y., Zhou, X., Chen, Q., Zheng, Zh., Tang, B., Wang, X., Qin, Y.: Incorporating Label Dependency for Answer Quality Tagging in Community Question Answering via CNN - LSTM – CRF, COLING (2016)

P101. Suggu, S. P., Goutham, K. N., Chinnakotla, M. K., Shrivastava, M.: Hand in Glove: Deep Feature Fusion Network Architectures for Answer Quality Prediction in Community Question Answering, COLING (2016)

P102.   Romeo, S., Da San Martino, G., Barrón-Cedeño, A., Moschitti, A., Belinkov, Y., Hsu, W-N., Zhang, Y., Mohtarami, M., Glass, J.: Neural Attention for Learning to Rank Questions in Community Question Answering, COLING (2016)

P103.   Yin, W., Yu, M., Xiang, B., Zhou, B., Schütze, H.: Simple Question Answering by Attentive Convolutional Neural Network, COLING (2016)

P104.   Kumar, V., Joshi, S.: Non-sentential Question Resolution using Sequence to Sequence Learning, COLING (2016)

P105.   Xu, K., Feng, Y., Huang, S., Zhao D.: Hybrid Question Answering over Knowledge Base and Free Text, COLING (2016)

P106.   Bao, J., Duan, N., Yan, Zh., Zhou, M., Zhao, T.: Constraint-Based Question Answering with Knowledge Graph, COLING (2016)

P107.   Barrón-Cedeño, A., Da San Martino, G., Romeo, S., Moschitti, A.: Selecting Sentences versus Selecting Tree Constituents for Automatic Question Ranking, COLING (2016)

P108.   Zhou, G., Chen, Y., Zeng, D., Zhao, J.: Group Non-negative Matrix Factorization with Natural Categories for Question Retrieval in Community Question Answer Archives, COLING (2014)

P109.   Xiao, Y., Zhao, W. X., Wang, K., Xiao, Zh.: Knowledge Sharing via Social Login: Exploiting Microblogging Service for Warming up Social Question Answering Websites, COLING (2014)

P110.   Soulier, L., Tamine, L., Nguyen, G-H.: Answering Twitter Questions: a Model for Recommending Answerers through Social Collaboration, Conference on Information and Knowledge Management CIKM (2016)

P111.   Goodwin, T. R., Harabagiu, S. M.: Medical Question Answering for Clinical Decision Support, CIKM (2016)

P112.   Meng, L., Li, Y., Liu, M., Shu, P.: Skipping Word: A Character-Sequential Representation based Framework for Question Answering, CIKM (2016)

P113.   Da San Martino, G., Romeo, S., Moschitti, A.: Learning to Re-Rank Questions in Community Question Answering Using Advanced Features, CIKM (2016)

P114.   Das, A., Yenala, H., Chinnakotla, M., Shrivastava, M.: Together we stand: Siamese Networks for Similar Question Retrieval, Association for Computational Linguistics ACL (2016)

P115.   Angeli, G., Nayak, N., Manning, C. D.: Combining Natural Logic and Shallow Reasoning for Question Answering, ACL (2016)

P116.   Tan, M., dos Santos, C., Xiang, B., Zhou, B.: Improved Representation Learning for Question Answer Matching, ACL (2016)

P117.   Dai, Z., Li, L., Xu, W.: CFO: Conditional Focused Neural Question Answering with Large-scale Knowledge Bases, ACL (2016)

P118.   Xu, K., Reddy, S., Feng, Y., Huang, S., Zhao, D.: Question Answering on Freebase via Relation Extraction and Textual Evidence, ACL (2016)

P119.   Guzmán, F., Màrquez, L., Nakov, P.: Machine Translation Evaluation Meets Community Question Answering, ACL (2016)

P120.   Zhou, G., He, T., Zhao, J., Hu, P.: Learning Continuous Word Embedding with Metadata for Question Retrieval in Community Question Answering, ACL (2015)

P121.   Dong, L., Wei, F., Zhou, M., Xu, K.: Question Answering over Freebase with Multi-Column Convolutional Neural Networks, ACL (2015)

P122.   Yih, W-t., Chang, M-W., He, X., Gao, J.: Semantic Parsing via Staged Query Graph Generation: Question Answering with Knowledge Base, ACL (2015)

P123.   Barrón-Cedeño, A., Filice, S., Da San Martino, G., Joty, S., Màrquez, L., Nakov, P., Moschitti, A.: Thread-Level Information for Comment Classification in Community Question Answering, ACL (2015)

P124.   dos Santos, C., Barbosa, L., Bogdanova, D.,   Zadrozny, B.: Learning Hybrid Representations to Retrieve Semantically Equivalent Questions, ACL (2015)

P125.   Wang, D., Nyberg, E.: A Long Short-Term Memory Model for Answer Sentence Selection in Question Answering, ACL (2015)

P126.   Zhou, X., Hu, B., Chen, Q., Tang, B., Wang, X.: Answer Sequence Learning with Neural Networks for Answer Selection in Community Question Answering, ACL (2015)

P127.   Yao, X., Van Durme, B.: Information Extraction over Structured Data: Question Answering with Freebase, ACL (2014)

P128.   Bao, J., Duan, N., Zhou, M., Zhao, T.: Knowledge-Based Question Answering as Machine Translation, ACL (2014)

P129.   Yih, W-t., He, X., Meek, C.: Semantic Parsing for Single-Relation Question Answering, ACL (2014)

References

1. Xuchen, Y., Van Durme, B.: Answer Extraction as Sequence Tagging with Tree Edit Distance, The Conference of the North American Chapter of the Association for Computational Linguistics (2013)

2. Unger, C.; Freitas, A.; and Cimiano, P.: An introduction to question answering over linked data. In Reasoning Web. Reasoning on the Web in the Big Data Era. 100–140 (2014)

3. Yang, Z., He, X., Gao, J., Deng, L., Smola, A.:Stacked Attention Networks for Image Question Answering. 29th IEEE Conference on Computer Vision and Pattern Recognition. (2016)

4. Noh, H., Seo, P. H., Han, B.: Image Question Answering Using Convolutional Neural Network With Dynamic Parameter Prediction. 29th IEEE Conference on Computer Vision and Pattern Recognition.(2016)

5. Zhao, Zhou & Yang, Qifan & Cai, Deng & He, Xiaofei & Zhuang, Yueting "Expert Finding for Community-Based Question Answering via Ranking Metric Network Learning", IJCAI, (2016)

6. Dwivedia, S., Vaishali, S.: Research and reviews in question answering system. International Conference on Computational Intelligence: Modeling Techniques and Applications (2013)

7. Shekarpour, S., Endris, K. M., Kumar, A. J., Lukovnikov, D., Singh, K., Thakkar, H., Lange, Ch.: Question Answering on Linked Data: Challenges and Future Directions. World Wide Web Conference (2016)

A Review of Automated Planning and its Application to Cloud e-Learning

Krenare Pireva[1], Petros Kefalas[2], and Anthony J. Cowling[3]

[1] South-East European Research Center, 24 P. Koromila, 54622, Thessaloniki, Greece
[2] The University of Sheffield International Faculty, City College, 3 L. Sofou, 54624, Thessaloniki, Greece
[3] Computer Science Department, The University of Sheffield, 211 Portobello, Sheffield, UK

Abstract. Automated planning is being used in various domains for generating processes that require to bridge a current and a desired state of affairs. Learning can be seen as a process that guides a learner to bridge her current knowledge and skills to some desired ones. The main issue is to select the most appropriate learning resources to include in a personalised learning path. This becomes even more challenging in Cloud e-Learning, where the resources can be anything that is stored in the Cloud. This paper gives an overview of the fundamental concepts of planning as a key area of artificial intelligence and furthermore it explores existing planners and algorithms used for different purposes. Automated planning is introduced as the final process of Cloud e-Learning. A practical example is presented to demonstrate suitability of planning to the generation of personalised learning paths.

1   Introduction

Given an initial and a desired state of a world, **planning** is the process of generating a sequence of actions in partial or complete order so that, if these actions are performed one can reach the desired goal. In Artificial Intelligence the planning process can be fully automated in a variety of ways depending on the nature of the problem as well as the constraints imposed for the final solution (plan).

Learning can be viewed as a planning process. The learner is at some initial state with skills and knowledge already acquired through previous experience and would like to change (learn) to a new desired state which will contain more skills and knowledge. The process of assembling learning material to form a, so called, learning path is equivalent to a planning.

Cloud e-Learning (CeL) is a new paradigm for e-learning[1, 2] in which learners are presented with an automatically generated learning path that utilize any suitable sources from the cloud. CeL is considered as an advancement of e-Learning and aims to provide personalised services that will increase interaction between users by sharing a pool of experiences and knowledge available in cloud and suggest structured courses that match learners preferences and knowledge

level. The knowledge available on the cloud comprise different sources for CeL. In CeL, we consider that everything stored in the cloud can be potentially used for learning. The goal is to automatically put together such learning objects in a sequence (CeL path) that reasonably meets the profile and desires of the learner.

The aim of this paper is to review automated planning, formulate the generation of a learning path in CeL as a planning process and propose what type of process is the most appropriate to generate a personalised learning path in CeL.

The remainder of this paper is structured as follows: Section 1 introduce the paper. Section 2 convers the planning and the terminology used throughout the paper. Section 3, treats the Learning as a planning process, whereas section 4, gives a concrete examples of planning in CeL. And finally, concluding the paper.

2   Planning

In our everyday life, the usual tasks are accomplished intuitively as an automatic reaction without having to plan in advance anything. With the increasing complexity of tasks, there is a need to plan, and even in some complex cases, there is a need to plan different alternatives in order to achieve certain goals. **Planning** is an important component of rational behaviour[3] and could be defined as the task to design the behaviour of entities that act individually either on their own or as part of a group of activities [4]. The purpose of Planning as a subfield of AI is to cover the computational aspect of intelligence rather than just performing a plan as a set of activities for providing a solution to particular problems. A **Plan** is defined as a sequence or parallelization of activities or actions, which aim is to achieve specified goals and satisfies the domain constraints based on some initial state given a priori. Often, the problems are described using conceptual models, which are used to describe the elements of problems, through explanation of basic concepts, analysis of the requirements and representation of them.

2.1   Planning Formal definition

A planning domain and problem is usually modeled through representation languages, such as STRIPS, ADL, PDDL. In principle, in order to generate a plan using classical planner, three components must be defined: the description of the system, the initial state and the objectives (the goals). Formally, a **planning problem** is a tuple:

$$P = (S, A, E, \gamma, s_0, g) \tag{1}$$

where

- S is defined as the **set of states**;
- A is the **set of actions** which are going to be performed in order to achieve the stated goal;
- E is a **set of events**;

Table 1. Taxonomy of Domains for Planning

Planning Domain	Description
Path and Motional	Commonly used to find a path for a robot or agent, from the initial state to the defined goal. The algorithms are used in different fields, starting from bioinformatics, animation of characters, industrial automation, robot navigation etc.
Perception	Concerned to process the current state of environment, by gathering the information through sensors. It relies in decision theory of problem, when, which and how the information are needed. For example, the perception planner is required when modeling a complex environment from set of images.
Information gathering	A form of perception is assembled while querying the system instead of sensing
Communication	Outflow in dialog between various agents in order to justify when and how to query required information and which feedback to provide in the meantime
Navigation	Combines the path and perception planning in order to explore the environment. For example following a particular road by processing and avoiding the obstacles as component of the particular road

- γ is the **state transition function** denoted as γ: S x A x E $\rightarrow 2^S$;
- s_0 is the **initial state**;
- g is the **set of goal states**.

2.2   Types of Planners

Planners involve the representation of actions executed by intelligent agents. Since there are various types of actions, we have different types of planners which are applied for various tasks, such as: path and motional planning, process planning, perception planning, navigation planning, etc., each of them described in table 1.

In the other side, there are different approaches on planning, there could be domain **specific/depended** planning or **domain independent** planning, **online** or **offline** planning, **classical** or **temporal** planning, **linear** or **non-linear** planning respectively. The domain specific planners are specified precisely for particular problems and their drawback is that each planning problem is tightly connected with the domain problem. Whereas, domain independent relies in an abstract model, starting from the simplest model of action which allows a limited reasonable action to those advanced models with more complex capabilities [3]. Meanwhile, a partial-order plan or non-linear planner starts the initial state with a partial plan and continues to refine the plan until the goal state is achieved. The actions within partial-order plan are unordered, except those necessary, whereas, the total-ordered plan or linear planner generates a sequence of totally ordered

Table 2. Taxonomy of Techniques for Planning

Planning Technique	Description	Planners
Total order	The total order technique or linear planning specify the exact ordering of the actions within the plan. Example in state-space planning, a totally ordered plan is refined.	SHOP[5], HATP [6]
Partial ordered	The partial ordering technique or non-linear planning specifies the ordering of the actions only when necessary. Example in plan-space planning, a partial-ordered plan is refined continually until the desired plan could satisfy the state goals.	UC-POP[7], NOAH[8], PL-PLAN[9]
Heuristic Task Network	HTN Planning approach provides a plan by decomposing the tasks into smaller subtasks by selecting heuristically the best decomposition among the possible ones until reaching the primitive tasks that can be performed directly by planning operators	AltAlt[10], FF[11], GRT[12], LPG[13], VHPOP[14], H2O[15]
SAT-based and Contingency	SAT as a logic-base approach converts the planning problem into Satisfiability problem and the plan is generated based in the efficient solution of the resulting satisfiability problem. In both techniques the actions are not deterministic, and their effects may or may not be observable.	SATPLAN[16], Madagascar[17], ZANDER[18], BlackBox[19]
Temporal	The temporal planning differs from the classical planning, cause the action have durations and some of them might be executed concurrently.	LPG-td[20], TALplanner[21], OPTIC[22], CRIKEY[23]
Case-based	The case based planning approach, adapts (reusing previous plans or partial of plans) previous cases with similar initial and goal state by recalling them from the library and modifying the retrieved solution for new upcoming problems.	CHEF[24], CaPER[25], Prodigy/Analogy[26]

actions, even when steps do not need to be ordered. Based on the algorithms used, each of the planning technique is described in table 2, considering some of the planners used in each of the specified techniques.

2.3 Techniques for Planning

The scenario of classical planning could be defined as a static planning for one scenario, with a known initial state, deterministic actions performed one at a time, and the algorithms used are usually categorized into: state-space planning, plan-space planning [27]. The **Plan-Space (PSP)** planner differs from the **State-Space (SSP)** planner not only in search space but also how the problem is solved. For example PSP uses a partial planning with infinite actions that will be refined continually until the final goals are satisfied whereas SSP

uses a finite sequence of actions that is proposed from initial state to final goal. For example, using SSP the node is the initial state and the arc is the transition, whereas using PSP planner, a node is defined as a partially specified plan, and the arc is the refinement operations to further complete the partial plan.

The scenario of neoclassical planning encounters the parallelized activities through graph-based planning and satisfiability algorithms, through AI planning techniques. The neoclassical planners provide an open planning approach while taking in consideration several extension to classical planning, such as time, resources and information gathering action.

The automated planning conceptualized as automated reasoning relies in domain independent and in order to solve a problem, the planners take as input the problem specification and the knowledge about its domain. Based on the forms of reasoning as planning capabilities there are identified: (i) Project planning, (ii) Scheduling and resource allocation and (iii) plan synthesis. Among all, the scheduling and resource allocation include temporal, precedence and resource constraints to be used from each action. A scheduling application takes the action together with resource constraints and optimization criteria as input and returns the temporal organized plan with resource allocation which aims to achieve the defined input criteria. Generally, in automated planning, the Planning and Scheduling are related problems, where the planning deals mainly how to generate a set of actions (the plan) in order to achieve the specified goal, whereas the scheduling is concerned on time and resource allocation for the set of actions defined previously.

During the last decades, there has been done a lot of research toward planning in different domains, by proposing new methods and techniques for improving the planning systems either by introducing new definition languages or by developing algorithms with improvement performances in known and unknown environments. For example, in [28] [29] [30], are developed flexible and distributed planning of multi-agent systems in dynamic environment.

2.4   Representation language PDDL

Planning Domain Definition Language representation language (PDDL) is a standard notation used to encode planning domains. There are different versions of PDDL, mainly supporting different syntactic features such as [31]: conditional effects, basic strips style actions, specification of hierarchical actions etc. The PDDL modeling language is inspired by STRIPS and ADL a previously specification languages for describing the system[32]. PDDL, as a domain definition language is supported by various planners, through which it could define the properties of the domain, the precondition and the actions. Using the defined properties the planner is aiming to generate a plan for achieving the desired goal. PDDL contains requirement clause, such as: typing, strips, fluent etc which could be used further in the function and actions only if they are primarily declared.

3 Learning as a Planning Process

Learning can be defined as a change of state in the learner's cognitive, psychomotor and affective domains [33]. Learning is based on learning outcomes from the levels **Bloom Taxonomy** and ways (teaching and assessment methods) to accomplish them. Therefore, the learners are confronted with a series of learning materials, which we call **Learning Objects (LOs)**, such as texts, videos, assignments, exams etc. that they have to achieve in order to meet the learning outcomes. These form a **learning path** which can be seen as a solution to a planning problem. One could define learning as a planning process as follows:

$$Learning = (S_l, A_l, \gamma_l, s_{0l}, g_l) \tag{2}$$

where:

- S_l is the set of all possible states that characterise a learner;
- A_l is the set of all LOs;
- γ_l a set of transitions which change the state of a learner;
- s_{0l} is the initial state of the learner
- g_l is the set of learning outcomes to achieve

Lately, the automated planning has been also proposed to be integrated in learning domain through learning activities, for being able to develop various learning designs. Garrido et al. (2014) proposed a three level approached procedure to generate learning designs using domain independent planners. The learning activities represented by XML schema are translated through metadata in automated planning, where (i) the course definition is presented as panning domain, (ii) the students learning information as a planning problem of that domain and (iii) the learning design as a plan generated by a domain independent planner. Each of LOs within the planning domain is presented as one or more planning actions, its dependencies relations as preconditions and its outcomes as effects[34]. R-Moreno et al.[35] presented CAMOU as a tool to facilitate the learning and acquire knowledge through interaction between students and teachers and also to help the latter to design courses through IPSS, an integrated automated reasoning system in CAMOU which uses planning and scheduling modules as main reasoning module. In [36], a way how to personalise an e-learning path is presented, based on case-based planning (CBP). Case-based planning is used for definition, memorization, retrieval and adaptation of learning routes. In order to provide solutions to a particular planning problem with respect to CBP, these steps are followed: (i) to retrieve plan that is stored in memory, (ii) to repair the actual plan if any discrepancies are faced, (iii) to test and revise the tested plan, and finally (iv) to store as a new case in the library of case bases. The previous CPB generated plans are stored as cases and can be reused to solve similar planning problems in the future. The best stored learning routes for each students profile and course objective could be reused further, so the system does not have to create a plan from scratch. When discrepancies are

detected, the learning route is readapted and improved to meet new objectives, and finally a new learning route is stored further. This proposal as explained contributes on translating the e-learning template into PDDL (Planning description definition language) durative actions and CBP repository contained personalised learning information based on case-based planner. This LOs repository is modified by teachers, and the final approach is tested as an added value in open elearning platforms, such as Moodle and ILIAS. In [37], a system called PASER (Planner for Automatic Synthesis of Educational Resources) is proposed which deals with a larger problem such as synthesizing curricula using planning and machine learning techniques rather than dealing only with courses. The system is very general and it aims to use an automated planner, given the initial state, the available actions and the goals, which then resulted in producing an entire curriculum.

4 Planning in CeL

4.1 A brief Overview of CeL

CeL as a new paradigm of e-Learning, aims to provide personalised learning paths by sharing a pool of knowledge resources available in the cloud[1, 2].
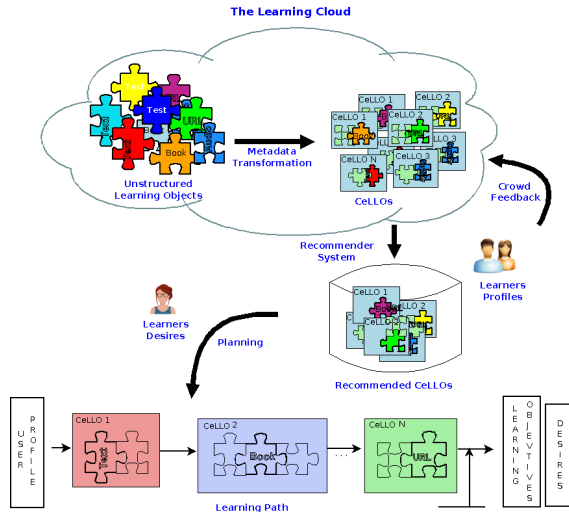
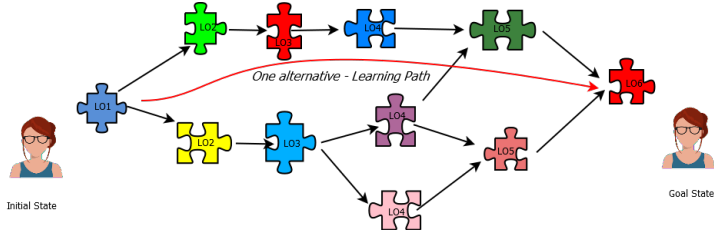

Fig. 1. The overall view of CeL

Fig. 2. The proposed learning path from CeL planner

Figure 1 presents the big picture of the CeL, including all the processes and technologies used. To provide limited number of learning objects to the planner that matches learners profile and desire, the CeL Recommender System filters the most relevant ones. Details of the various processes involved are presented elsewhere, such as the representation of learning objects[38] and the recommender system[39].

The automated planning as the final process shown in Figure 2 generates a personalised learning path, considering the background of the learner together with their desire as initial state, and the achieved learning outcomes as the goal state. In a nutshell, the plan defines a sequence of CeLLOs having indented learning outcomes (LeOs) that correspond to what the student knows and what the student achieves respectively. Planning offers alternative learning paths in case that a learner needs to backtrack to a previous point due to failing to meet the indented LeOs.

4.2 CeL as a Planning Problem

Therefore, with the process described above we end up with a pool of suitable CeLLOs that would take part in the planning process. Formally, the Planning in CeL is a tuple:

$$PCeL = (S_{cel}, A_{cel}, \gamma_{cel}, s_{0cel}, g_{cel}) \tag{3}$$

where:

- S_{cel} is the set of all possible propositions that describe the user profile, knowledge, skills and desires
- A_{cel} is the set of all CeLLOs
- γ_{cel} is the state transition function which given a state of a learner and a CeLLO returns a new state which includes new knowledge and skills that the learner has acquired through this CeLLO
- s_{0cel} is the initial state of the learner
- g_{cel} is the set of goal states that include the desires in terms of skills and knowledge by the learner

In the context of CeL, defined in previous papers [1, 2], the planning approach as the final phase, where all recommended CeLLOs, are offered as part of the planning problem and the CeL planner, will try to synthesize the right CeLLOs in the personalised sequence based on learners background and learners interest (Algorithm 1).

Algorithm 1: Invoking Automated Planning in order to generate a personalised learning path

   Input : Recommended CeLLOs from the CeL and profile constraints of learner
   Output: personalised learning path for the learner
1 if *!isEmpty(recommendedCeLLOs)* **then**
2 | Action 1: Select the potentially relevant existing CeLLOs;
3 | Action 2: Insert the selected CeLLO from CeL to the plan;
4 | Action 3: Propose the personalised plan to the learner;
5 else
6 | reInitiate the CeLRS;
7 end

4.3 Planning in CeL: An example

Here we present an example, in which a learner (learner 1) is interested to learn java so that she can be able to acquire skills at level 4 of the bloom taxonomy, i.e. analysis. The learner profile is listed among other profiles in Table 3.

Table 3. Sample Learner Profiles

Name	Knows	Type of Learner	Desires to Learn
learner1	maths at level(1) and algorithms at level (1)	visual	java at level(4)
learner2	maths at level(3)	audio	ai at level(4)

Learner1 expresses her desire through an unstructured query. The CeL recommender system filters the number of available CeLLOs which might be relevant to the desire of the learner. Relevance is determined also by the ontology related to the desire, in this case, java is related to variables, control statements of programming languages through the ACM ontology [40]. Some of them are videos, audios, podcast and others texts format types, while some others are self-evaluation tests to assess learner's progress (Table 4). The CeLLOs that are potentially relevant contain materials about algorithms, java, object oriented programming and maths. In each of the CeLLOs the cognitive level of the contained material is defined (Bloom level), as well as the pre-requisites required

Table 4. Sample CeLLOs in some abstract format

Type of Learner	Available Format	Cello ID	Bloom level	Topic	Prerequisites
visual	video	c1	4	java syntax	none
visual	video	c2	3	oop	none
visual	video	c3	3	algorithms	control statements at level(3) and variables at level(3)
visual	text	c4	1	maths	none
visual	text	c5	3	control statements	none
visual	text	c6	3	variables	none
audio	podcast	c7	3	control statements	none
audio	podcast	c8	3	variables	none
any	test	t1	4	java syntax	none
any	test	t2	3	oop	none
any	test	t3	3	algorithms	none
any	test	t4	1	maths	none
any	test	t5	3	control statements	none
any	test	t6	3	variables	none

in order to be able to deal the material. For example, in order to deal with algorithms one must deal with control statements and variables (CeLLO c3).

A simple linear Planner will create a goal state start out of the desires of the learner. The learner's profile forms the initial state. The plan generated is the learning path which consists of the most appropriate CeLLOs.

In our example the personalised learning path for learner1 based on her profile and her desires is as follows:

1. Watch *c2*, a video on *oop*;
2. Take the test *t2*;
3. Study text *c5* on *control statements*;
4. Take the test *t5*;
5. Study text *c6* on *variables*;
6. Take the test *t6*;
7. Watch the video *c3* on *algorithms*;
8. Take the test *t3*;
9. Watch the video *c1* on *Java syntax*;
10. Take the test *t1*.

4.4 Discussion

In addition to the previous examples, there might be a need to define the duration of each action (watch, study, take test etc.) that the learner should do. In such case, we should specify the time frames as constraints for the action, precondition and effects. If we consider the same actions with planning and scheduling
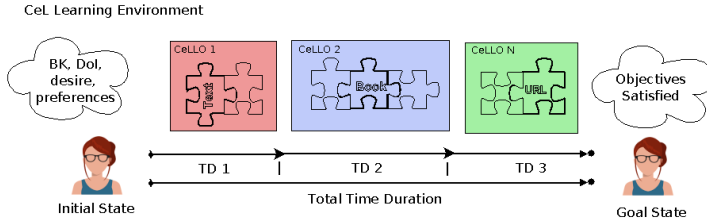
Fig. 3. The CeL Planning Domain

techniques, beside the constrainsts, the action is specified with its resource requirements as well (which might be consumable or reusable resources) and three variables (starting time, ending time and duration).

In CeL, the CeLLOs are treated as reusable resources, which have fixed duration, as shown in figure 3. During learning, the learner may face problems, that is, fail to follow the personalised path for some reason, e.g. fail the assessment test. In such case, the planner should be able to define alternatives learning paths or to re-plan from that point of failure.

5   Conclusion

We have formally defined Cloud e-Learning as a Planning problem with the goal to find a personalised learning path for any learner with a specific profile and particular desires to acquire new knowledge and skills. The validity of the approach was demonstrated through an example. So far, we have managed to implement the problem using linear planning, i.e. STRIPS notation, through PDDL. Future work will include to consider the temporal planning techniques and to investigate more the benefits of Planning and Scheduling techniques, particularly the case of 'job-shop' problem, as a new technology which besides the time constraints deals also with resource constraints, as consumable or borrowable resources.

Bibliography

[1] K. Pireva and P. Kefalas, "The use of multi agent systems in cloud e-learning," in *Doctoral Student Conference on ICT*, 2015, pp. 324–336.

[2] K. Pireva, P. Kefalas, D. Dranidis, T. Hatziapostolou, and A. Cowling, "Cloud e-learning: A new challenge for multi-agent systems," in *Agent and Multi-Agent Systems: Technologies and Applications.* Springer, 2014, pp. 277–287.

[3] M. Ghallab, D. Nau, and P. Traverso, *Automated Planning: theory and practice.* Elsevier, 2004.

[4] D. McDermott and J. Hendler, "Planning: what it is, what it could be, an introduction to the special issue on planning and scheduling," *Artificial Intelligence*, vol. 76, no. 1-2, pp. 1–16, 1995.

[5] D. Nau, T.-C. Au, O. Ilghami, U. Kuter, D. Wu, F. Yaman, H. Munoz-Avila, and J. W. Murdock, "Applications of shop and shop2," *IEEE Intelligent Systems*, vol. 20, no. 2, pp. 34–41, 2005.

[6] R. Lallement, L. De Silva, and R. Alami, "Hatp: An htn planner for robotics," *arXiv preprint arXiv:1405.5345*, 2014.

[7] J. S. Penberthy, D. S. Weld *et al.*, "Ucpop: A sound, complete, partial order planner for adl." *Kr*, vol. 92, pp. 103–114, 1992.

[8] E. D. Sacerdoti, "A structure for plans and behavior," DTIC Document, Tech. Rep., 1975.

[9] P. Fournier-Viger and L. Lebel, "Pl-plan, java open-source ai planner," http://www.philippe-fournier-viger.com/plplan/, 2009, online; accessed 10 May 2017.

[10] R. S. Nigenda, X. Nguyen, and S. Kambhampati, "Altalt: Combining the advantages of graphplan and heuristic state search," *Knowledge Based Computer Systems*, pp. 409–421, 2000.

[11] E. Keyder and H. Geffner, "The ff (ha) planner for planning with action costs," *Proceedings of the International Planning Competition (IPC)*, 2008.

[12] I. Refanidis and I. Vlahavas, "Grt: a domain independent heuristic for strips worlds based on greedy regression tables," in *European Conference on Planning.* Springer, 1999, pp. 347–359.

[13] A. Gerevini and I. Serina, "Lpg: A planner based on local search for planning graphs with action costs." in *AIPS*, vol. 2, 2002, pp. 281–290.

[14] H. L. Younes and R. G. Simmons, "Vhpop: Versatile heuristic partial order planner," *Journal of Artificial Intelligence Research*, vol. 20, pp. 405–430, 2003.

[15] N. Waisbrot, U. Kuter, and T. Könik, "Combining heuristic search with hierarchical task-network planning: A preliminary report." in *FLAIRS Conference*, 2008, pp. 577–578.

[16] H. Kautz and B. Selman, "Satplan04: Planning as satisfiability," *Working Notes on the Fifth International Planning Competition (IPC-2006)*, pp. 45–46, 2006.

[17] J. Rintanen, "Madagascar: Scalable planning with sat," *Proceedings of the 8th International Planning Competition (IPC-2014)*, 2014.

[18] S. M. Majercik and M. L. Littman, "Contingent planning under uncertainty via stochastic satisfiability," *Artificial Intelligence*, vol. 147, no. 1-2, pp. 119–162, 2003.

[19] H. Kautz and B. Selman, "Unifying sat-based and graph-based planning," in *IJCAI*, vol. 99, 1999, pp. 318–325.

[20] A. Gerevini, A. Saetti, I. Serina, and P. Toninelli, "Lpg-td: a fully automated planner for pddl2. 2 domains," in *In Proc. of the 14th Int. Conference on Automated Planning and Scheduling (ICAPS-04) International Planning Competition abstracts*, 2004.

[21] J. Kvarnström and P. Doherty, "Talplanner: A temporal logic based forward chaining planner," *Annals of mathematics and Artificial Intelligence*, vol. 30, no. 1, pp. 119–169, 2000.

[22] J. Benton, A. J. Coles, and A. Coles, "Temporal planning with preferences and time-dependent continuous costs." in *ICAPS*, vol. 77, 2012, p. 78.

[23] K. Halsey, D. Long, and M. Fox, "Crikey-a temporal planner looking at the integration of scheduling and planning," in *Workshop on Integrating Planning into Scheduling, ICAPS*, 2004, pp. 46–52.

[24] K. J. Hammond, "Chef: A model of case-based planning." in *AAAI-86 Proceedings*, 1986, pp. 267–271.

[25] B. P. Kettler, J. A. Hendler, W. A. Andersen, and M. P. Evett, "Massively parallel support for case-based planning," *IEEE Expert*, vol. 9, no. 1, pp. 8–14, 1994.

[26] M. M. Veloso, *Planning and learning by analogical reasoning.* Springer Science & Business Media, 1994, vol. 886.

[27] I. Vlahavas and I. Refanidis, "Planning and scheduling," http://www.eetn.gr/index.php/about-eetn/eetn-publications/ai-research-in-greece/planning-and-scheduling, online; accessed 10 May 2017.

[28] R. M. Jensen and M. M. Veloso, "Aset: A multi-agent planning language with nondeterministic durative tasks for bdd-based fault tolerant planning," in *Proc. 15th International Conference on Automated Planning and Scheduling (ICAPS-05).2005*, 2005.

[29] A. Komenda, J. Vokřínek, M. Pěchouček, G. Wickler, J. Dalton, and A. Tate, "Distributed planning and coordination in non-deterministic environments," in *Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems-Volume 2.* International Foundation for Autonomous Agents and Multiagent Systems, 2009, pp. 1401–1402.

[30] H. Hayashi, "Stratified multi-agent htn planning in dynamic environments," in *KES International Symposium on Agent and Multi-Agent Systems: Technologies and Applications.* Springer, 2007, pp. 189–198.

[31] C. Aeronautiques, A. Howe, C. Knoblock, I. D. McDermott, A. Ram, M. Veloso, D. Weld, D. W. SRI, A. Barrett, D. Christianson *et al.*, "Pddlthe planning domain definition language version 1.2," 1998.

[32] M. Kalisch and S. König, "Comparison of strips, adl and pddl, introduction to ai planning," *Lecture Notes, Bamberg University.[4] Baker, K*, 1998.

[33] D. R. Krathwohl, "A revision of bloom's taxonomy: An overview," *Theory into practice*, vol. 41, no. 4, pp. 212–218, 2002.

[34] A. Garrido, E. Onaindia, L. Morales, L. Castillo, S. Fernández, and D. Borrajo, "Modeling e-learning activities in automated planning," in *Proceedings of International Competition on Knowledge Engineering for Planning and Scheduling*, 2009.

[35] M. D. R-Moreno, D. Camacho, and U. Obieta, "A plan-based tool for automatic elearning courses redesign," *International Journal of Computer Science Applications*, 2008.

[36] A. Garrido, E. Onaindia, and O. Sapena, "Automated planning for personalised course composition," in *Advanced Learning Technologies, 2009. ICALT 2009. Ninth IEEE International Conference on*. IEEE, 2009, pp. 178–182.

[37] D. Vrakas, F. Kokkoras, N. Bassiliades, and I. Vlahavas, "Towards automatic synthesis of educational resources through automated planning," in *Hellenic Conference on Artificial Intelligence*. Springer, 2006, pp. 421–431.

[38] K. Pireva, P. Kefalas, and I. Stamatopoulou, "Representation of learning objects in cloud e-learning," Work in progress, Paper Submitted 2017.

[39] K. Pireva and P. Kefalas, "A recommendation system based on hierarchical clustering for cloud e-learning," Work in progress, Paper Submitted 2017.

[40] "The 2012 acm computing classification system," https://www.acm.org/publications/class-2012, 2012, online; accessed 10 May 2017.

Gamification Platforms for Higher Education: Challenges and Opportunities

Nikolaos Margaritis, Ioannis Demelis, and Thanos Hatziapostolou

The University of Sheffield International Faculty - CITY College, Thessaloniki, Greece
{nimargaritis,idemelis,a.hatziapostolou}@city.academic.gr

Abstract. Gamification of higher education courses is challenging, mostly due to the fact that lecturers have to find new ways of managing and tracking the participants' progression. Gamification platforms are not that common, especially for educational purposes. As a consequence, lecturers are resorting to custom spreadsheets or standalone software. This paper, investigates common gamification practices in order to identify what higher education lecturers use and need for their gamified courses. Based on our conclusions, we propose a gamification platform that aims to address these needs.

Keywords: *gamification, gamification platforms, education, game mechanics, game components, challenges*

1   Introduction

Gamification is a very trending topic, finding application in multiple verticals [1, 2]. There is evidence that gamified experiences manage to engage users, they are less boring and more productive [3]. Gamification is known to boost interactions between users and serve as a driving factor for motivation [1, 3]. Verticals that gamification finds an application include Marketing, Management, Product Development and Education [1, 2]. Research [2] suggests that 27% of gamified software targets the education industry, making education the second most popular area in which gamification is applied. This comes down to the ever existing problem of teachers trying to engage and motivate students, which can be addressed through gamification [1]. As defined by Deterding [4], gamification is the use of game design elements in non-game contexts. Teachers use gamification to engage and motivate their students. In order to implement a gamified experience, teachers need to define the projected dynamics and utilise components to gamify an activity.

Dynamics, Mechanics and Components are the key elements to gamification [5] as described by Werbach. Dynamics are the desires of the players, what drives the player to perform certain actions, most often they are linked with human emotions or human nature [5]. Dynamics also include constraints, since not all gamification components will be applicable based on the projected outcome of an activity. Lastly, another part of dynamics is narrative or else the story behind the activity. A mere sample of dynamics could include curiosity, urgency, rarity, social pressure, loss aversion and others. Mechanics, on the other hand, orchestrate the interaction of players with the

game, essentially representing the methods used to gamify the activity [5, 6]. For example, mechanics are controlling how the players progress into a game or how they are rewarded. There are several lists of which elements are included into mechanics [7, 8, 9, 10, 11]. Some of the definitions are mixing core mechanics of a game with realisation examples of these mechanics, also referred to as components, by Werbach. Hence, based on [5], and after analysing [7, 8, 9, 10, 11], it can be concluded that mechanics include the following: (non-exhaustive list) Competition, Achievements, Progression, Scheduling Problems, Discovery, Quests, Leaderboards, Modifiers, Lottery, Trading, Gifting and Ownership.

Academics have pinpointed that gamification can have strong benefits on student motivation [12] and several instructors attempt to gamify courses and measure the outcomes. Gamification, however, requires a system or platform that stores and projects students' points, badges, leaderboards and other game elements. Based on what teachers have tried [13, 14, 15, 16, 17, 18, 19, 20, 21, 22], it is observed that most of them utilise online spreadsheets or standalone tools in order to gamify a course. One possible reason for this may be that available educational gamification platforms are over-specialised or do not take into account all challenges involved in the process. For instance, a leaderboard can be both a "hall of fame" for students ranking at the top but also a "hall of shame" for students that are not performing well and are ranked at the bottom of the list. In general, a gamification platform should provide the functionality of key dynamics, mechanics and components, enable teachers to easily gamify a course but also address pedagogical challenges.

This paper provides a critical review of how teachers currently attempt to gamify higher education courses, what are the key dynamics, mechanics and components in place and what are the technical and pedagogical challenges involved. Our aim is twofold: to assist teachers in making an informed decision when selecting a gamification platform and second, to make a proposal for a gamification platform that addresses the needs of academics. The rest of the paper is structured as follows. Section 2 discusses gamification elements that are used in higher education. Section 3 evaluates existing platforms and maps teachers' needs with features offered by these platforms. Section 4 makes a proposal for a gamification platform for education, and finally, section 5 concludes the paper.

2   Gamification Elements Used in Higher Education

Although gamification is not a new concept, when it comes to gamification in education it appears to be a fairly new trend [2, 12]. The education field is trying to grasp the offerings of gamification and apply them in courses [12]. An analysis of the following lecturer stories [13, 14, 15, 16, 17, 18, 19, 20, 21, 22] show that the gamification elements that are most commonly used include experience points, leaderboards, quests, badges, levels and avatars. Less frequently, lecturers also use

branching choices, storylines, knowledge maps, health points, chance, collaboration, unlocking content and statuses. These game elements can be mapped to gamification mechanics. In the following section, a short summary of these mechanics will be discussed along with the dynamics and challenges associated with applying these mechanics to higher education courses.

2.1   Mechanics, Dynamics and Challenges

Achievements: Achievements denote individual accomplishments and they can serve as a way of feedback [8, 9]. Example of achievements based on what lecturers have tried can be badges, levels and statuses. Achievements, primarily aim to motivate students by triggering emotions related with desire, pride, rarity and social status [7, 9]. Most of the achievements fell into the category of extrinsic motivation due to the fact that an individual is being motivated to perform a certain action in order to gain a reward. Research [23] suggests that extrinsic motivation can cause decrease in intrinsic motivation, for individuals that are already intrinsically motivated; because extrinsic motivation puts the focus over the reward instead of the task per se. On that note, there should be plenty of achievements for an individual to gain and they should not be taken back from individuals once awarded. Revoking achievements can demotivate the individual and have negative effects to his progression.

Progression: Progression displays the means under which a 'user' progresses through the game. Progression can be realised with several components including levels, experience points, health points, status and knowledge bars [8, 9]. Several progression components, such as levels and points as standalone elements have no real use. Progression is used along with other mechanics, such as leaderboards to elevate certain dynamics, as this of social pressure. An important challenge coming with progression is loss aversion. Loss aversion is defined as the desire of people not to lose over gaining something [24]. Progression should focus on giving and not removing progress from individuals.

Competition: Competition is an aspect of our lives. Examples of competition would include comparing progression, achievements and other student accomplishments with other students. Since the primal concern of a lecturer is to motivate and engage all students, strict competition could prove problematic. Social comparison theory [25], states that individuals compare to one another in order to reduce uncertainty and validate progress. In case that the gap between student groups is big in terms of progression and achievements then students might start feeling bad and lose their motivation and engagement.

Quests: Quests define a specific task that an individual has to process. In the scope of education, quests are primarily related with coursework and other activities that students have to perform in order to be evaluated upon [8, 9]. Quests trigger emotions related with time pressure, urgency, social pressure. Quests should fit the narrative of the story and coordinate with other game mechanics to deliver a solid experience.

Leaderboards: Leaderboards show where a user stands relatively or absolutely to other individuals. Leaderboards provide an extrinsic motivation and social pressure to users [8, 9] and can have either a positive or negative impact on student motivation. Essentially, leaderboards provide fame, virality, social pressure and a display for social status. Leaderboards provide the feedback individuals will use to compete, since they represent a social standing ladder [26]. On that note, if leaderboards are used to display absolute standings then students at the top of the ladder will feel excited, famous and not pressured while students at the bottom will feel as not worthy and pressured. Therefore, leaderboards should not show absolute standings but rather relative. However, showing relative ranking and including summary of points or achievements could also have the same effect. This is because, the students will feel less motivated as the gap between their score increases. Having relative leaderboards without giving metrics from which individuals could be demotivated in the long run is worth investigating. Hence, leaderboards should complement the effort to gamification but should not drive it.

Customisation: Customisation provides the means to individuals to select certain parts of the game. For example, set an avatar, select a custom name or customize quests and journeys [8, 9]. Gamifying an experience should offer some short of customization. For example, allowing users to choose a nickname could remove some of the social pressure they feel, since other students will not know who the individual is. Apart from that, customization could also come in the forms of journeys. If individuals are given the opportunity to choose their path and therefore are interested in the certain direction, this can serve as a sign of intrinsic motivation.

Discovery: Discovery allows an individual to explore the storyline of a gamified experience. It shows the journey of the user for instance, through a knowledge map or an achievements map [8, 9]. Discovery comes with emotions of fun and mystery [7]. It can also add pressure and urgency [9].

3   Comparison of Gamification Platforms

After examining what are the gamification elements that are used more frequently in an educational setting, an evaluation of existing gamification platforms is required in order to identify if and how these platforms satisfy the needs of the academics. To perform this evaluation, an evaluation framework is constructed. The comparison focuses in two main areas. The first area includes key characteristics that the platform should have and the second area includes key components previously identified. More specifically, the following characteristics and components are evaluated.

Gamification platform characteristics include:
- Student accessible, meaning that the platform should be accessible by the student to view performance, rewards, etc.

- Open to customization, meaning that the lecturers are able to make changes to the platform in order to easily gamify their content.
- Higher education, meaning that the platform is built with Higher education in mind, taking into consideration the needs of Higher education lecturers.
- Groups, meaning that the platform provides group assessment functionality.

Gamification platform components include:
- Experience: provides a way to display an user's score (e.g. experience points)
- Leaderboard: keeps track of the participants' performance (e.g. scoreboard)
- Quest: offers group or individual assignments for users.
- Levels: provides a way to show how participant make progress.
- Badges: offers some form of virtual rewards (e.g. badges or trophies)
- Profile customization: supports personalization of users' profile (e.g. avatars, profile pictures, nicknames, etc.)

Five gamification platforms have been identified as the most popular ones used in educational settings. These include Rezzly, bluerabbit, Classcraft, Pagamo and Youtopia.

Rezzly [27] is a gamification platform that is free to use for small scale classrooms. It offers an experience point (XP) based system with multiple ranks, rewards and it is open to customization. Teachers can review submitted quests, reward students with extra awards, badges and achievements. The platform also provides basic communication, topic discussion and announcements features. However, the platforms fall short to meet all of the mapped needs. Although, tutors are able to create groups, group quests are tricky and require some extra effort from the part of the tutor as it is not a main feature of the platform. Classroom statistics can be viewed from all students and this can function as both a hall of fame and a hall of shame. Finally, tutors are unable to award individual XP based on the performance of the student, instead, they will have to reward them with custom badges, achievements, etc.

Bluerabbit [28] is a learning enhancer with gamified elements. It uses an XP based system and it includes virtual currency and achievements. Coursework and group assignments are in the form of quests and missions. However, the platform is limited, providing a fixed leveling system that cannot be modified. It also offers a very basic quest system. The students are rewarded with XP as soon as the quest is completed making the teachers unable to review submissions. If the tutor is not satisfied with the submitted work, he will have to work around the already rewarded quest with tickets and negative achievements.

Classcraft [29] is an online platform highly inspired by Role Playing Games (RPG) with students taking the roles of healers, mages and warriors. Students earn XP and gold by completing quests. They can then spend the rewarded points to learn new powers that they can use during the class. These powers can vary from eating during class, to getting a hint during exams. The powers accessible by the students can be highly customized, unlike game mechanic elements like the XP needed for leveling

up. Although Classcraft was not created with Higher Education in mind, there have been successful applications of Classcraft in University courses.

Pagamo [30] could be better categorized as a learn-by-gaming education platform, rather than a gamification platform. Teachers can create assignments through missions for their students and review progress. However, the platform fails to provide most of the customization features that lectures need in order to properly transform their content into a gamified curriculum. This is due to the fact that Pagamo offers a virtual world where students hold and expand their land by answering questions that the teacher is providing. It could be used for lower grade students or as a solution for quiz examinations but it fails to deliver key elements and mechanics identified as lecturers needs.

Youtopia [31] is a web platform that allows the lecturers to create virtual challenges and activities that have to be completed by the students. It provides tools for the creation of custom badges and goals that are awarded to the students. Any submitted work can be reviewed before the points are awarded to the students. Unfortunately, the platform is unable to display participant progression other than the total number of points earned. It is worth to mention that the scoreboard was accessible from all uses functioning as both a hall of fame and a hall of shame.

The following two tables provide summaries of the aforementioned platforms characteristics and components.

Platform	Student accessible	Open to customization	Higher education	Groups
Rezzly	yes	yes	no	yes
bluerabbit	yes	no	no	yes
Classcraft	yes	yes	no	yes
Pagamo	yes	no	no	no
Youtopia	yes	no	no	yes

Table 1: Comparison of platform characteristics

Platform	Experience	Leaderboard	Quest	Badges	Levels	Avatar
Rezzly	yes	yes	yes	yes	yes	yes
bluerabbit	yes	no	yes	yes	yes	no
Classcraft	yes	yes	yes	no	yes	yes
Pagamo	yes	yes	yes	yes	yes	yes
Youtopia	yes	yes	yes	yes	no	no

Table 2: Comparison of platform components

4 Gamification Platform Proposal

Currently, to the best of our knowledge, there are no platforms that can effectively and efficiently support the most commonly used gamification elements used by instructors. This may very well be one of the reasons why many academics create custom online spreadsheets in order to gamify their courses. Furthermore, the review of the existing gamification platforms reveals that these systems are either too specialized or too complicated or do not provide requested functionality. Our proposal is a highly customizable gamification platform. The goal is to remove gamification from the trenches, where the lecturers need to create custom spreadsheets in order to keep track of the student progress and provide a system that could help them with this task.

This new gamification platform should have a minimum learning curve and should be an easy-to-use system that helps the lecturer with the creation of the gamified course, as well as, the necessary course maintenance and tracking of the progress of the students. It should certainly take into consideration both extrinsic and intrinsic motivation, as well as, the previously analysed mechanics, dynamics and challenges. The proposed platform should include the following gamification elements.

Progression could be achieved with the implementation of an experience based system. Progress bars displaying the current state of the students' progress as well as, the next achievable level that the student can reach. The system should provide a way for the lecturer to customize this progress bars and as discussed in 2.1, progression should be focused on giving and not removing experience points from individuals. For example, the lecturer should be able to specify the levels or ranks available to the students. Their limit (if any) and amount of experience points required to achieve the next rank. This should be fluid rather than a fixed value.

By providing a *leaderboard* that only displays relative standings of the students, the lectures can be sure that their leaderboard is a hall of fame and not a hall of shame for the students that did not perform well. Another valuable solution is the combination of nicknames and hidden score. With the use of nicknames, anonymity is ensured and with the use of hidden scores the participants will not be demotivated by huge score gaps.

Achievements can be tackled with the implementation of a reward system. This could include, but not limited to, awards, badges and any kind of unlockable, collectible, visual reward. There is no limit to unlockable achievements and their content. Achievements could be both functional and funny, giving a sense of accomplishment to the participants. Uniqueness is also a valuable characteristic. The platform should provide a way for the lecturers to create their own unlockable achievements that they can award to their students. This should be done automatically, with the completion of a quest as well as, manually by the lectures.

Quests should be supported either in the form of personal or group activities since they are a great way to improve engagement. They should be fun to complete and

challenging, in order to keep the participants focused and provide a sense of accomplishment when the quest is completed. The platform should provide the lecturers with tools to create and customize their own quests. Finally, it should provide ways for the lecturers to review submitted quests and reward the participants with the necessary experience points, achievements, etc.

Group work is a common method used to improve communication skills, boost engagement, critical thinking and decision making. For that reason, it is essential for the platform to provide an easy way of creating and managing groups and group assignments, making it easier for the lecturer to handle the task.

Choice. Allowing the participants to choose their own path is an excellent way to increase intrinsic motivation. This could be achieved by individual or small group quests. The platform should be built with variability in mind, allowing the lecturers to create multiple versions of the same quest with minor changes supporting this functionality.

The platform should be highly *customizable*. Apart from providing profile customization to the participants, the platform should not focus on a specific need or one way of delivering specific mechanics. Instead, it should provide lecturers with a plethora of available options to choose from in order for them to gamify their existing curriculum without the need of extra content creation. In order to avoid huge configuration overhead, the platform should be pre-configured with some popular options (based on the existing attempts of gamified lectures).

Some key *statistics* should be available to the lecturers, in order to accurately track participant engagement, time spent on subjects, time spent logged into the platform, etc. Only time can tell the information that should be considered relevant and necessary for tracking. Deadlines are the most common form of time management for projects and tasks in general. The platform should provide a way to enforce such forms of time tracking with the form of a deadline implementation, time system, etc. However, the platform should not be limited to one form of time tracking, since there may be a need for a more fluent system that provides multiple solutions to cover more needs. The platform should also be able to keep track of the time needed to perform a task with the form of a timer. An example of such a system being used is the following. A quest designed to be repeatable, giving the opportunity for the participants to fail as many times as needed in order to finally accomplish the task. The lecturer then needs a way to keep track of the time spend per initial submission (failed attempts) and the final submission (successful attempt).
.

5   Conclusion

This paper presented how the lecturers attempt to gamify education. Experience points, Leaderboard, Quests, Badges, Levels and Avatars are the components primarily used by the lecturers for the gamification of their courses. Achievements, Progression, Competition, Quests, Leaderboards, Customization, Discovery and Collaboration are the underlying mechanics associated with the identified game components. The challenges that lecturers face when applying these game elements is analysed. A brief explanation of those elements is presented to help the reader understand the importance of the correct delivery of the identified mechanics, components and dynamics. An evaluation framework is constructed and a platform comparison based on the identified components and mechanics is conducted. The examined platforms are Rezzly, BLUErabbit, Classcraft, Pagamo and Youtopia. The results of the evaluation showed that, all of the evaluated platforms are implementing an experience based system as well as, quests. Eighty percent of them featured a leaderboard and an achievement system. Only sixty percent of the platforms were providing customization capabilities for the participating, in the form of Avatars, nicknames, or profile pictures. Finally, a platform proposal is presented that can cover most of the needs of lecturers trying to gamify their courses. A discussion of the proposed platform and how it could solve the challenges faced by the lecturers is presented to explore the feasibility of the solution. Future expansions of this platform could support a cross course structure.

References

[1] J. J. Lee and J. Hammer, "Gamification in education: What, how, why bother?," *Academic exchange quarterly*, vol. *15, no.* 2, p. 146, 2011.

[2] A. Darejeh and S.S. Salim, "Gamification Solutions to Enhance Software User Engagement—A Systematic Review," *International Journal of Human-Computer Interaction*, vol. *32*, no. 8, pp. 613-642, 2016.

[3] L. Seixas, A. S. Gomes and M. Filho, "*Effectiveness of gamification in the engagement of students,*" *Computers in Human Behavior*, vol *58*, pp. 48-63, 2016.

[4] S. Deterding, et al., "*From game design elements to gamefulness: defining gamification,*" In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environment,* pp. 9-15. September 2011.

[5] K. Werbach and D. Hunter, *For the win: How game thinking can revolutionize your business.* Wharton Digital Press, 2012.

[6] M. Sicart (2008). *Defining Game Mechanics. Game Studies [Online]. Available:* http://gamestudies.org/0802/articles/sicart?viewType=Print&viewClass=Print. [Accessed : Apr. 10, 2017].

[7] E. Schonfeld (2010, Aug. 25), *SCVNGR's Secret Game Mechanics Playdeck.* techcrunch.com [Online] Available: https://techcrunch.com/2010/08/25/scvngr-game-mechanics/ [Accessed: Apr. 11, 2017].

[8] *50 Gamification Mechanics and Elements* [Online]. Available: https://www.gamified.uk/user-types/gamification-mechanics-elements/ [Accessed: Apr. 11, 2017].

[9] *Game Mechanics* [Online]. Available: http://gamification.org/wiki/Game_Mechanics [Accessed: Apr. 11, 2017].

[10] R. Nelson (2015, Apr. 05), *Gamification Mechanics, Dynamics and Components* [Online]. Available: https://www.uwplatt.edu/ttc/gamification-mechanics-dynamics-and-components [Accessed: Apr. 11, 2017].

[11] I. Bunchball, *Gamification 101: An introduction to the use of game dynamics to influence behavior.* 2010. *[Online]. Available: https://www.csh.rit.edu/~ajman/summer2012/gamification101.pdf.* [Accessed: Apr. 11, 2017].

[12] D. Dicheva, C. Dichev, G.Agre and G. Angelova, "*Gamification in education: A systematic mapping study,*" Educational Technology & Society vol. 18, no. 3, pp. 75-88, 2015.

[13] S. O'Donovan, J. Gain and P. Marais, "*A case study in the gamification of a university-level games development course,*" In *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference,* pp. 242-251, October 2013.

[14] B. Kay and C. Thomas, "*Gamification of a Software Engineering course and a detailed analysis of the factors that lead to it's failure,*" *Interactive Collaborative Learning (ICL), International Conference on.* IEEE, 2013.

[15] G. Barata et al., "*Engaging engineering students with gamification," In Games and Virtual Worlds for Serious Applications (VS-GAMES), 2013 5th International Conference on, pp. 1-8, September 2013.*

[16] J. Hamari, J. Koivisto and H. Sarsa, "*Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification," 2014 47th Hawaii International Conference on System Sciences*, pp. 3025-3034, 2014.

[17] P. de Byl, "*Factors at play in tertiary curriculum gamification,*" *International Journal of Game-Based Learning (IJGBL)* vol. 3, no. 2, pp. 1-21, 2013.

[18] S. Villagrasa et al., "*Teaching case of gamification and visual technologies for education,*" *Journal of Cases on Information Technology (JCIT)*, vol. *16, no.* 4, pp. 38-57, 2014.

[19] L. Kolb (2015, Mar. 20). *Epic Fail or Win? Gamifying Learning in My Classroom.* Edutopia.org [Online]. Available: https://www.edutopia.org/blog/epic-fail-win-gamifying-learning-liz-kolb [Accessed: Apr. 11, 2017].

[20] A. Iosup and D. Epema. "*An experience report on using gamification in technical higher education." Proceedings of the 45th ACM technical symposium on Computer science education.* ACM, 2014.

[21] Resource - Spreadsheet [Online]. Available: https://docs.google.com/spreadsheets/d/1qU74DFbNf0Lcz9RJ91Ms_w2r_Rp5a7YbXVLmhEXnFlk/edit#gid=0 [Accessed: Apr. 11, 2017].

[22] Resource - Spreadsheet 2 [Online]. Available: https://docs.google.com/spreadsheets/d/1R3qAvOqLUbgHu8hkdkOPlQg68iP_LY6ShlCpWK61kfE/edit#gid=0 [Accessed: Apr. 11, 2017].

[23] E. L. Deci, R. Koestner and R. M. Ryan, "*Extrinsic rewards and intrinsic motivation in education: Reconsidered once again,*" *Review of Educational Research*, vol. 71, pp. 1-27, 2001.

[24] D. Kahneman and A. Tversky, "*Choices, Values, and Frames,*" *American Psychologist*, 1984.

[25] L. Festinger, "*A theory of social comparison processes." Human relations*, vol. *7, no.* 2, pp.117-140, 1954.

[26] M. D. Hanus and J. Fox, "*Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance." Computers & Education*, vol. *80*, pp. 152-161, 2015.

[27] Rezzly | Heroic learning, come play! [Online]. Available: http://rezzly.com/ [Accessed: Apr. 11, 2017].

[28] Gamification for education | BLUErabbit [Online]. Available: http://bluerabbit.io/ [Accessed: Apr. 11, 2017].

[29] Classcraft - Make learning an adventure [Online]. Available: https://www.classcraft.com [Accessed: Apr. 11, 2017].

[30] PaGaMo [Online]. Available: https://www.pagamo.org [Accessed: Apr. 11, 2017].

[31] Youtopia [Online]. Available: http://www.youtopia.com [Accessed: Apr. 11, 2017].

Society and Human Development: Psychology, Politics, Sociology, and English Studies

Sonic EEG neurofeedback environment to train emotional self-regulation – Piloting mixed method approach to assessment of training effectivity, perceived control over the game and motivation induced during the first training session

Cyril Kaplan [1]

[1] Charles University in Prague, Faculty of Arts, Department of Psychology
cyril.kaplan@gmail.com

Abstract. Three previously neurofeedback (NF) naive subjects underwent one session of new NF protocol designed for emotional self-regulation training. The continuous recordings of physiological indicators of momentary activation and training performance (EEG band relative powers) were used during the analysis of post-session interviews.

Our focus laid mainly in four areas: in how our subjects perceived control over the training environment, in their expectations towards neurofeedback aroused by the first training experience, in their insights into training mechanisms and in gathering their remarks and observations about the sonic environment fluency and training dynamics of our new protocol in development.

Main objective of this study was to pilot the system of evaluation of a neurofeedback training performance through combination of various sources of data. This paper presents one of possible approaches to application of mixed method methodology to the area of NF training – merging the standard ways of quantitative evaluation of performance (Gruzelier, 2014) with more recent neurophenomenological approach (Bockelman, Reinerman-Jones, Gallagher, 2013).

Keywords: neurofeedback, EEG, self-regulation, mixed-method design, pilot study

1   Introduction

As we worked with a really limited sample size so far, we do not intend to present findings in an usual fashion (giving full account of methodological details, broad description of sample and sampling techniques…). This paper describes first steps on the way to the design of a study that could bring us to the stage of making inferences about neurofeedback assisted training of emotional self-regulation.

This paper starts with description of the theoretical background of our approach to NF. We continue with description of the process of creation of our training protocol, accounting specifications of the sonic training environment we created for providing the feedback, and the hardware and software choices we made on the way. Further on, we describe the process of analysis of both quantitative (QN) and qualitative (QL) data obtained during the training session and subsequent post-session interviews. Following chapters belong to pinpointing of the ways of merging the two sources of data (QN and QL) with a goal of obtaining fuller view on our research problem. At the end, we summarize our partial findings, impressions and scratch the implications for our next research steps.

The main outcome of our study is a proposal of sophisticated mixed method approach to exploration of NF training protocols, centered around the trainee's feelings and experience.

2   Theoretical background

EEG Neurofeedback training (NF) is a term that covers wide area of diverse protocols with distinct aims and targets (Gruzelier, 2014; Micolaud-Franchi et al., 2015), generally designed to help with the control of one's own momentary emotional and mental states that partially manifest through our brain waves (Knyazev, 2007).

The prevalent quantitative reporting approach in this area has its specific limitations, namely frequent occurrences of studies with very small sample sizes that tend to identify misleading effects or do not achieve any significant findings at all (Micolaud-Franchi et al., 2014). For example, one particular study worked with a sample of 42 probands divided into two experimental groups (treatment and control). With this sample size, there is an 80% chance of detecting effect of 0.9 or larger (Dagenais et al., 2014). It would be almost to bold to expect an effect that large in NF training study, it might be too much even for a common controlled pharmacological study. There are clear, and understandable, reasons causing this repetitive problems of NF experimental studies – to name one, the process of recruiting and maintaining a research sample that could ensure reliable and valid experimental results is of outmost difficulty (Engelbregt et al., 2016). Yet there is no clear reason why researchers in this specific area should adapt this conceptually clearly insufficient approach.

We agree with Micolaud-Franchi (2014) who suggests that the qualitative approach to assessing the NF protocols' efficacy can in fact bring more accurate and relevant

information about training effects because the information gathered this way is much closer to the actual experience of real trainee in real training situation, therefore possibly more relevant for the neurofeedback practice and research.

3   Developing new neurofeedback protocol

The vast majority of existing neurofeedback protocols focuses on one specific EEG parameter whose psychological correlates are usually more or less well described.[1] Our new NF protocol aims to provide training of willful switching between several different mental states, each specified by activity of a certain brain wave band. Similar approach to NF training was taken for example by Maurizio et al. (2013). Their protocol consisted of interlaid alpha and beta training rounds – during the session, their probands were rewarded for switching their brain wave activity to fit the different requirements of each round.

Our protocol is being designed having in mind the cohort of adults without severe specific neurological or psychical disorders – we expect that the probability to help a motivated adult to better his/her ability of self-regulation of momentary emotional state should be an appropriate job for the neurofeedback training (Schwartz, Stapp and Beauregard, 2004).

    The feedback is provided in purely sonic form, as the sense of hearing is supposedly the most convenient one for orientation in multiparameter signal (Hinterberger, 2011). Though the purely sonic training environment is common only for a specific deep relaxation protocols (Gruzelier et al., 2014) we felt a need to further explore the efficacy of sound as a vehicle for the feedback in context of activation and switch-between-states training.

---

[1] Such a single parameter centered feedback (for example very common training of lower beta activity in sensorimotor cortex) is in most cases being used as a form of complementary therapy for symptoms of specific psychological and neurological disorders (in the case of lower beta training, the target would be the inattentiveness and hyperactivity – the symptoms of ADHD [for more details see Lofthouse et al., 2012]). The theoretical foundation for this use of NF lays in confidence in the fact that distinct EEG bands at distinct locations on cortex correlate with distinct cognitive processes and neurophysiological states (Gruzelier, 2014, Micolaud-Franchi et al., 2015). In fact, there are parallel theories that contest this correlation theory. Using EEG monitoring in NF settings, we can infer only on a presence and timing of a change in activation, the attribution of such a change to correspondent cognitive and emotional processes remains only indirect (Norris, Currieri, 1999).

The structure of the training session

The training protocol consists of nine three-minute-long rounds formed by four different soundscapes. In total, the trainee spends six minutes training the alpha frequency (which occurrence correlates with inhibition of the activity that is domain of the specific area right under the electrode [Knyazev, 2007]), six minutes the lower beta and six minutes training the higher beta activity. Beta band activity at prefrontal region is being associated with various processes that are generally being connected to activation of the observed area of the cortex, for example taking part at control of the motor cortex activity (Picazio et al., 2014) or in the working memory related processes (Hanslmayr, Matuschek and Fellner, 2014).

First three minutes of the session are dedicated to obtaining baseline measurement, following three minutes belong to training of diminishing of the muscle activity that interferes with the accuracy and fluency of the training. Third round belongs to the alpha training, rounds four to seven are dedicated to the beta training, the eights round brings back the alpha training and the last round offers control of all the parameters at once.

Table 1.: Training rounds overview

Round no.	Game parameter	Game name
1	none	baseline
2	EMG	you want no tone
3	alpha	lower the tone
4	lower beta	widen the chord
5	higher beta	make more tones
6	lower beta	widen the chord
7	higher beta	make more tones
8	alpha	lower the tone
9	all	just play

Hardware choice and electrode positioning

Mindset by Neurosky, having one dry active electrode (Fpz1) and a reference/ground ear clip, was chosen as the EEG acquisition device for purposes of this pilot study (for comparison of the Neurosky headset with other EEG acquisition devices see Maeskaliunas et al., 2016 and Neurosky, 2009). The main advantage of the device is that it is easy to install and run, therefore it has a potential of being used outside of classic NF

settings. Its use does not require previous extensive experience with EEG acquisition. In combination with NF software such as ours, that enables automatic modification of the threshold of game parameters throughout the session, it forms a NF system convenient for use at a variety of settings and, before all, without need of lengthy learning for the user nor administrator.

Neurofeedback environment design

The neurofeedback game was designed using opensource graphical programing platforms OpenVibe and Pure Data. The EEG signal acquisition, the filtering (using Butterworth filter), squaring and time based epoching (epoch duration 0.5s, epoch overlap 0.1s) were performed at OpenVibe. Three EEG bands and one EMG signal parameters (filtered and averaged) are transmitted online (at the rate 10Hz) via UDP as Open Sound Control messages and are being further processed in Pure data where the following **game control parameters** are prepared: the **relative power** of the respective bands (the squared absolute power of the band multiplied by three and divided by the sum of the three remaining band powers; the resulting measure is unit free, it only expresses the ratio of the observed band's power relative to the rest of monitored electrical activity), the **mean power** of each band and its **standard deviation**.

The sonification of the signal is performed in Pure data. Four independent soundscapes were developed, using sound synthesis. Each of the four soundscapes reflect changes in one specific EEG parameter and works as a single round of the neurofeedback session.

Table 2.: Game parameters overview

NF parameter:		sound type:	modification:	range:
EMG	28-32 Hz	deep bass tone	velocity	7 steps
Alpha	8-12 Hz	sin wave tone	pitch	8 tones
		sound of waves	low pass filter	0 - 10 000 Hz
			velocity	0, 1
Beta I.	12-16 Hz	chord	number of tones in chord	0 - 7
		beat bursts	velocity	0, 1
		beat burst delay	repetition speed	75, 125, 250 ms
Beta II.	16 - 20 Hz	arpeggiator	number of tones	0 - 16
			low pass filter	0 - 1000 Hz
		arpeggiator, double time	velocity	7 steps

4   Methods

We decided to use a mixed method research approach to uncover the specificities of a newly developed NF protocol.

Three subjects (two male and one female, aged 29, 44 and 73, all Czech residents, two speaking fluent English and one speaking Czech, all of them having a masters degree in fine arts) recruited from authors close surroundings underwent one session of neurofeedback. Sonic feedback reflecting the relative power of specific brainwave bands was provided to the three subjects throughout the 30min session.

Cortex activity (EEG) and muscular tension (EMG) were monitored throughout the session. Mood changes were assessed using the short Self-Assessment Manikin Scale (SAM) (Lang, Bradley, 1994) administered after each training round.

A semi-structured interview was conducted immediately after the session, lasting 22 minutes in average, targeting feelings and thoughts of subjects about the training, their previous experience with neurofeedback and other cognitive enhancement methods and their understanding of and feelings towards computer-assisted training of emotional self-regulation. Thematic analysis (Braun, Clarke, 2006) was performed to identify patterns and themes within collected qualitative data. Simultaneously the subjects' ability to react to NF training was estimated based on EEG and EMG data acquired during the training session (Engelbregt et al., 2016; Mealla et al., 2014). As a last step of the data analysis, themes identified in the subjects' statements were related to the subjects' training performance.

5   EEG band powers and training performance

To assess the effectivity of the training - the ability of subjects to change their brainwave activity in concordance with the demands of presented auditory feedback - the relative powers of the EEG bands used as game parameters at each round were displayed on a line graph. We visually inspected the progression of our subjects during the training session - their ability to accommodate their EEG according the requirements of the game. Due to the size of our sample, no correlation analysis was performed.

Table 3.: Mean alpha relative power (8-12Hz) for all the subjects throughout the session
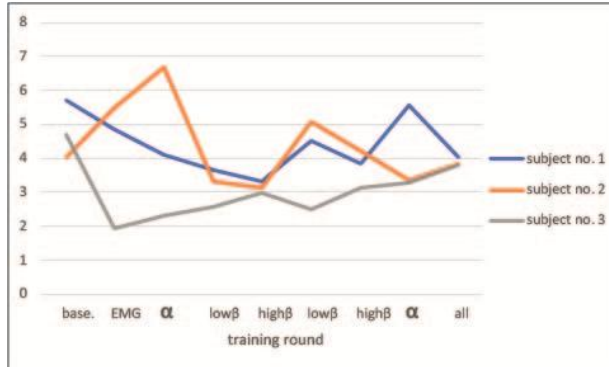

The subject no. 1 was able to accommodate his alpha band power level throughout the session. There is an apparent decrease in the alpha relative power after the first alpha training round, accompanying the switch to the beta training for the two following rounds. The alpha power reached the peak value in the 8th round that was dedicated to alpha training again.

The subject no. 2 managed to rise the alpha relative power at first alpha training round. This rise is followed by great depression of the alpha power level for the two subsequent beta training rounds. This rise was not repeated during the next alpha training round (round no.8), were we can observe a decrease instead.

The subject no. 3 was able to rise the alpha relative power at both alpha training rounds (3 and 8).

Table 4.: Beta relative power throughout the session, subject no.1
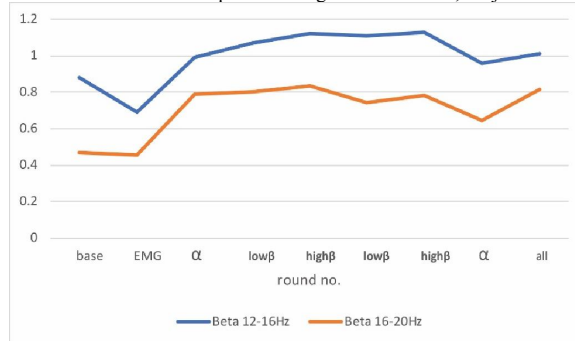
Both the lower and the upper beta power range of subject no.1were changing simultaneously. The rise in the power of both bands for the beta training rounds 4 to 7 indicates ability of our first subject to follow the training requirements, thought it might point out to the fact, that the two parameters were hard to modify independently of one another.[2]

Both observed beta bands manifested shared variance in our second subject's training results as well. Slight rise of beta power between first alpha and beta training rounds could indicate ability of the subject to follow the feedback provided by the game parameters.

In our third subject's results, the two distinct beta bands were changing value independently of one another, on the contrary to the shared behavior of the beta bands that we observed in subjects one and two.

6   Training session through the optics of the trainee

The central part of this study consisted in interviewing the subjects and analyzing their statements. The interviews were recorded using Cubase 5 software and the audio files were subsequently edited in the same program - cut into smaller chunks, each of them representing one motive. Recurring motives were coupled on the basis of their thematic

---

[2] This is in fact quite possible, taking in consideration our choice of electrode placement. The lower beta is usually being trained in the areas of sensorimotor and pre-motor cortices (Egner, Gruzelier, 2004).

similarity. Excerpts of the interviews were transcribed to represent specific thematic categories.

During the thematic analysis, we concentrated on few particular aspects that reflected objectives of this pilot study, with no ambition of providing rich description of the whole dataset. Our approach to analysis therefore could be called "theoretically driven" – we sought mainly for selected themes matching our research objectives (Braun, Clarke, 2006).

We performed mainly the semantic level of the thematic analysis (Braun, Clarke, 2006) - the interpretation of the motives and patterns was performed at a later stage of analysis and in context of the interpreted quantitative data. Below we offer our inferences accompanied by exemplary statements in italics, preceded by numeri identifier of the respondent. The interview with subject no. 1 was held in Czech language, featured samples of the interview were translated by the author of this paper.

Controlling yourself, controlling the game

The different rounds of the games (characterized by distinct soundscapes and different demands on trainee's brainwave activation) "felt" different:

1: It was more about getting relaxed… The other round was clearly about concentration.

All the subjects expressed perceived control over the game parameters, to some degree, considering the chaotic nature of the brain waves:

3: I really felt no mistrust in the game. … You cannot control things to precision, there will be always some kind of level of fluctuation of things.

The game elements were helping subjects to get more control over the game:

1: I focused on pushing the sequence one tone further, I concentrated for a moment and then I heard the new tone appear.

The control over the game parameters was perceived as capacity that evolves in time, either within the round,

2: I get the feeling that the beginning of some of the sequences I was managing fine and then I would lose it somehow.

within the session

2: The last round I drifted, I was forgetting I was supposed to do these exercises. I wasn't feeling that I was focusing on the task at hand.

or even across sessions:

3: At this (first) session I felt that the game is controlling me more than I control the game.

Motivation induced by the training experience

All subjects stated that they felt no boredom during the training session and that the training experience was interesting or pleasant. Yet, the NF session alone did not feel like a strong enough motivator for our subjects to feel considerable need for undergoing more NF sessions. According to our subjects, additional motivators should be introduced – as greater variability of the game sound scape,

2: "If I knew what to expect each time and it is a same thing, then I would quickly get bored. ... So, if the next session will be revealing more, and the whole thing would be more like a puzzle game, not puzzle, like, you know, the whole thing is a really big picture of something and at each session you uncover some elements of it and next session brings more, then you listen to some kind of a symphony which you part of, then it would kind of drive you to the next session, or wanting to do better."

and solid recommendation to train from respected source.

3: "I suppose if I thought that it was going to really help me to concentrate, I might be wanting to do it, but I would have to have definite prove. [If I heard that] this really does help you from a source that I felt was reliable, I might consider it."

7   Merging the qualitative and the quantitative data

There is of course a multitude of possibilities how to approach the process of joined interpretation of quantitative and qualitative data – for example you can enrich the QN data by QL information gathered in the process of peer-debriefing, or you can create categoric variables based on analysis of the QL data corpus and use this variables for subsequent statistical analysis, as if conducting QN research (for full account see Creswell, Piano Clark, 2007). Importantly, the choice should always depend on project objectives.

Based on our research goals, we decided to evaluate the training efficacy treating both sources of data as equally important. The more subtle issues as the motivation to train, the understanding of provided feedback or the subjective interpretation of the scale used for evaluation of mood changes during the session were approached mainly from the qualitative researcher positions.

Bellow we present the inferences we made based on joined interpretation of QN and QL data gathered, structured into three thematic sections.

Possibilities of use of the Self-Assessment Manikin Scale

The data acquired from Self-Assessment Manikin Scale were not used for the NF performance analysis, as was originally intended – we performed no statistical operations with the data gathered on Likert scales. Mere visual inspection of scores in SAM

subscales displayed on a line graph reflected no consistent trends – the scores showed no obvious dependence on the context (game round, time of the session…). The reason behind this surfaced during the post-session interviews - the interpretation and understanding of the scale in between subjects varied widely. This fact was most probably caused by the lack of instruction that is recommended for the standardized use of the scale (Lang, Bradley, 1994). The reason for the lack of instructions was the will to influence the subjects as little as possible regarding what they might expect from the training session, as they were to be questioned immediately after its end. As a result, we were able to see insights into how the SAM scale could be used in novel contexts - one of the subjects stated this during the post-session interview, referring to the dominance subscale:

1: *"I understood that this scale with body on one end and the head on another stood for the feeling of 'being in my body' vs 'being in my head.'"*

Table 5.: Self-Assessment Manikin, Dominance scale
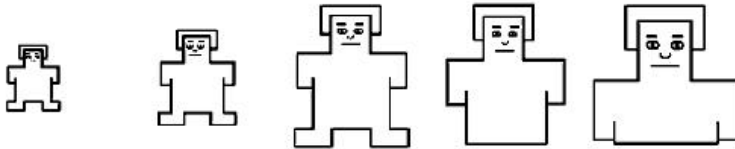
The use of the SAM scale in further research could prove beneficial, but with another purpose then was originally intended –as an instrument to approach feelings aroused by the game, as an instrument that could open neurophenomenological discussion.

Assessing the training efficacy

The QL and QN data describing the training course proved to be complementary. It turned out to be very beneficial to use both sources of data to evaluate the subjects' training performances. The subject no.1 who expressed most perceived control over the game environment of all our subjects and who showed strong interest in the NF game during the interview, happened to manifest strong game-dependent changes in his brain wave bands' powers coherent with the NF protocol. Quantitative and qualitative data confirmed each other's validity.

The QL data gathered from interviews helped us with the interpretation of discrepancies between expected evolution of the brain waves (e.g. expecting the rise in alpha frequencies, when the positive feedback for this rise is being provided) and the recorded performance. Subjects no.2 and no.3 both mentioned that they experienced feeling of "drifting away" during specific rounds – this knowledge, gathered from

interviews, proved useful to explain the difference of their real performance in the specific rounds and the expected performance that would be congruent with the provided feedback. We would expect that the trainee's beta band relative power will rise when reward for raising this band power is provided. If we worked only with QN data, the observation of the depression in the band power instead of expected rise could lead us to assumption that provided feedback was not comprehensible enough or that there was some other problem with the NF game environment and feedback provided. The subject statements, indications that during this specific beta training round they just drifted away, puts the QN data (the band power) in new light.

The length of the training session

The subject no.2 stated, that it was difficult for her to maintain her focus on the game all round through, that the rounds were perhaps too long for her. Having this statement on mind we decided to have a closer look on the evolution of her performance during each individual round. During the analysis of her performance in alpha training, we found that the relative power of the training frequency band showed ascending trend (as shown on table 6). Her statement about getting more tired as the round progressed seems not valid for the alpha training.

Table 6.: Alpha relative power evolution in both alpha training rounds, subject no. 2
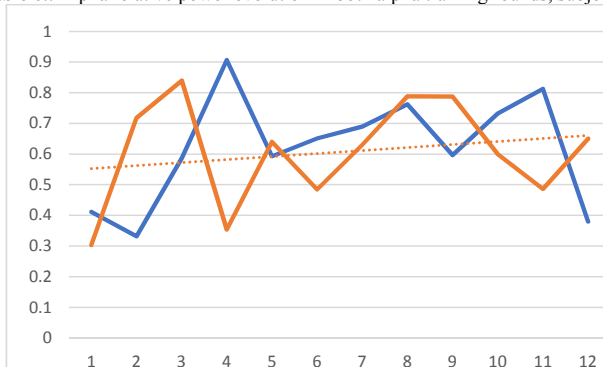
The case is different with the beta training, here her statement sheds a little more light on the performance analysis. The graph line for her lower beta training performance (see

table 7) displays big ups and downs during the round progression. Her performance had a descending trend. This is especially clear when we compare her performance with the performance of subject no.1 (see table 8), who stated that he felt quite focused and comfortable with the feedback during the lower beta band training.

Table 7.: Lower beta relative power in both lower beta training rounds, subject no.2
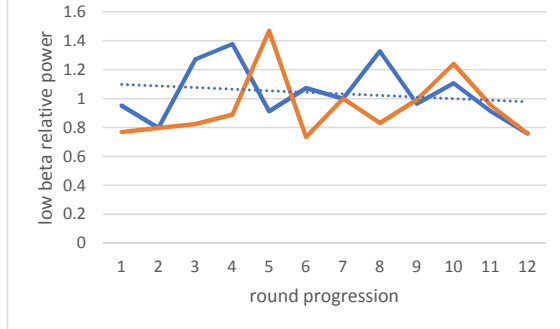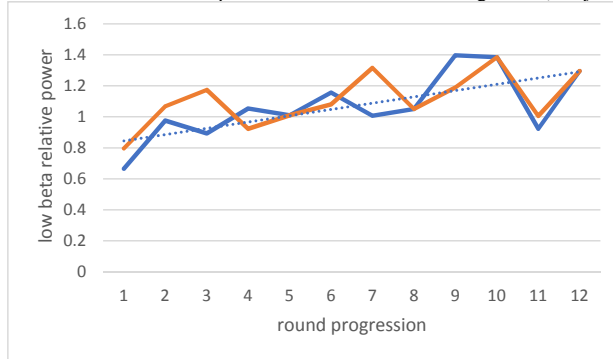
Table 8.: Lower beta relative power in both lower beta training rounds, subject no.1

8   Discussion and conclusions

The joint interpretation of the physiological data and thematically analyzed interviews proves useful for evaluation of the training session and for gathering feedback on the NF protocol and game environment specificities. This study was performed on a very limited sample, thus we cannot rely on statistical instruments. As it is commonly practiced by neurofeedback trainers or by neurologists interpreting single subject EEG recordings (Faber, 2005), we can visually observe the so called "curve of learning", as we showed in the chapters 5 and 7 of this paper. Parallelly we can look for indexes of the success analyzing the post-session interviews, for statements like this one, that referred to specific sound parameter controlled by higher beta relative band power:

1: I focused on pushing the sequence one tone further, I concentrated for a moment and then I heard the new tone appeared.

Or this one, referring to the whole soundscape of low beta training round:

1: This one was the most comprehensible, when my attention faded for a moment, I heard the tones disappearing, and, of course, the other way around.

The offered joint picture is much more complete and valid, then a picture drawn based purely on one source of data.

Regarding current methodological design, the SAM scale, as we used it in this study, does not bring comprehensible and consistent inputs as a measure of arousal and mood changes. It seems that it could prove more useful as a tool to gather neurophenomenological insights (administered after each training round and revisited

during post session interview). We decided to add another physiological measure of arousal instead for our future studies (heart rate variability and skin conductance measures may prove enriching as alternative measures of training effect).

As it is shown it the chapters 5 to 7 of this paper, we were able to collect inspirational insights to the game mechanisms. Based on the suggestions of the trainees, we got to several decisions about possible changes in the game design that need to be made before we proceed further with our next study: 1. adding more game elements for each parameter (current number is three elements for one training round directed by one EEG parameter); 2. making the resulting soundscape more personalized (by adding custom-tailored sounds that will take a different shape for every individual trainee at each session). Both mentioned points should help increasing the level of motivation to play the game, the level of intrinsic motivation to train.

Perhaps most importantly, in order to get complex and solid information about the training protocol, the number of sessions for each trainee must be increased. Although we collected some information about the training efficacy and the feelings that it induces in trainees, some of the subjects' statements can be proven true only with time, with their increasing experience with the training protocol – hence the section "Motivation induced by the training experience" in chapter 6 of this paper. One statement almost emblematically reflects the need of more time spent with the game for trainees to form deeper personal attitudes towards neurofeedback. The quoted sentence is a subject's response to my question if he thinks that he learned anything during the training session:
2: Honestly, I do not really know, at least not now…

Conceptually, we took the positions of pragmatic approach to the research – making the research problem a keystone of all our methodological choices (Creswell, Piano Clark, 2007). We did not have preconceptions about the form of research (experiment, case study…) prior to the formulation of our research problem– the creation of purely sonic NF environment to train emotional self-regulation. Our research of this topic – this study is a first step of the ladder – will remain to have mainly exploratory character. At the end, after a similar study on considerably bigger sample is performed, we should be able to describe how the new NF protocol and training environment work, what potential uses it has and what are the psychological and technical circumstances that make the effectivity of the training more probable.

References

Bockelman, P., Reinerman-Jones , L., Gallagher, S. (2013). Methodological lessons in neurophenomenology: Review of a baseline study and recommendations for research approaches. *Frontiers in Human Neuroscience*. Vol, 7, 608

Braun, V., Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3:2, 77-101.

Creswell, J.W., Piano Clark, V.L. (2007). *Designing and conducting mixed method research*. Thousand Oaks (CA): Sage Publications.

Dagenais, E., Leroux-Boudreault, A., El-Baalbaki, G., Bégin, J. (2014). Doubting the Efficacy/Effectiveness of Electroencephalographic Neurofeedback in Treating Children With Attention-Deficit/Hyperactivity Disorder Is As Yet Unjustified. J Clin Psychiatry;75(7):778–779

Egner, T., Gruzelier, J. (2004). EEG Biofeedback of low beta band components: frequency specific effects on variables of attention and event-related brain potentials. *Clin. Neurophysiol* 115, 131–139.

Engelbregt, H.J., Keeser, D., van Eijk, L., Suiker, E.M., Eichhorn, D., Karch, S., Deijen, J.B., Pogarell, O. (2016). Short and long-term effects of sham-controlled prefrontal EEG-neurofeedback training in healthy subjects. *Clinical Neurophysiology* 127, 1931–1937.

Faber, J. (2005). *QEEG, Correlation of analysis with psychological tests.* Praha: Galen.

Gruzelier, J.H. (2014). EEG-neurofeedback for optimising performance III: A review of methodological and theoretical considerations. *Neuroscience and Biobehavioral Reviews* 44, 159–182.

Gruzelier, J.H., Thompson, T., Redding, E., Brandt , R., Steffert, T. (2014). Application of alpha/theta neurofeedback and heart rate variability training to young contemporary dancers: State anxiety and creativity. *International Journal of Psychophysiology* 93, 105–111.

Hanslmayr, S., Matuschek, J. and Fellner, M.C. (2014). Entrainment of Prefrontal Beta Oscillations Induces an Endogenous Echo and Impairs Memory Formation. *Current Biology* 24, 904–909

Knyazev, G. G. (2007). Motivation, emotion, and their inhibitory control mirrored in brain oscillations. *Neuroscience and Biobehavioral Reviews* 31, 377–395.

Hinterberger, T. (2011). The Sensorium: A Multimodal Neurofeedback Environment. *Advances in Human-Computer Interaction*, *2011*, 1-10.

Lang, P.J., Bradley, M.M. (1994). Measuring emotion: The self-assessment manikin and semantic differential. *J. Beh. Th.and Exp. Psychiatry* 25 (1), 49-59.

Lofthouse, N., Arnold, L. E., Hersch, S., Hurt, E., & DeBeus, R. (2012). A review of neurofeedback treatment for pediatric ADHD. *Journal of Attention Disorders* 16(5), 351–372.

Maskeliunas, R., Damasevicius, R., Martisius, I. and Vasiljevas, M. (2016), Consumer-grade EEG devices: are they usable for control tasks? *Peer Journa.l* 4:e1746

Mealla, S.A., Oliveira, X., Marimon, T., Steffert, T., Jorda, S. and Valjamae, A. (2014). The role of personalization and multiple EEG and sound features selection in real time sonification for neurofeedback. *International Conference on Physiological Computing Systems*. 323-330.

Maurizio, S., Liechti, M.D., Heinriche, H., Janckeb, L., Steinhausen, H.C., Walitza, S., Brandeis, D., Drechsler, S. (2013). Comparing tomographic EEG neurofeedback and EMG biofeedback in children with attention-deficit/hyperactivity disorder. *Biological Psychology* 95, 31– 44.

Micolaud-Franchi, J.A., Quiles, C., Fond, G., Cermolacee, C., Dury, J.V. (2014). The covariation of independent and dependant variables in neurofeedback: A proposal framework to identify cognitive processes and brain activity variables. *Consciousness and Cognition* 26, 162–168.

Micoulaud-Franchi, J.A., McGonigal, A., Lopeze, R., Daudetf, C., Kotwash, I., Bartolomei, F. (2015). Electroencephalographic neurofeedback: Level of evidence in mental and brain disorders and suggestions for good clinical practice. *Neurophysiologie Clinique/Clinical Neurophysiology* 45, 423-433.

Neurosky (2009). Brainwave Signal (EEG) of Neurosky, Inc. *Online publication available 26/3/2017 at*
http://sleepshepherd.com/wp-content/uploads/2016/02/neurosky-vs-medical-eeg.pdf

Norris, S.L., Currieri, M. (1999). Performance enhancement training through neurofeedback. In: Evans,
J.R., Abarbanel, A. (Eds.), *Introduction to Quantitative EEG and Neurofeedback*. Academic Press, San
Diego, 224–240.

Picazio, S., Veniero, D., Ponzo, V., Caltagirone, C., Gross, J., Thut, G. and Koch1, G. (2014). Prefrontal Control over Motor Cortex Cycles at Beta Frequency during Movement Inhibition. *Current Biology* 24, 2940–2945

Schwartz, J.M., Stapp H.P. and Beauregard, M. (2004). The volitional influence of the mind on the brain, with special influence of emotional self-regulation. In M. Beaurgard (Ed.): *Consciousness, emotional self-regulation and the brain*. Amsterdam/Philadelphia: Johns Benjamins B.V.

Disentangling the Role of Bilingualism in Executive Functions

Aleksandra Laketa

City College – International Faculty of the University of Sheffield
Department of Psychology
alaketa@city.academic.gr
allaketa@seerc.org

Abstract. There is an ongoing debate regarding the role of bilingualism in non-linguistic executive functions. Researchers have suggested that the ability to speak more than one language comes with significant cognitive benefits, particularly in the executive control system. However, some newer studies have failed to document a bilingual cognitive advantage, thus questioning the robustness of earlier research. Given this inconsistency in overall findings, it can be assumed that, if there is a bilingual cognitive advantage, it is evident in specific tasks, at specific points in life, and within specific samples. The aim of the current project is to explore the interrelationship between these age-, task- and participant-related variables, as well as their individual influences, on executive control functions. Primary focus will be placed on addressing the limitations of past research, thus increasing control over a variety of confounding variables, both related to bilingualism (e.g. language pairs spoken, similarity between the languages, language switching experience) and independent of it (e.g. SES, culture, parenting style), as well as over important characteristics of the recruited sample. A more objective and in-depth measure of bilingualism, and all of its component features, will be used as well. Additionally, data collection will be conducted in new geographical locations, and will focus on participants who speak language pairs that have not been investigated so far. It is expected that the findings of this project will bring us a step closer to answering the questions about the bilingual cognitive advantage, and the specific circumstances under which it might occur.

Keywords: *Bilingual advantage; executive functions; language switching; cognitive development*

1   Introduction

Executive functions (EF) refer to a set of cognitive skills that are responsible for complex processes, such as working memory, inhibitory control, and attention shifting and flexibility (Miyake & Friedman, 2012). These cognitive processes are essential in the

context of novel problem solving, and goal-directed behaviour (Elliot, 2003). In addition, EF plays a crucial role in behavioral self-regulation (Hughes & Ensor, 2007), as well as in academic achievement (Best, Miller & Naglieri, 2011; Bull, Espy & Wiebe, 2008), which is in turn highly predictive of long-term health and well being (Duncan, Ziol-Guest & Kalil, 2010). EF develops gradually, changes during the course of a person's life, and can be improved or impaired by a range of different factors and experiences. Given this important role of EF in the academic environment, and in overall health and well-being, it is of central importance to identify as many factors as possible that have a significant impact on these complex cognitive skills.

   In this regard, previous studies have found that early developmental experiences, such as living in poverty and experiencing high levels of childhood stress, can have a detrimental effect on EF skills (Raver, Blair & Willoughby, 2013). Early parenting behaviour is also related to EF, with the negative dimensions of parenting (e.g. intrusive) being harmful to children's capacity for self-regulation (Gunnar & Donzella, 2002). Furthermore, research suggests that socioeconomic status (SES) is also strongly associated with EF performance. Studies have shown that SES is linked with the development of working memory, inhibitory control and cognitive flexibility, all of which are hallmarks of EF (Sarsour et al., 2011). Specifically, individuals of low SES tend to have poorer EF performance, as compared to their high-SES counterparts, a finding that has been supported across different measures of both SES and EF (Blair et al., 2011; Wiebe et al., 2011), as well as in different age ranges (Lipina, Martelli, Vuelta & Colombo, 2005). Therefore, depending on the level of SES (high vs. low), it can either hinder or promote EF development. Finally, both neuropsychological and brain imaging studies suggest that regular alcohol and cannabis use are two factors that can have a negative impact on several cognitive abilities, as exhibited by deficits in attention, memory and EF (Lundqvist, 2005).

   Opposed to this, several other factors have been found to improve EF skills. As previously mentioned, parenting plays an important role in children's cognitive development, at both functional and neural levels (Bernier, Carlson & Whipple, 2010). Whereas the negative dimensions of early parenting have a detrimental effect on EF, positive parenting behaviours (e.g. maternal sensitivity, scaffolding) have been associated with improvements in children's self-regulatory abilities, which are central to EF (Gunnar & Donzella, 2002). Moreover, studies have found that acute and chronic physical exercise also has the capacity to improve EF performance. A recent meta-analysis reported a moderate positive effect size of physical activity on EF, particularly on inhibition/interference control (Verburg, Königs, Scherder & Oosterlaan, 2014). Another factor believed to promote EF, which will be the primary focus of the current project, is bilingualism. Indeed, a large number of studies have reported that the ability to speak more than one language is accompanied by significant cognitive benefits, mainly manifested as enhancements in EF (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Bialystok & Viswanathan, 2009). However, several more recent studies have failed to document such a bilingual cognitive advantage (Paap & Greenberg, 2013; Paap & Sawi, 2014). To this day the overall findings are rather inconsistent, thus illustrating an

important need for further research in this area.

2 The Relationship Between Bilingualism and Executive Function

There is an ongoing debate regarding the potential benefits in EF among bilingual individuals, as compared to their monolingual counterparts. The reasoning behind a possible bilingual cognitive advantage is that the repeated use of two lexical systems calls for a sophisticated mechanism of control, which has to constantly disregard the non-target language and focus on the target language instead (Emmorey, Luk, Pyers, & Bialystok, 2008). Additionally, depending on the social context, different lexical systems are considered as being the target, thus requiring bilinguals to regularly shift their attention back-and-forth between the two languages as a function of the social environment (Bialystok, 2001). Therefore, it is proposed that the skills needed for this type of complex cognitive management of two lexical systems are extended into improvements of a more general neural mechanism, which is the executive control system (EF) (Fan, Flombaum, McCandliss, Thomas, & Posner, 2003). Studies that employ neuroimaging techniques have supported this claim, demonstrating that the same brain regions, specifically the dorsolateral prefrontal and anterior cingulate cortices, are activated during tasks that require both verbal and non-verbal attentional and inhibitory control (Emmorey et al., 2008).

To test this theory, there have been a large number of studies examining bilinguals' and monolinguals' cognitive abilities across a range of different tasks, and among different age groups. For example, Bialystok and colleagues (2004) found significant differences in the size of the Simon effect between monolingual and bilingual adults. In the Simon task, participants are presented with different stimuli on either the left or the right side of the computer screen, and they are required to press a button (on the left or the right side of the keyboard) according to the type of stimuli presented. "*Incongruent*" trials are ones where the stimulus and the correct response button lie on opposite sides, whereas in "*congruent*" trials the stimuli and the correct response button are on the same side. The Simon effect refers to the slower response times typically observed in "*incongruent*" trials, as opposed to "*congruent*" trials (Simon, 1990). In their study, Bialystok et al. (2004) found that bilingual adults had faster response times in "*incongruent*" trials, as compared to their monolingual peers, suggesting they were significantly better at inhibiting distracting stimuli, and focusing on task-relevant information instead. Similar findings were documented among monolingual and bilingual adults in the Stroop task (Bialystok, Craik, & Luk, 2008). In this task, participants are presented with a color-word written in a color either matching the actual word (e.g. the word "*Red*" written in red font), or in a color different from the actual word (e.g. the word "*Red*" written in green font). The participants are asked to state the color of the font in which the word is written, rather than to read the word. The Stroop effect refers to the finding that participants tend to take longer to respond to the mismatched trials, as opposed to the trials where the word and the font are the same (Bench, 1993). Bialystok and colleagues (2008) documented

that both younger and older bilingual adults had a smaller Stroop effect, and therefore took less time to respond to the mismatched trials, as compared to their monolingual counterparts. A similar cognitive advantage in EF was reported in a group of 6-year-old bilingual and monolingual children (Barac & Bialystok, 2012). The researchers found that bilingual children outperformed monolingual children on a switching task (i.e. the color-shape switching task), as measured by significantly smaller global switch costs. In this task, children are presented with two target cards that differ along two characteristics. For example, one card would be a red house and another card would be a blue cat, therefore differing in both shape and color. The children are then presented with a third card, which matches the two target cards along one of the characteristics (i.e. either shape or color), and are asked to sort it along one of the two characteristics at first, and then to switch and start sorting along the other characteristic (Zelazo, 2006). In their study, bilingual children performed significantly better when they had to switch from sorting by color to sorting by shape (Barac & Bialystok, 2012). Moreover, this advantage in task-switching was independent of factors such as culture, language similarity and language of education, suggesting that bilingualism was on its own accountable for the children's improved EF performance.

Furthermore, there is evidence to suggest that bilingualism could help impede age-related cognitive decline as well. Several studies have reported a strong relationship between bilingualism and improved cognitive skills among older adult populations. For example, Gold et al. (2013) found that older adult bilinguals significantly outperformed monolinguals on cognitive switching tasks. Another study found that bilingual patients diagnosed with dementia showed signs of cognitive decline between 3 to 4 years later, as compared to monolingual patients (Bialystok, Craik, & Freedman, 2007). The authors documented similar results in a more recent study that focused on individuals diagnosed with Alzheimer's disease (AD), where bilingual patients expressed symptoms of AD 4 to 5 years later, as compared to monolingual patients (Craik, Bialystok, & Freedman, 2010). Researchers have attributed this bilingual advantage in age-related cognitive decline to cognitive reserve. The cognitive reserve hypothesis asserts that individual differences in task processing create different levels of reserve against brain pathology (Stern, 2009). These individual differences can include factors such as intelligence, education, occupation, and also bilingualism (Tucker & Stern, 2011). Importantly, cognitive reserve is not related to specific conditions, but rather serves a more general protective function. Therefore, the benefits of enhanced cognitive reserve are evident in both healthy ageing, and in a variety of neurodegenerative conditions.

Despite the substantial amount of evidence in favor of a bilingual cognitive advantage, more recent studies have been unable to replicate these findings, therefore challenging the robustness of the reported bilingual advantage in EF. Some researchers have put into question the source of the advantage, whereas others have emphasized the need for more control over potential confounding variables, as well as over important characteristics of the recruited samples (Namazi & Thordardottir, 2010; Yow & Li, 2015). For example, Dunabeitia and colleagues (2014) reported that bilingual children did not outperform their monolingual peers in either the classical Stroop task, or the Numerical

Stroop task. Given that the recruited participants were very carefully matched for background factors, such as age and SES, the researchers concluded that the bilingual cognitive advantage was not present among their group of participants. In line with this, Morton and Harper (2007) found no significant differences in the Simon effect, as a function of the number of languages spoken. However, they did report a positive correlation between the participants' SES and their performance on the task, suggesting that it might be SES, rather than bilingualism, responsible for the variations in EF performance. In another study, Yang and Lust (2004) failed to document a cognitive advantage among 4-year-old bilingual and monolingual children in a Dimensional Change Card Sort task (i.e. a switching task), which aims to measure cognitive flexibility. Notably, they controlled for the children's native language (L1), in contrast to the majority of other studies that recruit participants from a variety of linguistic backgrounds and degrees of language proficiency. Indeed, a large number of studies that have reported a bilingual cognitive advantage in EF recruited bilingual participants who speak a variety of different language pairs, and come from different L1 and cultural backgrounds. Controlling for these variables is of central importance, because differences in the participants' linguistic and cultural backgrounds have been found to significantly affect cognitive development (Lewis et al., 2009). For example, it has been reported that children who learn Korean and Chinese tend to outperform children who learn Spanish on tests that measure EF performance, independently of linguality status (i.e. both bilinguals and monolinguals) (Yang & Lust, 2007). In addition, a recent systematic review reported considerable variations in EF performance across different geographical locations, as well as different language groups (Adesope, Lavin, Thompson, & Ungerleider, 2010). With this in mind, it should be of key importance for future studies to take into account participant's cultural and linguistic backgrounds, as well as overall language proficiency, when examining differences in EF ability.

Furthermore, findings regarding the effect of bilingualism on age-related cognitive decline have been rather inconsistent as well (Lawton et al., 2015, Zahodne et al., 2014). For instance, a study with Japanese-American men did not document a significant relationship between cognitive decline and the use of both spoken and written Japanese (Crane et al., 2010). Another study found no positive effects of bilingualism on symptoms of dementia (Crane et al., 2009). Hence, there is some evidence to suggest that bilingualism is in fact not related to cognitive reserve, and therefore has no protective role against cognitive decline. Researchers have tried to explain these insignificant findings mainly through analyzing study limitations. Most of the limitations emphasized the effect of confounding variables that were not controlled for, as well as the problem of objectively assessing and categorizing bilinguals, since proficiency and exposure to a second language are typically measured via self-report questionnaires. Therefore, it is also proposed for future studies to employ a more systematic index of bilingualism.

Lastly, as it was mentioned earlier, some researchers have questioned the source of the bilingual cognitive advantage. In line with the theory that switching between two lexical systems is what favors EF, Verreyt and colleagues (2016) argued that the everyday experience bilinguals have in language switching is the actual reason behind the cognitive

advantage, rather than the mere ability to speak two languages. Specifically, they suggested that the bilingual advantage would be most evident in bilinguals who show comparably high activation in both lexical systems at the same time, within the same contexts, and even within the same conversations/sentences. In contrast, bilinguals of equal language proficiency, who use different languages in different contexts, would be less likely to benefit from their bilingual ability, since they do not have the opportunity to switch between the two lexical systems as often (Verreyt et al., 2016). To test this hypothesis, the researchers compared EF performance of (1) Unbalanced (dominant) bilinguals, (2) Balanced non-switching, and (3) Balanced switching bilinguals. Balanced bilinguals are individuals who are equally proficient in both languages, whereas unbalanced (dominant) bilinguals are more proficient in one of the two languages they speak (Butler & Hakuta, 2004). Their findings illustrated that the group of balanced switching bilinguals had significantly better EF performance, as compared to both other bilingual groups. In turn, there was no significant difference in EF performance between the unbalanced and balanced non-switching bilingual groups. Overall, in their study second language proficiency (i.e. being balanced or dominant) played a significantly smaller role in EF performance, suggesting once again that it might be actual language switching experience that underlies the bilingual cognitive advantage.

Taken together, the overall findings in this area suggest that, if a bilingual cognitive advantage does indeed exist, it does so in specific tasks, at specific points in life, and within specific samples. Therefore, the general aim of the current project is to examine the interrelationship between all of these variables, as well as their individual contribution, in the context of a bilingual cognitive advantage. Considering that participants in this type of research cannot be randomly assigned to the study groups, and that there is a vast array of factors that can affect EF both independently (e.g. parenting style, cultural background, SES, physical activity, substance use), and within the bilingualism variable (e.g. balanced vs. dominant, language pairs spoken, similarity between the languages, language proficiency, age of L2 acquisition, language switching experience), the present study will also aim to increase control over any potential confounding variables, as well as over relevant characteristics of the recruited sample.

3   Need for Study

Understanding the cognitive correlates of bilingualism has significant practical implications, one of which is in the context of education. "*How best to educate children who are being taught in a non-native language?*" "*Is bilingual education effective?*" – these have been questions of key importance and debate for years (Cummins & Swain, 2014). Thus, additional research on the cognitive benefits of bilingualism would further inform policy-makers, and would help instructors make the most out of the teaching experience, for both themselves and the bilingual learner (Adesope, Lavin, Thompson, & Ungerleider, 2010). As for age-related cognitive decline, the importance of bilingualism could be discussed in terms of managing ill health. As stated above, speaking two

languages could potentially delay and lessen the symptoms of dementia. Hence, it is reasonable to assume that, if applied early in the treatment plan, learning and using a second language could help manage symptoms of several neurodegenerative conditions, such as Alzheimer's and Parkinson's disease. Additionally, if bilingualism does indeed have the capacity to improve EF, it could also be effective in reducing symptoms of ADHD. Since individuals diagnosed with ADHD tend to have difficulties in EF skills, the advantages of bilingualism could counterbalance the cognitive deficits associated with this condition (Mor, Yitzhaki-Amsalem, & Prior, 2015). Therefore, there are significant practical implications in the context of education, health practice and treatment.

4   Aims and Objectives

As mentioned earlier, the role of bilingualism in both EF and age-related cognitive decline is still rather ambiguous, and further research is undeniably needed in order to obtain a clearer picture. With this in mind, the general aims of the current project are as follows:

1. To add to the existing knowledge on the subject of bilingual advantage in EF.

2. To add to the existing knowledge on the effects of bilingualism on age-related cognitive decline, focusing on both healthy cognitive aging, and on certain neurodegenerative conditions.

In order to address the key limitations of previous research, the design of the current project will give high importance to 1) Controlling for potential confounding variables, 2) Controlling for important sample characteristics, and 3) Using more accurate measures of bilingualism and/or language switching experience. In addition, data collection will be conducted in new geographical locations, and will focus on recruiting participants who speak language pairs that have not been thoroughly examined so far. These are discussed in more detail below.

5   Proposed Methodology

Previous research on the bilingual cognitive advantage placed primary focus on examining between-group differences, whereas studies that make within-group comparisons are rather limited (Morton & Harper, 2007). Based on the aims of the current project, it is suggested that both between-group and within-group differences should be analyzed. This approach is expected to (1) Increase control over confounding variables, and (2) Help identify potentially important characteristics/factors within the bilingual sample. This kind of design will provide a more accurate and in-depth depiction of the bilingual advantage in EF, and will also bring us a step closer to determining the actual source of the advantage.

Another suggestion is to use the number and usage of translation equivalents (TEs) as an additional, more objective, measure of bilingualism. TEs refer to the different lexical representations an individual has for the same concept in each language (e.g. *dog* and *chien*) (Crivello et al., 2016). The acquisition of TEs allows the bilingual speaker to gain more practice in shifting between two languages, thus increasing selective attention and inhibition skills. However, the mere number of TEs does not necessarily indicate how often a bilingual speaker switches between the two languages in everyday life, which could be a key determinant of the bilingual cognitive advantage (Crivello et al., 2016). Hence, this project will take into account both the number and the usage of TEs as a measure of one's degree of bilingualism, as well as a detailed self-report measure of daily language switching experience (i.e. within conversations/sentences as well).

Between-group comparisons will aim to examine the differences between monolinguals and bilinguals on several EF tasks, with a primary emphasis on controlling for confounding variables. Within-group comparisons will focus on the bilingual group only, where the main objective will be to examine whether a higher degree of bilingualism (e.g. higher number and usage of TEs) and language switching experience predict better EF performance. This kind of design will be used when addressing both aims of the project, in order to obtain a clearer picture of the role of bilingualism, and all of its relevant features, in EF. Finally, given the aims of the current project, primary emphasis will be placed on including and assessing as many factors generally related to EF (e.g. parenting style, cultural background, SES, physical activity, substance use), as well as relevant features of bilingualism specifically (e.g. balanced vs. dominant, language pairs spoken, similarity between the languages, language proficiency, age of L2 acquisition, language switching experience). However, exact participant selection criteria, specific study measures and data analysis methods will be informed by a thorough literature review, which will include a systematic analysis of relevant peer-reviewed literature.

The project will seek ethical approval from the Department Ethics Committee, and will pay appropriate attention to ensuring that all participants are provided with full information and the opportunity to give considered consent. In order to maintain anonymity and confidentiality, participants will not be named in the subsequent write-ups and materials submitted for publication.

6   Conclusions

In conclusion, given the ongoing inconsistencies in reported findings, it is expected that the current project will fill an important gap in our understanding of the bilingual cognitive advantage. This project will provide a more extensive and in-depth view of the effects of bilingualism on EF for several reasons. First, bilingualism will be examined as a continuous variable with many different facets, rather than an all-or-nothing discrete variable. Combined with using more objective measures, it is believed that this kind of approach will result in a clearer picture of the role of bilingualism, and all of its component features, in cognitive functioning. Second, the project will put high emphasis

on controlling for potential confounding variables, which is one of the key limitations of previous research. Therefore, maximum attention will be paid to assessing as many factors relevant to EF as possible, in order to be able to control for them in subsequent data analysis. Third, control over the recruitment process will also be increased, in order to obtain a sample of participants that are very well matched on all characteristics that could interfere with the results of the study. Lastly, the project will be conducted in new geographical locations, and will focus on language pairs that have not been extensively studied so far, thus being an important addition to the overall research in this area. With all of this in mind, it is expected that the current project will bring us a step closer to answering the questions surrounding the bilingual cognitive advantage, and the specific circumstances under which it might exist.

References

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review
and meta
   analysis of the cognitive correlates of bilingualism. *Review of Educational
Research*, *80*(2), 207-
      245.

Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic
development: role of
   language, cultural background, and education. *Child Development, 83*(2), 413-
422.

Bench, C., Frith, C. D., Grasby, P. M., Friston, K. J., Paulesu, E., Frackowiak, R. S. J., &
Dolan, R. J.
      (1993). Investigations of the functional anatomy of attention using the Stroop
      test. *Neuropsychologia*, *31*(9), 907-922.

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to
self☐regulation: Early
      parenting precursors of young children's executive functioning. *Child
      Development, 81*(1), 326-339.

Best, J. R., Miller, P. H., & Naglieri, J. A. (2011). Relations between executive function
and academic
      achievement from ages 5 to 17 in a large, representative national sample.
      Learning and Individual Differences, 21(4), 327-336.

Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition.*
New York:
      Cambridge University Press.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with
advantages for bilingual
      children in two cultures. *Cognition*, *112*(3), 494-500.

Bialystok, E., Barac, R., Blaye, A., & Poulin-Dubois, D. (2010). Word mapping and
executive functioning
      in young monolingual and bilingual children. *Journal of Cognition and
      Development, 11*(4), 485-508.

Bialystok, E., Craik, F. I. M., Klein, R. & Viswanathan, M. (2004). Bilingualism, aging, and cognitive
control: Evidence from the Simon task. *Psychology & Aging, 19*(2), 290–303.

Bialystok, E., Craik, F. I., Freedman, M. (2007). Bilingualism as a protection against the onset of
symptoms of dementia. *Neuropsychologia, 45*(2), 459-464.

Bialystok, E., Craik, F., & Luk, G. (2008). Cognitive control and lexical access in younger and older
bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(4), 859.

Blair, C., Granger, D. A., Willoughby, M., Mills-Koonce, R., Cox, M., Greenberg, M. T., ... & Fortunato,
C. K. (2011). Salivary cortisol mediates effects of poverty and parenting on executive functions in early childhood. *Child Development, 82*(6), 1970-1984.

Bull, R., Espy, K. A., & Wiebe, S. A. (2008). Short-term memory, working memory, and executive
functioning in preschoolers: Longitudinal predictors of mathematical achievement at age 7 years. *Developmental Neuropsychology, 33*(3), 205-228.

Butler, Y. G., & Hakuta, K. (2004). Bilingualism and second language acquisition. *The handbook of
bilingualism,* 114-144.

Craik, F. I. M., Bialystok, E., & Freedman, M. (2010). Delaying the onset of Alzheimer disease:
Bilingualism as a form of cognitive reserve. *Neurology*, *75*(19), 1726–1729.

Crane, P. K., Gibbons, L. E., Arani, K., Nguyen, V., Rhoads, K., McCurry, S. M., Launer, L., Masaki, K.,
& White, L. (2009). Midlife use of written Japanese and protection from late life dementia. *Epidemiology, 20(*5), 766-774.

Crane, P. K., Gruhl, J. C., Erosheva, E. A., Gibbons, L. E., McCurry, S. M., Rhoads, K., Nguyen, V.,
Arani, K., Masaki, K., & White, L. (2010). Use of spoken and written Japanese did not protect Japanese-American men from cognitive decline in late life. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 65(*6), 654–666.

Crivello, C., Kuzyk, O., Rodrigues, M., Friend, M., Zesiger, P., & Poulin-Dubois, D. (2016). The effects of
      bilingual growth on toddlers' executive function. *Journal of Experimental Child Psychology*, *141*, 121-132.

Cummins, J., & Swain, M. (2014). *Bilingualism in education: Aspects of theory, research and practice.*
      Oxon: Routledge.

Dunabeitia, J. A., Hernandez, J. A., Anton, E., Macizo, P., Estevez, A., Fuentes, L. J., & Carreiras, M.
      (2014). The inhibitory advantage in bilingual children revisited: Myth or reality? *Experimental Psychology, 61*(3), 234–251.

Duncan, G. J., Ziol☐Guest, K. M., & Kalil, A. (2010). Early-childhood poverty and adult attainment,
      behavior, and health. *Child Development, 81*(1), 306-325.

Elliott, R. (2003). Executive functions and their disorders. *British Medical Bulletin, 65*, 49-59.

Emmorey, K., Luk, G., Pyers, J., & Bialystok, E. (2008). The source of enhanced cognitive control in
      bilinguals: Evidence from bimodal bilinguals. *Psychological Science*, *19*(12), 1201–1206.

Fan, J., Flombaum, J. I., McCandliss, B. D., Thomas K. M., & Posner, M. I. (2003). Cognitive and brain
      consequences of conflict. *Neuroimage, 18*(1), 42-57.

Gold, B. T., Kim, C., Johnson, N. F., Kryscio, R. J., & Smith, C. D. (2013). Lifelong bilingualism
      maintains neural efficiency for cognitive control in aging. *The Journal of Neuroscience, 33(*2), 387-396.

Gunnar, M. R., & Donzella, B. (2002). Social regulation of the cortisol levels in early human development.
      Psychoneuroendocrinology, *27*(1), 199-220.

Hughes, C., & Ensor, R. (2007). Executive function and theory of mind: Predictive relations from ages 2 to
      4. *Developmental Psychology, 43*(6), 1447-1459.

Lawton, D. M., Gasquoine, P. G., and Weimer, A. A. (2015). Age of dementia diagnosis in community
dwelling bilingual and monolingual Hispanic Americans. *Cortex, 66*, 141–145.

Lewis, C., Koyasu, M., Oh, S., Ogawa, A., Short, B., & Huang, Z. (2009). Culture, executive function, and
social understanding. *New Directions for Child and Adolescent Development*, *2009*(123), 69-85.

Lipina, S. J., Martelli, M. I., Vuelta, B., & Colombo, J. A. (2005). Performance on the A-not-B task of
Argentinean infants from unsatisfied and satisfied basic needs homes. *Interamerican Journal of Psychology, 39*(1), 49.

Lundqvist, T. (2005). Cognitive consequences of cannabis use: comparison with abuse of stimulants and
heroin with regard to attention, memory and executive functions. *Pharmacology Biochemistry and Behavior, 81*(2), 319-330.

Miyake, A., & Friedman, N.P. (2012). The nature and organization of individual differences in executive
functions: Four general conclusions. *Current Directions in Psychological Science, 21*(1), 8-14.

Mor, B., Yitzhaki-Amsalem, S., & Prior A. (2015). The joint effect of bilingualism and ADHD on
executive functions. *Journal of Attention Disorders, 19*(6), 527-541.

Morton, J. B., & Harper, S. N. (2007). What did Simon say? Revisiting the bilingual advantage.
Developmental Science, 10(6), 719-726.

Namazi, M., & Thordardottir, E. (2010). A working memory, not bilingual advantage, in controlled
attention. *International Journal of Bilingual Education and Bilingualism*, *13*(5), 597-616.

Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in
executive processing. *Cognitive Psychology*, *66*(2), 232-258.

Paap, K. R., & Sawi, O. (2014). Bilingual advantages in executive functioning: problems in convergent

validity, discriminant validity, and the identification of the theoretical constructs. *Frontiers in Psychology*, *5*, 962.

Raver, C. C., Blair, C., & Willoughby, M. (2013). Poverty as a predictor of 4-year-olds' executive function:
New perspectives on models of differential susceptibility. *Developmental Psychology, 49*(2), 292.

Sarsour, K., Sheridan, M., Jutte, D., Nuru-Jeter, A., Hinshaw, S., & Boyce, W. T. (2011). Family
socioeconomic status and child executive functions: The roles of language, home environment, and single parenthood. *Journal of the International Neuropsychological Society, 17*(01), 120-132.

Simon, J. R. (1990). The effects of an irrelevant directional cue on human information processing.
Advances in Psychology, *65*, 31-86.

Stern, Y. (2009). Cognitive reserve. *Neuropsychologia, 47*(10), 2015-2028.

Tucker, A. M., & Stern, Y. (2011). Cognitive reserve in aging. *Current Alzheimer Research, 8(*4), 354-360.

Verburgh, L., Königs, M., Scherder, E. J., & Oosterlaan, J. (2014). Physical exercise and executive
functions in preadolescent children, adolescents and young adults: A meta-analysis. *British Journal of Sports Medicine, 48*(12), 973-979.

Verreyt, N., Woumans, E., Vandelanotte, D., Szmalec, A., & Duyck, W. (2016). The influence of
language-switching experience on the bilingual executive control advantage. *Bilingualism: Language and Cognition*, *19*(01), 181-190.

Wiebe, S. A., Sheffield, T., Nelson, J. M., Clark, C. A. C., Chevalier, N., & Espy, K. A. (2011). The
structure of executive function in 3-year-old children. *Journal of Experimental Child Psychology*, *108*(3), 436–452.

Yang, S., & Lust, B. (2004, November). Testing effects of bilingualism on executive attention: Comparison
of cognitive performance on two non-verbal tests. In *Boston University Conference on Language Development* (pp. 5-7).

Yang, S., & Lust, B. (2007). Cross-linguistic differences in cognitive effects due to bilingualism:

       Experimental study of lexicon and executive attention in two typologically distinct language groups. In *Proceedings of Boston University Conference on Language Development (BUCLD)* (Vol. 31, pp. 692-703).

Yow, W. Q., & Li, X. (2015). Balanced bilingualism and early age of second language acquisition as the

       underlying mechanisms of a bilingual executive control advantage: Why variations in bilingual experiences matter. *Frontiers in Psychology*, *6*, 164.

Zahodne, L. B., Schofield, P. W., Farrell, M. T., Stern, Y., and Manly, J. J. (2014). Bilingualism does not

       alter cognitive decline or dementia risk among Spanish speaking immigrants. *Neuropsychology,* 28, 238–246.

Zelazo, P. D. (2006). The Dimensional Change Card Sort (DCCS): A method of assessing executive

       function in children. *Nature Protocols-Electronic Edition*, *1*(1), 297.

Does the bilingual advantage with respect to the Theory of Mind continue into adulthood? The case of Greek- Albanian speakers

Arvesa Studenica[1]

[1] Department of Psychology, International Faculty of the University of Sheffield

arstudenica@seerc.org

Abstract. Studies examining the effects of using two languages on a daily basis have been focused in linguistic development as well as in non-verbal cognitive development. As with regard to non-verbal cognitive development those using two languages have shown to outperform monolinguals in relation to executive control tasks. These results were found in children as well as in adults. Bilingual children have shown to not only outperform monolingual children in executive function tasks but also they have shown to have a greater understanding of mind, thus score higher in Theory of mind (ToM) tasks. The present study aims on investigating if this advantage continues into adulthood. The study will employ a random sample matched-pairs design and will assess the participants in several variables (non-verbal intelligence, cognitive ability, vocabulary ability and theory of mind). The participants (aged 21-25) will be of four groups: Albanian-Greek bilinguals, Greek-Albanian bilinguals, Albanian monolinguals and Greek monolinguals. Measures will include RAVENS test for non-verbal intelligence, DVK (Depth of vocabulary knowledge) for vocabulary ability; Stroop task for cognitive ability; and "the faux pas recognition" and "reading the mind behind the eyes" tasks for ToM (adult versions).The study will add value to the current re-search of bilingualism in providing information about whether there is a bilingual advantage in relation to the theory of mind in adults and it will be of particular interest providing that bilinguals constitute a substantial portion of the population in Greece.

Keywords: *theory of mind, bilingualism, language, cognition*

1   Introduction

"The mental development of the individual and his way of forming concepts de-pend to a high degree upon language. This makes us realize to what extent the same language means the same mentality. In this sense thinking and language are linked together". – Albert Einstein (1941)

Over the past decade there have been a vast number of studies examining the effects of using two languages in daily basis. Such effects have been demonstrated in linguistic development as well as in non-verbal cognitive development Studies show that bilinguals outperform monolinguals in relation to executive control (attention/inhibition, shifting, updating) tasks such as Attention Network Test (ANT), Simon task etc. These results were found in children (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Yang, Shih, & Lust, 2005) as well as adults (Bialystok & Craik, 2010).This was assumed to stem out of the need to constantly monitor and switch between languages; thus, enhancing the function of inhibition as part of the executive control. Regarding linguistic development, studies show that bilingual children perform poor in vocabulary tasks compared to monolingual children (Peets & Yang, 2010; Oller, Pearso & Cobo-Lewis, 2007); however, they perform better in meta-linguistic awareness (Adesope et. al., 2010; Bialystok, 1999; Cromdal, 1999; Ricciardelli, 1992).

According to Perner, Lang and Kloo (2002) children's executive functioning was proposed as a developmental precursor to understanding of mind. That being said, if bilinguals demonstrate an advantage in some components of executive functions, they might also have advantage in understanding of the mind. Goetz (2003) examined 3 to 4 year old bilinguals and monolinguals with regard to the ability to understand and attribute mental states — beliefs, intents, desires, pretending, knowledge, etc. — to oneself and others (Theory of Mind-ToM). The study found that bilinguals had enhanced performance in ToM task. The results have been attempted to be justified in terms of the bilinguals' greater meta-linguistic understanding, greater sensitivity to social cues or the initial finding that bilinguals do actually have a cognitive advantage with regard to cognitive functioning compared to monolinguals. Such results were also replicated by Farhardian et. al. (2010), assessing Kurdish-Persian bilingual preschoolers. Cheung, Mak, Luo & Xiao (2010) compared bilinguals with 2nd language learners and found that bilinguals had more sociolinguistic awareness which predicted ToM uniquely. Bock, Gallaway & Hund (2015) gave 7-12 age battery of age-appropriate tasks measuring working memory, inhibition, flexibility, theory of mind, and vocabulary. The study found that components of EF predicted ToM over and above age and vocab. This study's result suggested that the link between the childhood and ToM are linked beyond its emergence in the early childhood; more precisely, middle childhood and adulthood.

In light of these findings, it is evident that most of the studies used child samples ranging from 3-13 years old. To the best of author's knowledge, there are no studies investigating advantages of bilingualism with regard to ToM using adult samples. Importantly, adults have been found to make ToM errors (Bernstein, Thornton, & Sommerville, 2011); thus, it would be crucial to see if these errors are different in bilinguals and monolinguals. Although there are studies proposing a cognitive advantage in bilinguals with regard to executive function (inhibition, shifting etc.); there is a controversy with regard to the findings' results. Many scholars argue that there exists a positivity bias toward the bilingual advantage research (de Bruin, Treccani & Della Sala, 2015). Also, many studies tend to make distinctions between who is considered to be a bilingual (Pavlenko, 2003). Thus, results of these studies cannot be generalized to the whole bilingual population. A clear definition of bilingualism is

crucial when con-ducting such studies.

The present study aims in investigating if the advanced understanding on ToM tasks in bilinguals continues into adulthood. It is hypothesized that there will be a difference in ToM between bilingual and monolingual adults. Also, bilingual adults will contribute to changes in ToM more than monolinguals even after taking controlling for nonverbal intelligence, vocabulary and cognitive ability. The present study will add value to the current research of bilingualism in providing information about whether there is a bilingual advantage in relation to the theory of mind in adults. The present study will be of particular interest providing that bilinguals constitute a substantial portion of the population in Greece.

2 Proposed Methodology

The study will employ a random sample matched-pairs design. The participants will be of four groups: Albanian-Greek bilinguals, Greek-Albanian bilinguals, Albanian monolinguals and Greek monolinguals. Bilinguals will be defined in terms of the simultaneous exposure to both languages. The participant's age range will be 21-25 years old and they will be divided equally by gender, with the same educational level but with different Socio-economic status (SES). A between subject design will be employed in order to see the expected differences between the four groups. The independent variables will be non-verbal Intelligence, Number of languages spoken (Bilingual vs. Monolingual), Vocabulary Ability and Cognitive Ability; whereas the dependent variable will be the ToM scores. The present study will employ five measures: Non-verbal(NV) Intelligence: RAVENS test (higher scores indicating higher NV Intelligence); Vocabulary ability: DVK (Qian & Sched, 2004) higher scores indicating higher Vocabulary ability; Cognitive Ability: Stroop task, shorter reaction time indicating better cognitive ability; and ToM: "the faux pas recognition" and "reading the mind behind the eyes" tasks (adult versions).

All participants will be tested twice, a week apart. In order to test if there are differences between the four groups (first hypothesis) a Three-way ANOVA will be carried out(Vocal Ability: High vs. Low; Cognitive Ability: High vs. Low; Nonverbal Intelligence: High vs. Low). A 2-step multiple linear hierarchical regression will be employed to see whether language status (bilingual vs. monolingual) will predict ToM after taking into account non-verbal intelligence; vocabulary and cognitive ability(second hypothesis). Predictors in the first step will include the non-verbal intelligence; vocabulary and cognitive ability whereas in the second step language status (bilingual vs. monolingual) predictor will be added. The dependent variable will be the theory of mind scores.

3 Conclusion

Certain limitations have been identified in the present study. Firstly, there have been a vast number of studies focusing on who is considered a bilingual. Thus, defini-

tion of the bilinguals (e.g. focus on those who were exposed both languages simultaneously) may not be generalized to the whole bilingual population. Also, another limitation might be that the study's result cannot be generalized to the other language population.

The present study will not impose the participants in any kind of risk and they will be informed for their right of withdrawal. Ethical approval will be requested from the Ethical Committee of the University of Sheffield before data collection.

The study would add to the literature of bilingualism in general but also would be of particular interest in studies relating to Theory of Mind (TOM).

References

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research*, *80*(2), 207-245.

Bernstein, D. M., Thornton, W. L., & Sommerville, J. A. (2011). Theory of mind through the ages: Older and middle-aged adults exhibit more errors than do younger adults on a continuous false belief task. Experimental aging research, 37(5), 481-502.

Bialystok, E. (1986). Factors in the growth of linguistic awareness. *Child development*, 498-510.

Bialystok, E., Barac, R., Blaye, A., & Poulin-Dubois, D. (2010). Word mapping and executive functioning in young monolingual and bilingual children. *Journal of Cognition and Development*, *11*(4), 485-508.

Bialystok, E., & Craik, F. I. (2010). Cognitive and linguistic processing in the bilingual mind. *Current directions in psychological science*, *19*(1), 19-23.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition*, *112*(3), 494-500.

Bock, A. M., Gallaway, K. C., & Hund, A. M. (2015). Specifying links between executive functioning and theory of mind during middle childhood: Cognitive flexibility predicts social understanding. *Journal of Cognition and Development*, *16*(3), 509-521.

Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental science*,*11*(2), 282-298.

Cheung, H., Mak, W. Y., Luo, X., & Xiao, W. (2010). Sociolinguistic awareness and false belief in young Cantonese learners of English .*Journal of experimental child psychology*, *107*(2), 188-194.

Cromdal, J. (1999). Childhood bilingualism and metalinguistic skills: Analysis and control in young Swedish–English bilinguals.*Applied Psycholinguistics*, *20*(01), 1-20. de Bruin, A., Treccani, B., & Della Sala, S. (2015). Cognitive advantage in bilingualism an example of publication bias?. *Psychological Science*, *26*(1), 99-107.

Farhadian, M., Abdullah, R., Mansor, M., Redzuan, M. A., Gazanizadand, N., & Kumar, V. (2010). Theory of mind in bilingual and monolingual preschool chil-dren. *Journal of Psychology*, *1*(1), 39-46.

Goetz, P. J. (2003). The effects of bilingualism on theory of mind develop-ment. *Bi-*

lingualism: Language and Cognition, *6*(01), 1-15.

Oller, D. K., Pearson, B. Z., & Cobo-Lewis, A. B. (2007). Profile effects in early bilingual language and literacy. *Applied Psycholinguistics*, *28*(02), 191-230.
Pavlenko, A. (2003). " I Never Knew I Was a Bilingual": Reimagining Teacher Identities in TESOL. *Journal of Language, Identity, and education*, *2*(4), 251-268.

Peets, K. F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition*, *13*(4), 525-531.

Perner, J., Lang, B., & Kloo, D. (2002). Theory of mind and self-control: More than a common problem of inhibition. *Child development*, *73*(3), 752-767.

Qian, D. D., & Schedl, M. (2004). Evaluation of an in-depth vocabulary knowledge measure for assessing reading performance.*Language Testing*, *21*(1), 28-52.
Ricciardelli, L. A. (1992). Bilingualism and cognitive development in relation to threshold theory. *Journal of psycholinguistic research*, *21*(4), 301-316.

Yang, S., Shih, J., & Lust, B. (2005, April). Exploring cognitive advantages of childhood bilingualism through new tests of executive attention. In *Poster presented at the biennial meeting of the Society for Research in Child Development, Atlanta, GA* (pp. 7-10).

Motivational Factors of Greek and Italian High-School Learners of English:
A Comparative Study

Ms. Paola Marrone

English Studies Department, The University of Sheffield, International Faculty, CITY College.

Email: pmarrone@citycollege.sheffield.eu; paola.marrone4@istruzione.it

Abstract. The study investigates motivational orientations of Greek and Italian high-school learners of English as a foreign language from three diverse socio-cultural milieus, through the lens of a revised version of the 'L2 Motivational Self System'. By means of a quantitative method, 171 Greek and Italian teenagers, aged 16 and 17, studying in an urban area of northern Greece and an urban and rural area of central Italy, were surveyed via online questionnaires delivered during class hours. Data analysis revealed that all three groups of respondents think that studying English is important to travel internationally, for future studies and a job career. The calculated medians and correlational coefficients show that Italian and Greek urban learners share a common motivational pattern while the rural Italian ones exhibit small-size differences in terms of motivational orientations. Overall, diverse socio-cultural contexts seem to have a medium-size effect on teenage learners of English. Likewise, schools' formative 'language friendly' activities appear to have enhanced their interest towards an international English speaking community. Although of a small-scale, the present study might suggest guidelines for language teachers and educational institutions within Greece and Italy so to design more stimulating and motivating language syllabuses, classroom and extracurricular activities while adapting them to the learners' socio-cultural background and life orientations.

Keywords: *English language, motivational orientations, high-school learners, socio-cultural differences, context.*

1. Introduction

It is commonly assumed that an individual who starts learning a second/foreign language should be motivationally involved in order to succeed. Since the early 1960s, motivation in language learning has been one of the main spheres of interest of researchers in the field. Gardner and Lambert (1959), Gardner (1982 and 1985), Clèment and Kruidenier (1983), Dörnyei (1994 and 1998), just to mention some primary figures, conducted studies that examined the socio-psychological factors influencing the language learner's motivational orientations namely, *aptitude*, *attitude*, *integrativeness* and *instrumental motivation*.

Several years spent as an English teacher in Italian high schools and a few living in a Greek urban environment stirred our interest in research on language learning motivation. We had experienced Italian people's hardship in speaking English as an L2 and how most Italian students could not grasp the implications of learning English as a Foreign Language (hereafter, EFL) in a globalised world, whereas Greek teenagers showed a higher level of English language proficiency compared to their Italian counterparts. Recent studies conducted in the Italian and Greek contexts

(European Commission, 2012; Languageknowledge.eu, 2012; Dendrinos et al., 2013) endorsed the above-mentioned perception based on our observation and experience. Thus, in accordance with the shared belief that a motivated language learner is more likely to succeed, it was hypothesised that through investigation, Greek teenage students of English would have shown a more favourable disposition in learning the language than the Italian ones. It was furthermore assumed that specific context-related factors might contribute in building their motivational drive, namely socio-cultural stimuli (e.g. family encouragement, afternoon attendance to language schools), and socio-psychological orientations (e.g. attitude towards the target language community, integrative and instrumental motivation). In line with the described rationale, three European EFL learning environments were investigated. Sixteen and seventeen-year-old pupils from two Italian upper secondary schools (an urban and a rural one) and from a Greek urban high school were surveyed. All three educational institutions shared similar characteristics: 'language friendly' and 'internationally oriented', currently involving students in European school-projects with institutions abroad (e.g. ErasmusPlus, Progetto Lingue 2000, Model United Nations), as well as organizing extracurricular language learning activities (e.g. in preparation for language certifications such as EILTS and Cambridge). Furthermore, with the aim of meeting the European Community requirements for languages (Common European Framework of Reference for Languages (Council of Europe, 2001)) they have been working on building their students' 'international posture' (Yashima, 2002).

The present study adds a tile to research into foreign language learning motivation through a European perspective and the lens of an adapted version of the mainstream motivational model, the "L2 Motivational Self System". It compares teenage-learners within their country specific ELT school environment intending to uncover their FLL orientations. It furthermore means to verify whether diverse socio-cultural backgrounds might affect the language learners' degree and direction of motivation. Moreover, although of small extent this research may provide guidelines for English language teachers and schools wishing to design more effective language syllabuses while observing the learner's social background and life orientations.

In agreement with the above-mentioned rationale, the study surveyed 171 Greek and Italian high-school pupils in order to find answers to the following research questions:

RQ1: *How do Italian and Greek high-school learners of English from an urban area differ in terms of motivational orientations?*

RQ2: *Comparing Italian English language learners from an urban and a rural high school, what kind of motivation emerges?*

RQ3: *How are the three groups of learners differently motivated in learning English as a foreign language?*

In response to the questions above and with reference to RQ1 we hypothesise that due to contextual variables, the present research would find Greek students from an urban area more instrumentally oriented than their Italian equals so to become internationally and locally competitive in the job market. With respect to RQ2, Italian high-school students from a rural area will presumably show a lower motivation compared to their urban counterparts as well as a dimmed idealised-image of themselves as future L2 speakers of English. Ultimately we hypothesise that, among

the three groups of participants, Greek urban students will appear the most instrumentally motivated while the Italian rural the most integratively orientated.

2. Literature Review

Motivation in Second Language Acquisition (SLA) and Foreign Language Learning (FLL): from the '60s to the Turn of the 21st Century.

As anticipated in the introductory section, the present research project has aimed at investigating whether diverse degrees of motivational factors characterise the surveyed Italian and Greek 16 and 17 year-old high-school learners of English as a FL. More than focusing on the participants' 'learning experience' and classroom dynamics, investigation was oriented towards testing the social psychological and socio-cultural variables affecting them. Since Gardner and Lambert's early contribution, experimentation in the field suggested that the individual, the context where he lives and studies, and motivation, are interrelated. Recently, Dörnyei and Ushioda (2011) have pointed out two contextual areas influencing the learner, namely the *instructional context* (where learning activities work as motivational variables), and *the social* and *cultural influences* (teachers, school peers, the school dynamics and ethics policy, the family as well as society and the learner's cultural environment). Within the first contextual area, the *socio-economic factor* is seen as also affecting the individual's motivation. As it will be noted at the end of this section, research in the field is integrating "context as variable" (Dörnyei and Ushioda, 2011, p.32) into the language learner's self-system and his cognitive and emotional traits.

The pioneering studies of Canadian social psychologists Robert Gardner and Wallace Lambert (1959 and 1972) initially assumed that the learner's *attitude* towards the target language community plays an important motivational role. Further variables were afterwards added such as *aptitude* and "indices of motivational intensity and orientation" (Gardner and Lambert, 1959, p. 267), the former measuring the effort and enthusiasm expressed by the language learner, the latter the goal pursued in studying the language, either *integrative* or *instrumental. Integrative orientation* represented the learner's desire to assimilate with the target language community while the *instrumental* one expressed the aspiration to become speaker of a language other than the native one for 'pragmatic' and useful reasons, such as finding a good job position, getting good marks in proficiency tests or studying abroad. In the scholars' collective report (Gardner and Lambert, 1972) other relevant aspects of motivation were identified, namely the social and psychological dimensions inferring the language learner's desire to become part of the language community while embracing its culture, behaviour and styles (Ushioda and Dörnyei, 2012). Since then, the social-psychological facet of motivation has become a benchmark in the field and the point of departure for almost sixty years of investigation in the specific area of interest. While Gardner (1985) and Gardner and MacIntyre (1993) were testing the validity of Garner's socio-educational model within the Canadian Second Language Acquisition (hereafter, SLA) environment, studies on motivation in Foreign Language Learning (hereafter, FLL) started following different paths. Dörnyei and Ushioda (2011) have identified three subsequent phases of experimentation such as the *cognitive-situated* period, the *process-oriented* and the current *socio-dynamic* one, each directing research towards distinct domains. Not discarding the social-psychological dimension,

Crookes and Smith (1991) advocated the necessity that current discussion on motivation focused on cognitive and educational perspectives since the language classroom where FLL occurred had been neglected (Dörnyei and Ushioda, 2011). The integrative and instrumental constructs were thus integrated with more complex motivational orientations influencing the learner's interest in a second or foreign language, namely intrinsic and extrinsic. In 1994, Dörnyei conducted experiments where he assessed students' attitudes, motivation towards learning English and anxiety, along with their perception of classroom cohesion and atmosphere. The scholar's theory (Dörnyei, 1994 and 1998) comprised a *language level* (integrative and instrumental constructs), the *learner* and *learning situation* levels (related to course and learning situation motives). Not completely dissociating from the traditional social-psychological orientation and in line with the reform movement, William and Burden (1997) proposed a detailed framework of the learner's motivational factors in which they claim that the "individual's motivation is also subject to social and contextual influences [such as] culture and context and social situation" (p. 121). A few years later, a new instrument set the basis for future research in the field (Noels et al., 2000): a range of *extrinsic* and *intrinsic* orientations blended with Clèment and Kruidenier's (1983) four motivational variables, namely *instrumental orientation, knowledge, travel* and *friendship*.

At the turn of the 21st century, studies on motivation in language learning were redirected towards more dynamic features, in the specific, towards motivation at the beginning of the learning process and throughout the whole stage. Further contribution to this phase that Dörnyei and Ushioda (2011) identified as the *process-oriented* period, was provided by Dörnyei and Ottò's (1998) 'Process Model of L2 Motivation' in which two dimensions were singled out: *Action Sequence* and *Motivational Influences*. The former expressing the hopes, desires and wishes that build motivation in learning, the latter the motivational forces that lie behind the learning process. Whereas the 'process-model' had highlighted the significance of self-regulatory strategies related to students' autonomy, further variables needed to be tested in order to measure the multifaceted motivational dynamics of a classroom. Thus, in the light of current theories on motivational psychology, investigation began orienting towards the FLL dynamics involving the self and its relationship with context: the *socio-dynamic* period of research (Dörnyei and Ushioda, 2011).

Current Research in the Field of Motivation in Foreign Language Learning (FLL)

With the spread of Global English, the traditional concept of integrative orientation in learning English as a second/foreign language, as Gardner and Lambert had conceived it, started being replaced by a new integrative construct based on the learner's desire to become part of an international culture. Pioneering research on motivation in language learning had been conducted in the Second Language Acquisition (SLA) environment, in a milieu where learners were immersed in the L2 community (as in the case of Gardner and Lambert's Canadian learners of French). Whereas, 21st century investigation was carried out in a Foreign Language Learning (FLL) milieu (Dörnyei et al., 2006) reinterpreting the learner as part of the global community where he acquires an *international posture* (Yashima, 2002). Testing his construct on Japanese learners, Yashima found that their motivation and willingness to

communicate (WTC) were due to the appeal of the globalised community. Moreover, English represented for them the world around Japan and a gateway towards integration with foreign countries (Yashima, 2000).

This revised concept of motivation, as well as influences from emerging theories from educational psychology, namely Markus and Nurius's (1986) 'Possible Selves', set aside the static trait of motivation in favour of a dynamic one. Motivation was conceived as a whole with the individual-self and the environment the student is immersed into. From this perspective, Lamb (2004) investigated Indonesian junior high-school learners of English whose integrative motivation showed to resemble "some basic *identification process* within the individual's self-concept" (Lamb, 2004, p. 13): an identification with a *bicultural identity* expressing the learners' ethnicity and the globalised culture young people are immersed into, through means of the internet and the media (Lamb, 2004).

The shift of reference to an unidentified international community the language learner aims at integrating with, represents an important moment in the field of investigation on FLL motivation. Backed by results of one of the major longitudinal surveys ever conducted in the context of Hungarian FLL (refer to Dörnyei et al., 2006), Dörnyei developed the current 'L2 Motivational Self System'. In his study (Dörnyei, 2005) the scholar reinterprets the traditional concepts of integrative and instrumental orientations through a dynamic vision of how the language learners' motivation can change according to their fluid idea of "what they *might* become, what they *would like* to become and what they are *afraid* of becoming" (Dörney, 2005, p. 100). In line with mainstream motivational theory, Markus and Nurius's *Possible Selves* (1986), he developed a construct in which the learner's hopes, desires sense of personal duties and responsibilities are synthesised as follows:

- The *Ideal L2 Self* interprets the learner's desire to be a future proficient speaker of the language filling the gap between what he is and what he would like to be;
- The *Ought-to L2 Self*, or the representation of the language learner's duties and responsibilities.

Additionally, the two outlined variables are typified respectively by a "*promotion focus*" (growth and accomplishments), and by a "*prevention focus*" (responsibilities and obligations) (Dörnyei, 2005, p. 101).

Further features of Dörnyei's model included the *L2 Learning Experience,* where the learning environment and experience are seen as relevant in building motivation (Dörnyei, 2005), and the traditional concept of *instrumentality* that the scholar integrated with two new components: *Instrumentality Promotion* and *Instrumentality Prevention,* respectively correlated to the variables of *Ideal L2 Self* and *Ought-to L2 Self*.

In later years, large-scale surveys tested the model in contexts different from the Hungarian one: in Japan, China, Iran (Ryan, 2009; Taguchi et al., 2009) confirming the validity of the construct and of important correlations between the traditional *Integrativeness* and the *Ideal L2 Self*, as well as between the *Instrumentality Prevention* and the *Ought-to L2 Self* motivational variables.

Motivation Research in FLL in the Italian and the Greek Context

In the Italian and the Greek context, few studies have investigated motivation in learning English as a foreign language. In Italy, scholars as Virginia Pulcini (1994, 1997, 2002, 2008) explored how Italian people accommodated and accepted English into their culture and society quite late compared to other European countries (Pulcini, 1997). The Italian population's high level of illiteracy until mid-20th century, the diffused dialects, "the humanistic tradition of Italian education" (p. 82) that encouraged the grammar-translation method in the ELT classroom as well as the 'purist' policy of the Fascist Regime are pointed out as some of the causes. According to Faez (2011), the level of language proficiency of most Italian students is not yet acceptable if related to European requirements due to, among others, a "superficial rather than deep" (Faez, 2011, p. 38) level of motivation correlated to individual and historical reasons. In the same year, Mariani (2011) reported that motivation of Italian learners of English can be related to psychological, and macro and micro sociocultural variables. A few years later, Palombizio (2015) tested Dörnyei's 'L2 motivational Self System' in Italian high-school learners of English as an International Language (EIL) highlighting that along with *integrativeness* other factors contributed to their motivation, namely the *instrumental* one (Palombizio, 2015, p. 37).

To the best of our knowledge, not many studies have researched motivation in Greek language learners. Applying Gardner's socio-educational model Nikolau (2004) found that Greek high-school students had a positive attitude towards learning English and a high degree of instrumental motivation rather than integrative. Confirming Greek learners' drive towards the language, Dendrinos et al. (2013) reported their good level of proficiency due to family encouragement, language learning in language schools and private tuitions. Kofou collected similar results in 2015 through a survey in a class of an Experimental Senior High School in Thessaloniki. Data analysis revealed that teachers and parents' influence was relevant in building motivation and that the instrumental orientation prevailed.

In the light of the reviewed literature, it can be noted that no contrastive studies on motivation involving Greek and Italian high-school FLL contexts were ever conducted. Similarly, the effect of socio-cultural variables on motivation of Italian public high-school learners of English from an urban and a rural context have never been object of analysis. With the intent of filling the mentioned literature gap, Taguchi et al.'s 2009 questionnaires were adapted to the requirements of the present research project.

3. Methodology

The study was conducted adopting a quantitative research method and administering close-ended Likert scale online questionnaires to 171 students from three high schools, two public ones from a central area of Italy and a private one from Northern Greece. In the specific, the two Italian state schools were located respectively in an urban and a rural location of the Alto Lazio region, while the Greek private one in an urban culturally active area of Macedonia. Owing to the autonomous nature of Italian schools, approval to proceed with the survey was given in a short time span by school principals. Whereas, the selected Greek urban state Experimental Lykeio required the Greek Ministry of Education, Research and Religious Affairs' approval in order to participate. The time limitations of the study suggested exclusion of the Greek public

school from the project. Despite the risk of inconsistency, the option of comparing a private Greek educational institution to an Italian public one revealed to be acceptable. Italian state schools are generally representative of the local socio-economic and socio-cultural population of students, as Italian parents prefer to send their children to public institutions rather than to private ones (Forleo, 2015). Conversely, despite their country's economic crisis, Greek parents, when possible, seem to prefer private schools. A recent statistical study (Fortsakis, 2016) found that "the majority of students of [Greek] private schools are members of an average Greek family (p. 1). Thus, the survey was accordingly diverted towards the selected private Greek urban high school.

Participants

Data collection took place in October and November 2016. A stratified random-sampling procedure was applied to select the surveyed population. After obtaining permission from the school principals and parents through information sheets and consent forms, participants were drawn by their English teachers who had been previously instructed by the researcher. Overall, 171 students were examined equally sampled from the course of studies offered by each school. As Table 1 presents, the participants, aged 16 and 17, were balanced between males and females from the second and third year of the Greek Lykeio and the third and fourth year of the Italian urban and rural secondary schools. Being in their mid-teens and near the conclusion of their upper-secondary course of studies they could be regarded as quite a reliable sample, as presumably mature enough to orient themselves towards future life perspectives and endowed with adequate cognitive competences.

| | | | Gender | | | | |
School involved	Country/ Region	Total	Females	Males	Age mean	High-school year	Sampling from specific course of studies
Greek private high school	Northern Greece	60	36	24	16.18	2nd / 3rd Lykeio	General
Italian urban high school	Central Italy	57	27	30	16.29	3rd / 4th year Liceo	• Sciences and Sports • Sciences • Applied Sciences
Italian rural high school	Central Italy	54	31	23	16.57	3rd / 4th year Liceo/Vocational	• Classical • Technical • Sciences • Commerce
Number of participants:		171	94	77			

Table 1. Schools involved, gender and age of the participants, course of studies and year of high school.

The demographical summary depicted in Table 1, shows that the adopted random sampling procedure has guaranteed the representativeness of the three schools' population in terms of gender, age and course of studies.

The Research Instrument

A close-ended five-item Likert scale questionnaire is the research instrument adopted. Questionnaires have traditionally been employed in motivation research in SLA because easy to construct and administer while gathering large amounts of information from big numbers of participants as well as ensuring anonymity (Dörnyei, 2007). The one delivered to our Greek and Italian teenagers is an adapted version of Taguchi et al.'s 2009 questionnaires based on Dörnyei's 2005 seminal work *The Psychology of the Language Learner* (Dörnyei, 2005). This modified version was organised in two parts. Part One counted 51 statements where the respondents needed to choose five options reporting their level of agreement or disagreement, from 'Strongly Disagree' to 'Strongly Agree'. In Part Two, six items asked for the students' background information, age, sex, whether they ever had a native English teacher, spent a period longer than three months in English speaking countries and participated to school projects abroad. Appendix B summarises results from the second part of the questionnaire.

As anticipated, the first part counted 51 motivational variables that aimed at measuring the L2 learners' orientations. For analysis purposes, variables have been grouped into ten factors carrying the same information as follows:

1. The *Ideal L2 Self* criterion: aimed at interpreting the learner's desire to be a future proficient speaker of the language in order to fill the gap between what he is and what he would like to be;

2. The *Ought-to L2 Self* or the representation of the language learner's duties and responsibilities;
3. *Instrumentality Promotion*: "concerned with hopes, aspirations, advancements, growth and accomplishments" (Dörnyei, 2010, p. 79) and related to a 'pragmatic' reason for learning a foreign language such as getting good marks or earning a good job;
4. *Instrumentality Prevention:* associated with responsibilities, obligations and the intent of avoiding negative outcomes (Dörnyei, 2010, p. 80);
5. *Travel Orientation:* assessed the samples' interest in learning English to travel abroad (Taguchi et al., 2009);
6. *General Integrativeness*: tested the students' desire to learn English in order to become similar to the people from English speaking countries and learn about their culture;
7. *Cultural Interest*: measured the respondents' attitude towards the culture of the L2 and the international community.
8. *Interest in the English Language*: explored the emotions perceived by the student while exposed to English;
9. *Parental Encouragement*: investigated the degree of influence of the family in the course of the language learning process;
10. *Attitudes towards the L2 Community*: assessed the students' appreciation and interest towards people living in English speaking countries and the international community in general.

The third component of Dörnyei's construct, the *L2 Learning Experience*, was not included into the questionnaire developed for the present study, as the main intent was to uncover the immediate and personal perceptions of Greek and Italian language learners towards the English language in consideration of social, cultural and geographical factors. Furthermore, the related effort-oriented and classroom dynamics were not tested not to psychologically affect the learners while responding. Ultimately, this aspect will be verified as a follow-up of the present project through face-to-face questionnaires conducted in a friendly atmosphere. In terms of administration, the survey was delivered online via Google forms 2016, in the respondents' native language to ensure that all items were fully understood. Thus, translations of the original English version of the instrument into Greek and Italian were provided.

Data Analysis Procedure
All data collected via the Google Forms questionnaires were processed by means of SPSS 20, a statistical software toolkit. Responses were subsequently downloaded to Excel files and coded in a numerical form so to proceed with statistical analysis. The 51 variables were then reduced into broader ones according to the criteria explained in the section devoted to the research instrument. Thus, the internal consistency and reliability of the obtained scale were checked applying the Cronbach Coefficient Alpha and the Inter-Item correlation tests (Pallant, 2005). In order to identify the emerging motivational variables among responses, the mean, median and standard deviation of items and grouped items were calculated. In the specific case, during data analysis the median values were observed more closely. Being median scores not easily influenced by outliers, they can offer a fairer representation of results.

Ultimately, in order to look at the relationship, direction and strength among motivational variables, a Pearson two-tailed correlation coefficient was measured (Dörnyei, 2007). As in Applied Linguistics research correlations are considered meaningful in the range between r=0.3 and r=0.5 and are said to measure equally when in the range above r=0.6, observation of coefficients was directed towards the items measuring r=0.5 and above.

4. Data Analysis Results

The present section displays outcomes of the calculated mean, median (in bold in Table 2) and standard deviation as well as correlation analysis results. As summary Table 2 below shows, the highest median values in all three sets of questionnaire grouped-items are related to *Travel Orientation*, *Instrumentality Promotion* and *Attitudes towards the L2 Community* ranging between Mdn=3.6 to Mdn=4.3 on a 5-point scale. That means that respondents had a favourable disposition towards learning English for travelling purposes, for practical reasons and because they liked people from English speaking countries, while the lowest scores can be attributed to the *Ought-to L2 Self* in the two Italian groups, and to the *Instrumentality Prevention* in the Greek group of students.

Table 2: Mean, median and standard deviation of the questionnaire factors.

Variable name	Item n°	Greek urban Mean Median St. deviation	Italian urban Mean Median St. deviation	Italian rural Mean Median St. deviation
Ideal L2 Self	1 - 3	4.0667 **4.0000** (0.74863)	3.8655 **4.0000** (0.69253)	3.3642 **3.3333** (0.82738)
Ought-to L2 Self	4 - 7	3.0042 **3.0000** (0.73860)	2.6360 **2.5000** (0.66324)	2.7176 **2.7500** (0.58084)
Travel Orientation	8 - 10	4.1444 **4.1667** (0.62094)	4.2456 **4.3333** (0.63160)	3.9938 **4.0000** (0.89135)
General Integrativeness	11 - 13	3.5222 **3.6667** (0.76988)	3.2105 **3.0000** (0.64436)	3.0432 **3.0000** (0.81146)
Cultural Interest	14 -18	3.8433 **3.8000** (0.62609)	3.4947 **3.4000** (0.72319)	3.1407 **3.2000** (0.81090)
Instrumentality Promotion	19 - 28	4.0783 **4.0000** (0.48331)	3.9368 **4.0000** (0.46122)	3.6481 **3.6500** (0.72026)
Instrumentality Prevention	29 - 35	2.8714 **2.8571** (0.75579)	2.8571 **3.0000** (0.71734)	3.1058 **3.2143** (0.68269)
Interest in the English Language	36 - 40	3.6600 **3.8000** (0.79941)	3.5965 **3.6000** (0.62962)	3.3481 **3.4000** (0.78782)
Parental Encouragement	41 - 46	3.5500 **3.6667** (0.67530)	3.6053 **3.6667** (0.72143)	3.4105 **3.5000** (0.75978)
Attitudes towards the L2 Community	47 - 51	3.8633 **3.8000** (0.63405)	3.7439 **3.8000** (0.66414)	3.5407 **3.6000** (0.84195)

A closer look to the *General Integrativeness* values reveals that in both groups of Italian respondents this factor produced the lowest scores (Mdn=3.0). Among other interesting differences it is to be noted that the *Ideal L2 Self* median value records the lowest (Mdn=3.3) in the Italian rural group compared to the Greek and Italian urban ones (Mdn=4.0). These specific findings will be discussed and interpreted in the following section and in the light of correlation results that were carried out among grouped motivational factors.

Correlational Results

As stated in the methodology section, a Pearson correlation coefficient was calculated in order to compare the relationship among motivational variables, to observe their strength and direction within each group of sampled participants. As a first step, the *Ideal L2 Self* and the *Integrativeness* factors were associated considering that previous studies (e.g. Dörnyei, 2010; Taguchi et al., 2009; You and Dörnyei, 2014) had found that the integrative disposition could be related to the *Ideal L2 Self,* indicating that the L2 learner has an idealised L2 image of himself as being "not only personally

	Integrativeness			Cultural Interest		
	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural
Ideal L2 Self	0.311*	0.314*	**0.610****	0.367**	0.371**	**0.580****
Integrativeness				**0.529****	**0.480****	**0.681****
	Attitudes towards the L2 Community			Interest in the English Language		
	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural
Ideal L2 Self	0.374**	0.452**	**0.575****	0.367**	0.463**	**0.624****
Integrativeness	**0.695***	**0.590****	**0.698****	**0.822***	**0.697****	**0.791****

agreeable but also professionally successful" (Dörnyei, 2010, p. 79). As Table 3 shows, also other correlations were carried out in order to verify whether other immediate motivational antecedents, namely *Attitudes towards the L2 Community* and the *Instrumentality* factors resulted interrelated, as also suggested by the above-mentioned studies.

Table 3: Correlations *Ideal L2 Self*, *Integrativeness* and across-related factors (all three groups of participants).
*. significant at the 0.05 level (2-tailed).
**. significant at the 0.01 level (2-tailed).
Values in **bold** have a significant relationship.
Values in ***bold italics*** have a non-significant relationship.

As displayed, in the Greek and Italian urban samples the correlated *Integrativeness* and *Ideal L2 Self* factors registered a low coefficient (r=0.31) compared to previous studies. Conversely, it reached the r=0.61 in the Italian rural group where the mentioned variables show a strong relationship despite the recorded low median values. Interestingly, in all groups the *Integrativeness* variable correlates above the r=5.0 range with most cross-related factors (*Cultural Interest, Attitudes towards the L2 Community, Interest in the English Language*) meaning that in line with former

studies, although indirectly, *Integrativeness* represents a leading motivational variable in learning English as an L2.

Table 4 below shows results of correlations carried out to check whether the *Ideal L2 Self* had a significant relationship with *Instrumentality Promotion* and *Travel Orientation*, as well as with other across-related factors that similarly measured a high median value, i.e. *Cultural Interest*, *Interest in the English Language* and *Attitudes towards the L2 Community*.

Table 4: Correlations *Ideal L2 Self*, *Instrumentality Promotion* and across-related factors (all three groups of participants).

	Instrumentality Promotion			Travel Orientation			Cultural Interest		
	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural
Ideal L2 Self	**0.521***	**0.489***	**0.784****	0.254*	0.345**	**0.538****	0.367**	0.371**	**0.580****
Instrumentality Promotion				**0.494****	**0.600****	**0.749****	**0.546****	**0.542***	**0.661***
Travel Orientation			**0.749****				**0.574****	0.441**	**0.569***

	Interest in the English Language			Attitudes towards the L2 Community		
	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural
Ideal L2 Self	0.367**	0.463**	**0.624****	0.374**	0.452**	**0.575****
Instrumentality Promotion	**0.520****	0.324**	**0.741***	0.344**	**0.548****	**0.670****
Travel Orientation	0.441*	0.379**	**0.630***	0.441*	**0.618****	**0.576****

*. significant at the 0.05 level (2-tailed).
**. significant at the 0.01 level (2-tailed).
Values in **bold** have a significant relationship.
Values in ***bold italics*** have a non-significant relationship.

As Table 4 presents, the *Ideal L2 Self* and *Instrumentality Promotion* as well as *Instrumentality Promotion* and other factors, correlate above r=0.5 in all three groups of students with the result that the *Ideal L2 Self* is indirectly projected into the framework of variables related to *Instrumentality Promotion*. This phenomenon most probably denotes that Greek and Italian learners' image of themselves as future proficient speakers of English is related to their instrumental orientation and indirectly to their travel orientation, their interest towards the culture of the target language community and the English language per se (Italian rural group). It is furthermore worth noting that despite the low median values related to the *Integrative Orientation* and to the *Ideal L2 Self* of the Italian rural group (Mdn=3.0 and Mdn=3.3) all motivational areas emerge in terms of correlational values.

To conclude, a last set of correlation coefficients was calculated, i.e. among *Instrumentality Prevention*, *Ought-to L2 Self* and *Parental Encouragement* (Table 5) as these factors were found relevantly associated in previous studies (see Taguchi et al., 2009).

Table 5: Correlations *Instrumentality Promotion/Prevention*, *Ought-to L2 Self*, *Parental Encouragement* (all three groups of participants).

	Instrumentality Promotion			Instrumentality Prevention			Parental Encouragement		
	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural	Greek urban	Italian urban	Italian rural
Instrumentality Prevention	0.287**	0.241*	**0.570***				*0.249*	0.214*	**0.632***
Ought-to L2 Self	0.466**	0.285*	0.291*	**0.516***	**0.630***	**0.573***	**0.531***	*0.239*	0.300*

*. significant at the 0.05 level (2-tailed).

**. significant at the 0.01 level (2-tailed).

Values in **bold** have a significant relationship.

Values in ***bold italics*** have a non-significant relationship

As predicted, all Pearson coefficients calculated between *Instrumentality Prevention* and *Ought-to L2 Self* recorded high values as shown in Table 5 meaning that most respondents believe that they should learn English in order to avoid possible negative consequences. In terms of *Parental Encouragement*, it seems that Italian urban students' *Ought-to L2 Self* and *Instrumentality Prevention* are not related to family influences. Conversely, Greek urban and Italian rural high-school learners of English appear to share the belief that their family's expectations should not be deluded for 'preventional' reasons (r=0.63 Italian rural) and for a sense of duty and responsibility (r=0.53 Greek urban). A further interesting result should be noted, namely the recorded coefficient of r=0.57 between *Instrumentality Promotion* and *Prevention* involving the Italian rural group which will be discussed in the following section.

5. Discussion of Findings
Distinctive Motivational Patterns
Figure 1 that follows depicts and compares the FLL orientations that emerged from all three groups of respondents involved in the survey. In the first place, it can be noted that despite the outlined differences in terms of knowledge of English between Italian and Greek teenagers already mentioned in the introductory section of this paper, findings show quite a similar motivational pattern within the participants of both countries. Most students referred that they learn English in order to travel internationally and because they are attracted by the L2 community (as in the case of Italian respondents) and by what is related to cultural motives as in the case of the Greek participants (see correlation Table 4). Furthermore, their motivation to learn English is determined by 'pragmatic' reasons as to find a job, even abroad, and study in foreign countries (*Instrumentality Promotion*). Quite interesting is how most Greek and Italian families appear to represent an influencing factor, yet with slight differences, as correlational results have shown, and that will be discussed in the next sub-section. Most probably, it is the outcome of Italian and Greek parents' concern about their offspring's future they see threatened by their countries' recent financial crisis.

Likewise, the three samples' attitude towards the people from English-speaking countries and communities comprises interest in meeting them, knowing more about their culture and how their language is used in conversation. In general, they refer enjoying learning English (see Appendix A).

In terms of differences, although no important deviances can be observed in Figure 1, few motivational factors acquire specific nuances depending to the socio-cultural context the group of learners is immersed into.

Figure 1. Motivational orientations in learning English as a FL of Italian and Greek
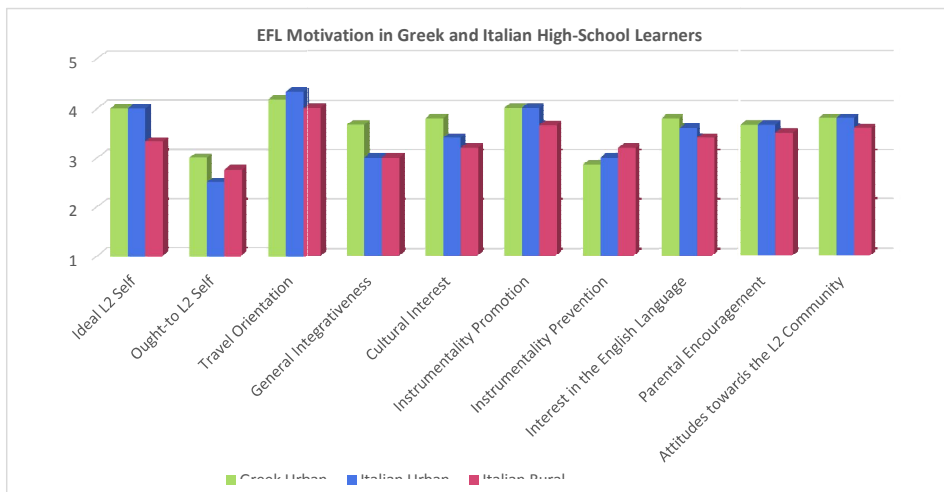
high-school students.

Greek and Italian Urban High-School Learners: Distinctive Motivational Features.

It is not just a stereotype that urban environments enhance sharing of ideas and cultures filling the atmosphere with internationality due to the presence of educational centres as universities, of social events and intercultural programs. This kind of context has most likely contributed to arising the two urban groups' *Ideal L2 Self*. The strong correlation between their *Ideal L2 self* and the *Instrumentality Promotion* focus additionally confirms the relationship between their idealized self-image as "someone who is able to speak English" (Appendix A, item 3) with international friends and colleagues and their hope for a good job in the near future (item 1 and 2).

Conversely, further observation of median and correlational results suggests a higher orientation of the Greek group in terms of *Integrativeness* with the English speaking community, yet below the range suggested by Dörnyei (2010) and the Asian studies (Taguchi et al., 2009; You and Dörnyei, 2014). However, both Greek and Italian urban samples expressed interest in English to know more about the culture and art of its speakers and because they liked the language "a lot" (items 11 and 13). Yet, only the Greek respondents claimed they wanted to identify with speakers of English which may be an implication of Greek people's strong need to find new opportunities in English speaking countries or a consequence of Greek teenagers' early learning experience in language schools (*Frontistiria*). On the other hand, most Italian participants disagreed that they learned English "to become similar to the people who speak English" (item 12). Evidently, the Italian people's late 'Americanization process' and their strong cultural and nationalistic identity (Pulcini, 1997) are still of some influence. Despite the relatively low median values of the Italian urban *Integrativeness* factor, correlation results reinforce its mediating role among motivational variables (Dörnyei, 2010).

As stated in the previous section, Greek and Italian parents encourage their children to study, use and practice English. In the specific case of Greek urban learners it was found that their *Ought-to L2 Self*, that is to say their sense of responsibility and duties, is closely related to their parents' encouragement and expectations and to preventing unsuccessful outcomes in their studies and future career (*Instrumentality Prevention*). Conversely, findings related to the Italian urban respondents' *Ought-to L2 Self* suggest that also their demanding school environment contribute in arising their motivation in learning English as a foreign language. Actually, Italian participants agreed to statements as "I have to learn English because I don't want to fail the English course" (item 29) or get bad marks (items 30 and 33).

Italian Urban and Rural High-School Learners: Distinctive Motivational Features.
As represented in summary tables 1 to 5 and in Figure 1, Italian urban and rural students' motivational orientations in learning English as a FL share some features common to all surveyed participants - as discussed above - but also display some distinctive aspects. In the first instance, the median values of *Instrumentality Promotion* recorded slightly lower (Mdn=3.65) among rural learners which is also confirmed by their lower predisposition to learn English in order to study abroad and to work globally (items 19, 24, 29). Secondly, the strongest deviation was recorded in the *Ideal L2 Self* framework. In the specific, the Italian rural students claimed they hardly could imagine themselves as being able "to speak English with international friends and colleagues" (items 2 and 3). It is most likely that the above-mentioned finding reflects the influence their socio-cultural environment has exerted on their FLL motivation. Actually, the urban participants live and study in a village 16.5 kilometres from the urban environment where the second survey took place. Thus, they supposedly have reduced possibilities to connect with a more stimulating socio-cultural setting unless they travel to the city in afternoon hours and at weekends. Moreover, no Language Schools, to the best of our knowledge, offer services in the vicinity, thus reducing the rural surveyed students' contact with the English language. To conclude, the specific socio-economic identity of the area is founded on

agricultural family activities where the young generation has been raised, an aspect that may have influenced the rural respondents' Ideal L2 Self that recorded quite low (Mdn=3.3) compared to the urban sample.

Analysing the role of the *Integrativeness* factor in both Italian groups, results displayed a lower median value compared to the Greek sample although in the Italian rural one coefficients recorded high indices of correlation with the *Ideal L2 Self* variable. Surprisingly enough, all the motivational variables from the rural high-school students' questionnaires correlated above r=0.50 among each other despite the relatively low medians of most grouped factors. This phenomenon might be interpreted as the reflection of the rural sample's sensitivity to all inputs received from their social environment (school and family) and from the virtual, more internationally oriented reality they are immersed into (e.g. the internet and the media).

As discussed previously, the *Family Encouragement* factor showed approximately the same median value in all groups. Yet, correlational analysis suggests again some differences. In the specific, it was found that parents' influence arise the rural learner's FLL motivation for 'preventional' reasons. Students from an Italian country village seem to be highly encouraged by their families (correlation *Parental Encouragement/Instrumentality Prevention*), an aspect that was not recorded among urban respondents who mainly revealed to study English "because [they] don't want to get bad marks" (item 30) as they are constantly worried of 'losing face' (correlation *Instrumentality Prevention/Ought-to L2 Self*).

Worth of further notice is the *Instrumentality Promotion/Prevention* correlation that in the rural group recorded high (r=0.57). This unexpected finding appears to subvert relationships tested in former studies employing the 'L2 Motivational Self System' model. This result could furthermore be interpreted observing responses from the questionnaire (Appendix A) and in the light of their socio-cultural milieu. Despite their frail image of themselves as future speakers of English (*Ideal L2 Self*), their awareness that English is important for practical reasons might have been raised by their school's 'language friendly' activities and projects as well as by the globalised virtual reality they are everyday immersed into.

6. Conclusion

Drawing on a small-scale study, the present paper reported on the motivational drive of Greek and Italian high-school learners of English from urban and rural contexts. Results highlighted that no important motivational differences characterise the three groups of learners. In the first place, it was found that the respondents' national and socio-cultural identity had a medium-size effect on those motivational variables that were initially expected to diverge. Comparison between the Greek and Italian group from an urban environment showed that they share the same degree if idealized L2 image, travel orientation, and parental encouragement as well as the belief that English is important for their life opportunities (*Instrumental Orientation*). In terms of *Integrativeness*, that Gardner's pioneering studies pointed out as the primary motivational factor in learning a second/foreign language, the two groups of Italian students (urban and rural) showed to slightly diverge with the Greek group expressing a major interest in learning English so to become similar to English-speaking people. Nevertheless, an unexpected phenomenon could be observed. The assessed

correlation of the integrative factor with the learners' ideal L2 Self did not reveal an important relationship as previously found by Dörnyei and his followers. We are most probably assisting to a variation of the traditional concept of *Integrativeness*, i.e. to a representation of the learner's hopes and desires to become part of the English-speaking international and globalised community.

While parents' encouragement seems to have an effect on the motivational orientation of all groups of Italian and Greek respondents with some minimal contextual variations emerging from correlational analysis, other interesting differences were noted. Italian learners from the country village school showed to have a feeble image of themselves using English in the future, as well as a not well-defined feeling of integration with the target language community they also shared with their urban counterparts, which denotes a motivational characteristic specific of Italian high-school learners of English.

Overall, most hypotheses in response to RQ1, RQ2 and RQ3 were not confirmed, revealing that socio-cultural diversities may have a middle-size effect on the surveyed language learners, who resulted highly motivated to travel internationally as well as instrumentally oriented, although the Italian rural group recorded slightly below average in some factors. Consequently, findings suggest that motivation of the surveyed samples could most likely be ascribed to their schools' 'internationally oriented' and 'language friendly' identity and to their families' encouragement, which as discussed earlier represent some of the samples' common features.

Although of small contribution and subject to several limitations due to time availability and technical circumstances, the present project may serve as a baseline for future research in the field. In terms of limitations, the participation of Greek students from public school environments (urban and rural) would have definitely been more indicative and meaningful, as it would have represented the entire Greek teenage population. Similarly, comparing Greek and Italian respondents from public rural high-school environments might have provided a broader and more complete picture of motivation in learning English in the areas of focus. Likewise, it could have been advisable also to assess the *Learning Experience* and *Intended Effort* of the three groups of samples as well as their appreciation of the language teacher. In order to avoid possible ethical issues and request additional approval from families and principals, it was decided that the above-mentioned variables be measured in future research via a qualitative method, i.e. through face-to-face interviews.

Results of the present study may find application in various fields of Applied Linguistics and in the ELT classroom: planning activities that meet the language learner's interests and life objectives should be one of the ELT teacher's primary concerns to motivate pupils. More broadly, it is advisable that language school syllabuses and programs be designed with the aim of meeting the learners' identity, needs and life expectations, thus arising their motivation. This goal may also be achieved introducing FLL motivation research as a praxis at the beginning of each school cycle so to adapt language curricula and activities to the specific socio-cultural and socio-psychological identity of the ELT classroom.

Concluding, within the European Union's requirements and perspectives, the present study may suggest that Greek and Italian high schools involve a greater number of teenagers in projects such as ErasmusPlus, Intercultura or MUN (Model United Nations) in order to raise their *international posture* (Yashima, 2002).

Accordingly, it may be recommended that Content Language and Integrated Learning (CLIL) be implemented in all English language syllabuses and upper secondary schools' ELT programs so to increase students' specific language competence while satisfying their interest in learning English for practical reasons. Overall, Greek and Italian teenagers revealed motivated in learning English as a FL in order to integrate with the international community and broaden their life perspectives.

References

Clément, R. and Kruidenier, B. G. (1983) Orientations in Second Language Acquisition: The Effects of Ethnicity, Milieu, and Target Language on their Emergence. *Language Learning*. 33(3), 273-291.

Council of Europe (2001) *Common European Framework of References: Learning, Teaching, Assessment*. Cambridge, Cambridge University Press. Available from: http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf [Accessed 29th August 2016].

Crookes, G. and Schmidt, R. W. (1991) Motivation: Reopening the Research Agenda. L*anguage Learning: A Journal of Applied Linguistics*. 41(4), 469-512.

Dendrinos, B. et al. (2013) *Foreign Language Learning In Greek Schools: European Survey on Language Competences*. National and Kapodistrian University of Athens. Available from: http://opencourses.uoa.gr/modules/document/file.php/ENL13/Instructional%20 Package/03.%20FL%20Teaching-Learning_GR/ESLC_EN.pdf [Accessed 31st August 2016].

Dörnyei, Z. (1994) Motivation and Motivating in the Foreign Language Classroom. *The Modern Language Journal*. 78(3), 273-284.

Dörnyei, Z. (1998) Motivation in Second and Foreign Language Learning. *Language Teaching*, 31 (3), 117-135.

Dörnyei, Z. (2005) *The Psychology of the Language Learner: Individual Differences in Second Language Acquisition*, Lawrence Erlbaum, Mahwah, NJ.

Dörnyei, Z. (2007) *Research Methods in Applied Linguistics: Quantitative, Qualitative and Mixed Methodologies*, Oxford University Press, Oxford.

Dörnyei, Z. (2010) Researching motivation: From Integrativeness to the Ideal L2 Self. In: Huston, S. and Oakey, D. (eds) *Introducing Applied Linguistics: Concepts and Skills*, Routledge, London, p. 74-83.

Dörnyei, Z. et al. (2006) *Motivation, Language Attitudes and Globalization: a Hungarian Perspective*, Multilingual Matters Ltd.

Dörnyei, Z. and Ottó, I. (1998) Motivation in Action: A Process Model of L2 Motivation. *Working Papers in Applied Linguistics,* Thames Valley University, London, p. 43–69.

Dörnyei, Z. and Taguchi, T. (2009) *Questionnaires in Second Language Research: Construction, Administration, and Processing*, Routledge.

Dörnyei, Z. and Ushioda, E. (2011) *Teaching and Researching Motivation,* 2nd Edition, Pearson Education, Harlow.

European Commission (2012) *Special Eurobarometer 386: Europeans and their Languages, Report* [online]. Available from: http://ec.europa.eu/public_opinion/archives/ebs/ebs_386_en.pdf [Accessed 21st August 2016].

Faez, F. (2011) English Education in Italy: Perceptions of Teachers and Professors of English. *Canadian and International Education / Education Canadienne et Internationale*, 40(3). Available from: http://ir.lib.uwo.ca/cie-eci/vol40/iss3/4

Forleo, C. (2015) Istruzione e Scuole Paritarie, tra Realtà e Miti da Sfatare si Perdono di Vista le Priorità. *International Business Times* [online], 8th March 2015. Available from: http://it.ibtimes.com/istruzione-e-scuole-paritarie-tra-realta-e-miti-da-sfatare-si-perdono-di-vista-le-priorita-1391789# [Accessed 17th November 2016].

Fortsakis, T. (2016) The Importance of Private Schools in Greece. *European Business Review* [online], July 19th 2016. Available from: http://www.europeanbusinessreview.eu/page.asp?pid=1554 [Accessed 15th November 2016].

Gardner, R. C. (1982) Language Attitudes and Language Learning. In: Bouchard, R. E. and Giles, H. (1982) *Attitudes towards Language Variation: Social and Applied Contexts*, Edward Arnold, London, p. 132-147.

Gardner, R. C. and Lambert, W. E. (1959) Motivational Variables in Second-Language Acquisition. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*. 13(4), 266.

Gardner, R. C. and Lambert, W. E. (1972) *Attitudes and Motivation in Second-Language Learning*. Rowley, Mass., Newbury House Publishers Inc.

Gardner, R. C. and MacIntyre, P. D. (1993) On the Measurement of Affective Variables in Second Language Learning. *Language Learning*, 43(2), 157-194.

Gardner, R. C. et al. (1985) The Role of Attitudes and Motivation in Second Language Learning: Correlational and Experimental Considerations. *Language Learning*. 35(2), 207-227.

Kofou, I. (2015) What Affects Motivation in English Language Learning in The Secondary Education In Greece? The Experience of the 2nd Experimental Senior High School of Thessaloniki. In: Gómez Chova, L. et al. (eds*) 8th International Conference of Education, Research and Innovation: Conference Proceedings, November 16th-18th, 2015 — Seville, Spain.* IATED Academy. p. 5454-5463. Available from: https://library.iated.org/view/KOFOU2015WHA [Accessed 23rd August 2016].

Lamb, M. (2004) Integrative Motivation in a Globalizing World. *System*. 32(1), 3-19.

Languageknowledge.eu (2012) *Knowledge of English in Europe* [online]. Available from: http://languageknowledge.eu/languages/english [Accessed 28th August 2016].

Mariani, L. (2011) Language Learning Motivation: a Multi-Dimensional Competence. *Perspectives, a Journal of Tesol-Italy*. Available at: http://www.learningpaths.org/papers/motivationtesol2011.pdf [Accessed 2nd September 2016].

Markus, H. R. and Nurius, P. (1986) Possible Selves. *American Psychologist*. 41, 954–69.

Nikolaou, A. (2004) *Attitudes and Motivation of Greek Upper Secondary School Pupils for Learning English as a Foreign Language*. PhD Dissertation, The University of Birmingham.

Noels, K. A. et al. (2000) Why are You Learning a Second Language? Motivational Orientations and Self-Determination Theory. *Language learning. 50*(1), 57-85.

Pallant, J. (2005) *SPSS Survival Manual.* 2nd Edition, Open University Press and McGraw-Hill Education, Maidenhead, England

Palombizio, C. (2015) *The L2 Motivational Self System among Italian Learners of English in the Context of Italian Public High School. An Examination of the different Facets of Integrativeness in an EFL Context.* MA ELT Dissertation, University of Brighton.

Pulcini, V. (1994) The English Language in Italy. *English Today. 10*(4), 49-52.

Pulcini, V. (1997) Attitudes to the spread of English in Italy. *World Englishes. 16*, 77-85.

Pulcini, V. (2002) Italian. *English in Europe, sous la Direction de Görlach M.* Oxford University Press, Oxford, p. 151-167.

Pulcini, V. (2008) Anglicisms in the 2006 Olympic Winter Games 2006. In: Fischer, R. and Pulaczewska, H. (eds) *Anglicisms in Europe. Linguistic Diversity in a Global Context*, Cambridge Scholars, Newcastle Upon Tyne, UK, p. 140-158.

Ryan, S. (2009) Self and Identity in L2 Motivation in Japan: The Ideal L2 Self and Japanese Learners of English. In: Dornyei, Z. and Ushioda, E. (eds) *Motivation, Language Identity and the L2 Self.* Multilingual Matters, Clevedon.

Taguchi, T. et al. (2009) The L2 Motivational Self-System amongst Chinese, Japanese and Iranian Learners of English: A Comparative Study. In: Dornyei, Z. and Ushioda, E. (eds) *Motivation, Language Identity and the L2 Self*, Multilingual Matters, Bristol, p. 66-97.

Ushioda, E. and Dörney, Z. (2012) Motivation. In: Gass, E. and Mackey, A. (eds) *The Routledge Handbook of Second Language Acquisition*, Routledge, New York, p. 396-409.

William, M. and Burden, R. L. (1997) *Psychology for Language Teachers*, Cambridge University Press, Cambridge.

Yashima, T. (2000) Orientations and Motivation in Foreign Language Learning: A Study of Japanese College Students. *The Japan Association of English Teachers (JACET).* Available from: http://kuir.jm.kansai-u.ac.jp/dspace/bitstream/10112/6873/1/KU-1100-20000315-09.pdf [Accessed 18th August 2016].

Yashima, T. (2002) Willingness to Communicate in a Second Language: The Japanese Context. *The Modern Language Journal*. 86, 54–66.

You, C. and Dörnyei, Z. (2014) Language Learning Motivation in China: Results of a Large-Scale Stratified Survey. *Applied Linguistics*. Oxford University Press. P. 1-26.

Appendix A – Summary table of the 51 questionnaire items' mean, median and standard deviation from   all three groups' responses.

ITEM N°	GREECE	ITALY URBAN	ITALY RURAL
Ideal L2 Self	**Mean Median Standard deviation**	**Mean Median Standard deviation**	**Mean Median Standard deviation**
1. Whenever I think of my future career, I imagine myself using English.	3.8333 **4.0000** (1.02786)	4.0526 **4.0000** (0.85400)	3.4074 **4.0000** (1.03739)
2. I can imagine myself speaking English with international friends or colleagues.	4.1500 **4.0000** (0.79883)	3.7193 **4.0000** (0.86095)	3.4074 **3.0000** (0.94207)
3. I imagine myself as someone who is able to speak English.	4.2167 **4.0000** (0.84556)	3.8246 **4.0000** (0.84775)	3.2778 **3.0000** (1.03553)
Ought-to L2 Self			
4. I study English because close friends of mine think it is important.	2.2833 **2.0000** (0.99305)	2.0000 **2.0000** (0.73193)	2.1111 **2.0000** (0.81650)
5. Learning English is necessary because people surrounding me expect me to do so.	3.7167 **4.0000** (0.88474)	2.2982 **2.0000** (0.98134)	2.6296 **3.0000** (1.01491)
6. Studying English is important to me because other people will respect me more.	2.6333 **3.0000** (1.11942)	2.4561 **2.0000** (1.11915)	2.4444 **3.0000** (0.92485)
7. Studying English is important to me because an educated person is supposed to be able to speak English.	3.3833 **4.0000** (1.07501)	3.7895 **4.0000** (1.04773)	3.6852 **4.0000** (0.90750)
Travel Orientation			
8. Learning English is important to me because I would like to travel internationally.	4.4167 **4.5000** (0.67124)	4.3860 **5.0000** (0.81841)	4.1667 **4.0000** (0.96642)
9. Studying English is important to me because without English I won't be able to travel a lot.	3.6667 **4.0000** (0.98577)	4.0702 **4.0000** (0.79865)	3.9444 **4.0000** (0.95989
10. I study English because with English I can enjoy travelling abroad.	4.3500 **4.0000** (0.68458)	4.2807 **4.0000** (0.75010)	3.8704 **4.0000** (1.09968)
General Integrativeness			
11. I think that learning English is important in order to learn more about the culture and art of its speakers.	4.0333 **4.0000** (0.84305)	3.7193 **4.0000** (0.90147)	3.5741 **4.0000** (1.03890)
12. I learn English to become	2.5333	2.1579	2.2963

	similar to the people who speak English.	**3.0000** (1.11183)	**2.0000** (0.95971)	**2.0000** (1.02109)

13. I like English a lot.	4.0000 **4.0000** (1.10469)	3.7544 **4.0000** (0.87179)	3.2593 **3.0000** (1.15228)

Cultural Interest

14. I want to learn English because I like the music of English-speaking countries.	3.6833 **4.0000** (1.14228)	3.5263 **4.0000** (1.19680)	3.2593 **3.0000** (1.04944)
15. I want to learn English because I like watching films in English.	4.0167 **4.0000** (0.87317)	3.4035 **3.0000** (1.04982)	2.9074 **3.0000** (1.15364)
16. I want to learn English because I am interested in reading English magazines, newspapers, or books.	3.7333 **4.0000** (1.05552)	3.1754 **3.0000** (0.98421)	2.7963 **3.0000** (1.10538)
17. I like TV programmes made in English-speaking countries.	4.0500 **4.0000** (0.81146)	3.8772 **4.0000** (1.11915)	3.4259 **4.0000** (1.19119)

18. I want to learn English to be able to surf the net without too many language barriers.	3.7333 **4.0000** (0.89947)	3.4912 **4.0000** (1.01985)	3.3148 **3.5000** (1.04293)

Instrumentality Promotion

19. Studying English can be important to me because I think it will someday be useful in getting a good job.	4.5000 **5.0000** (0.65094)	4.5263 **5.0000** (0.57025)	4.0926 **4.0000** (1.01440)
20. Studying English is important to me because English proficiency is necessary for promotion in the future.	4.1333 **4.0000** (0.70028)	3.9474 **4.0000** (0.71766)	3.9444 **4.0000** (1.01715)
21. Studying English is important to me because with English I can work globally.	4.4500 **4.5000** (0.59447)	4.4561 **5.0000** (0.78080)	4.0556 **4.0000** (1.03553)
22. Studying English is important because with a high level of English proficiency I will be able to make a lot of money.	3.5667 **3.0000** (0.98060)	3.1754 **3.0000** (0.75882)	3.2222 **3.0000** (0.86147)
23. Studying English can be important to me because I think I'll need it for further studies.	4.5500 **5.0000** (0.62232)	4.3860 **4.0000** (0.70088)	4.0370 **4.0000** (1.00870)
24. Studying English is important to me because I am planning to study abroad.	3.9333 **4.0000** (0.88042)	3.5965 **4.0000** (0.99749)	3.1111 **3.0000** (1.05806)
25. I study English in order	3.8500	3.2632	3.0741

to keep updated and informed of recent news of the world.	**4.0000** (0.86013)	**3.0000** (1.00935)	**3.0000** (1.02519)
26. Studying English is important to me in order to achieve a special goal (e.g. to get a degree).	4.2000 **4.0000** (0.65871)	4.0351 **4.0000** (0.88570)	3.6111 **4.0000** (1.03553)
27. The things I want to do in the future require me to use English.	3.8667 **4.0000** (0.99943)	4.1579 **4.0000** (0.86167)	3.7037 **4.0000** (1.02109)
28. Studying English is important to me because it offers a new challenge in my life.	3.7333 **4.0000** (0.91812)	3.8246 **4.0000** (0.88888)	3.6296 **4.0000** (0.91726)

Instrumentality Prevention

29. I have to learn English because I do not want to fail the English course.	2.6000 **3.0000** (1.13794)	2.8947 **3.0000** (1.02964)	3.1296 **3.0000** (0.86975)
30. I have to study English because I do not want to get bad marks in it.	2.5667 **3.0000** (1.06352)	2.7193 **3.0000** (1.03085)	3.3148 **4.0000** (1.04293)
31. Studying English is important to me, because I would feel ashamed if I got bad grades in English.	2.6333 **3.0000** (1.05713)	2.4386 **2.0000** (1.01801)	2.7222 **3.0000** (0.95989)
32. Studying English is important to me because, if I do not have knowledge of English, I will be considered a weak learner.	2.6833 **3.0000** (1.03321)	2.3509 **2.0000** (1.00873)	2.5926 **3.0000** (1.01904)
33. Studying English is necessary for me because I do not want to get a poor score or a fail mark in English proficiency tests.	3.0667 **3.0000** (1.20545)	3.1053 **3.0000** (1.09682)	3.4630 **4.0000** (0.92579)
34. I have to study English; otherwise. I think I cannot be successful in my future career.	3.4667 **3.5000** (1.08091)	3.4737 **4.0000** (0.98389)	3.3889 **3.0000** (0.99843)
35. Studying English is important to me because I do not like to be considered poorly educated person.	3.0833 **3.0000** (1.26614)	3.0175 **3.0000** (1.06051)	3.1296 3.0000 (1.01025)

Interest in the English Language

36. I feel excited when hearing English spoken.	3.6167 **4.0000** (0.99305)	3.4912 **3.0000** (0.68460)	3.1852 **3.0000** (1.01077)
37. I am interested in the way English is used in conversation	3.9833 **4.0000** (0.89237)	3.9825 **4.0000** (0.79037)	3.6667 **4.0000** (0.84675)
38. I find the difference	3.4833 **4.0000**	3.2982 **4.0000**	3.1852 **3.0000**

between vocabulary of my native language and English vocabulary interesting.	(0.89237)	(0.98134)	(0.97272)
39. I really enjoy learning English.	3.5833 **4.0000** (1.10916)	3.7368 **4.0000** (0.97333)	3.5185 **4.0000** (1.00453)
40. I like the rhythm of English.	3.6333 **4.0000** (0.99092)	3.4737 **3.0000** (0.86819)	3.1852 **3.0000** (0.99193)
Parental Encouragement			
41. My parents encourage me to study English.	4.1167 **4.0000** (0.64022)	4.2456 **4.0000** (0.85106)	3.9815 **4.0000** (0.87934)
42. My parents encourage me to take every opportunity to use my English (e.g. speaking and reading).	4.0167 **4.0000** (0.89237)	3.8947 **4.0000** (0.93892)	3.5370 **4.0000** (1.11106)
43. My parents encourage me to practice my English as much as possible.	4.0167 **4.0000** (0.77002)	3.9474 **4.0000** (1.09252)	3.7963 **4.0000** (0.97863)
44. My parents encourage me to attend extra English classes after class (e.g. at English language schools).	3.3000 **3.5000** (1.16880)	3.4035 **4.0000** (1.06670)	2.8148 **3.0000** (1.02927)
45. My family put a lot of pressure on me to study English.	2.4667 **2.0000** (1.15666)	2.7719 **3.0000** (1.10223)	2.9630 **3.0000** (1.04544)
46. My parents/family believe(s) that I must study English to be an educated person.	3.3833 **3.0000** (1.02662)	3.3684 **3.0000** (1.06287)	3.3704 **3.0000** (1.10396)
Attitudes towards the L2 Community			
47. I like to travel to English-speaking countries.	4.1667 **4.0000** (0.82681)	4.1754 **4.0000** (0.84775)	3.8333 **4.0000** (1.05955)
48. I like the people who live in English-speaking countries.	3.6167 **3.5000** (0.88474)	3.4561 **3.0000** (0.82527)	3.3333 **3.0000** (1.00939)
49. I like meeting people from English-speaking countries.	4.0000 **4.0000** (0.80254)	3.9649 **4.0000** (0.90564)	3.7778 **4.0000** (1.05806)
50. I would like to know more about people from English-speaking countries.	3.6333 **4.0000** (0.93820)	3.4737 **3.0000** (0.92785)	3.3333 **4.0000** (1.00939)
51. I am very interested in the values and customs of other cultures.	3.9000 **4.0000** (0.93337)	3.6491 **4.0000** (1.02628)	3.4259 **3.5000** (1.02058)

Appendix B – Summary table of participants who had a native teacher of English, an experience abroad for more than three months and participated to abroad school projects (part 2 of the questionnaire).

	Native English teacher	Period abroad	School projects abroad
Greek urban	33 students (55%)	7 students (11.7%)	35 students (58.3%)
Italian urban	29 students (50.9%)	4 students (7%)	14 students (24.6%)
Italian rural	37 students (68.5%)	3 students (5.6%)	15 students (27.8%)

Author Index

11th Annual South-East European Doctoral Student Conference

SEERC is a research centre of the International Faculty of the University of Sheffield, CITY College.

Mission

SEERC's mission is to support the development of South-East Europe by conducting pure and applied research in and for the region. To accomplish this, SEERC employs the existing research capacities of the University of Sheffield and CITY College- International Faculty of The University of Sheffield by facilitating collaborations between their research staff and by developing multi-disciplinary networks of researchers from across South-East Europe.

SEERC contributes to knowledge capacity building:

- By promoting a dialogue among SEE countries related to the development of the SEE region.

- By providing a forum for researchers in the SEE region.

- By disseminating research findings to academics, professionals, NGOs, and policy-makers through conferences, advising, published research papers, monographs, and working papers.

- By developing multi-disciplinary research perspectives through workshops and seminars.

- By promoting the integration of researchers from universities and research centres in the SEE region into networks of excellence.

The University Of Sheffield.

CITY College
An International Faculty Of The University.

SOUTH-EAST EUROPEAN RESEARCH CENTRE

SEERC