

# Translation of Texts from Croatian into English

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UNIVERSITY OF RIJEKA  
FACULTY OF HUMANITIES AND SOCIAL SCIENCES  
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**TRANSLATION OF TEXTS  
FROM CROATIAN INTO ENGLISH**

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of the requirements for the B.A. in English Language and Literature  
and Pedagogy at the University of Rijeka

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## **Abstract**

This B.A. thesis will discuss the problems which stem from translating texts from Croatian into English. The aim was to choose three texts of different styles and translate them with the highest degree of accuracy in order to maintain as much of the source's original meaning. Each translation is followed by the analysis of the source text and the commentary of the workflow. The provided analysis of source texts is done with the help of the Genre Analysis method. The workflow discusses the steps taken while translating and focuses on the key concepts and problematic phrases in the source text. At the end of this thesis is a conclusion which provides the summary of the whole work.

**Keywords:** translation, translation problems, Genre Analysis

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## 1. INTRODUCTION

In this thesis I will attempt to address the issues of translating texts of different styles from Croatian into English language. In doing so, I will attempt to provide accurate translations of three texts written in Croatian language. My aim is to produce a translation which is a meaningful and accurate representation of the chosen source texts. The first text I have chosen to translate is a review of a book called "*Evolucija i ljudsko ponašanje*" by Igor Kardum. The author of the aforementioned review is Tomislav Bračanović who is a scholar at the Faculty of Croatian Studies in Zagreb. The second text is a scientific paper written by Nenad Raos and the text deals with the concept of an element from the earliest beginnings of chemistry up until the modern day. The last source text is written by Mia Mucić, a music teacher who discusses the importance of teaching music culture to new generations.

Each translation is followed by a commentary and analysis of the source text, as well as the translated text. The texts are analyzed with the help of the technique called Genre Analysis, a method in which the source text is analyzed through a series of steps. The steps used in this thesis are: genre, source, audience, and purpose of writing, authenticity, style, level of formality, layout, content, cohesion, sentence patterns, and terminology of the subject. It is necessary to study and analyze the source text prior to translating it because we must be acquainted with the text and its meaning, purpose and the audience which the author targets. Furthermore, the translator must take into account its level of formality, key phrases and problematic words or sentences which must be translated to the target language while keeping their initial meaning. The translator must have a complete and deep understanding of the source text in order to produce a translation of good quality which maintains as much of the original meaning as possible.

## 2. SOURCE TEXT 1

### IGOR KARDUM: EVOLUCIJA I LJUDSKO PONAŠANJE

Autor knjige *Evolucija i ljudsko ponašanje*, kako doznajemo s njezina ovitka, izvanredni je profesor na Odsjeku za psihologiju Filozofskog fakulteta u Rijeci, gdje predaje kolegije Evolucijska psihologija, Emocije i motivacija i Povijest psihologije. Knjiga predstavlja uvod u evolucijsku psihologiju i u osnovne modele kojima ona objašnjava neke specifične tipove ljudskog ponašanja, a vrijedna je već i stoga što dopunjava oskudan izbor tematski sličnih publikacija na hrvatskom jeziku (valja spomenuti koristan zbornik radova *Sociobiologija*, koji je za istog nakladnika 1997. priredio Darko Polšek). Format i stil četiriju poglavlja knjige sugeriraju da je riječ o propedeutičko-popularnom štivu koje čitatelje želi na razumljiv način upoznati sa suvremenim idejama spajanja teorije evolucije i psihologije i potaknuti ih na daljnje istraživanje.

Prvo poglavlje ("Uvod u evolucijsku psihologiju") najprije izlaže standardno shvaćanje teorije evolucije (prema kojemu su za evoluciju neophodni varijacija, nasljeđivanje i selekcija) i upozorava na neteleološki karakter evolucijskog procesa i njegovo gradualno (postupno) odvijanje. U nastavku se spominju tri problema s kojima se teorija evolucije suočava od najranijih dana: (1) problem nasljeđivanja, (2) problem altruističkog ponašanja i (3) problem postojanja karakteristika koje izgledaju kao smetnje za uspješno preživljavanje. Problem (1) riješen je zahvaljujući Mendelovu otkriću zakona nasljeđivanja. Dva komplementarna rješenja problema (2) ponudili su Hamilton (teorija "ukupne reproduktivne uspješnosti", koja predviđa evoluciju altruizma u populaciji bliskih srodnika) i Trivers (teorija "recipročnog altruizma", koja predviđa evoluciju altruizma u populaciji nesrodnika ako postoji nekoliko specifičnih uvjeta koji nealtruističko ponašanje čine neadaptivnim). Problem (3) – postojanje karakteristika koje izgledaju kao adaptivne smetnje (klasičan primjer je paunov rep koji otežava kretanje i bijeg od grabežljivaca) – riješen je rehabilitacijom "teorije spolne selekcije", odnosno Triversovom "teorijom diferencijalnog roditeljskog ulaganja", koja tvrdi da su ženke izbirljivije pri odabiru

spolnoga partnera zbog njihova većeg ulaganja u potomstvo (oplodnja se odvija u njezinu tijelu, ona prolazi kroz trudnoću i period dojenja, ima ograničen broj spolnih stanica itd.). Zbog povećane ženske izbirljivosti povećava se kompeticija mužjaka za osvajanje spolnog partnera tako da mužjačka obilježja poput paunova repa evoluiraju radi "signaliziranja" ženka da je njihov nositelj dobar, snažan i poželjan spolni partner, kojeg se isplati prihvatiti kao oca svojega potomstva.

Biologija i psihologija oskudijevaju plodnim kontaktima. Poviješću psihologije dominira stav da za razumijevanje ljudskog ponašanja ne treba poznavati evoluciju naše vrste. Posebice suprotstavljen darvinizmu bio je biheviorizam, u kojem se smatralo da je ponašanje primarno rezultat *okoline* ili *učenja* i da ne postoji neki veći utjecaj naslijeđenih mehanizama. Šezdesetih godina 20. st. dolazi do otpora biheviorizmu, na što uvelike utječe razvoj *etologije*, a disciplina koja se posve posvećuje istraživanju adaptivnog ponašanja životinja i ljudi je *sociobiologija*, za čije je širenje (kodifikaciju) posebice zaslužan E. O. Wilson sa svojom knjigom *Sociobiology: The New Synthesis* (1975). Knjiga je izazvala oštre kritike, prije svega zbog tvrdnje da se mnoga "viša" obilježja ljudi mogu objasniti evolucijskim mehanizmima. Sociobiologija kasnije prerasta (ili se transformira) u *evolucijsku psihologiju*, čiji će se predstavnici (najpoznatiji su Leda Cosmides i John Tooby) obrušiti na tradicionalnu psihologiju i društvene znanosti, nazivajući ih "standardnim modelom društvenih znanosti" ili SSSM.

SSSM smatra društvene fenomene *autonomnim* i objašnjivim samo drugim društvenim fenomenima. Smatra se da je pojedinac isključivo produkt svoje kulture, dok su biološki faktori irelevantni jer ih nadvladava *kapacitet za kulturu*. Evolucijski pak psiholozi mnoge stavove SSSM-a smatraju *pogrešnim*: poput stava da ako određena psihološka obilježja nisu prisutna od rođenja, onda ih objašnjava samo socijalizacijski efekt; stava da su okolinski i genetski faktori uzajamno isključivi skupovi utjecaja i stava da kapacitet za kulturu predstavlja *općenamjenski mehanizam* koji nam omogućuje da tijekom socijalizacije usvojimo sve što je potrebno.

Detaljniji uvod u evolucijsku psihologiju počinje razmatranjem evolucije *homo sapiensa*: prikazom "multiregionalnog modela", prema kojemu je *homo sapiens* nastao paralelno u različitim dijelovima svijeta iz arhaičnog *homo sapiensa*, te "monogenetičkog modela", prema

kojemu je moderni čovjek nastao u Africi odakle se proširio na ostale kontinente. Važna zajednička crta ovih modela je slaganje da su se moderni ljudi razvili prije oko 100.000 godina. Imajući ovo u vidu, evolucijski psiholozi ističu bitnu razliku između okoline u kojoj smo evoluirali i okoline u kojoj danas živimo. Okolina u kojoj smo evoluirali je okolina pleistocena (razdoblje započelo prije oko 1.8 milijuna godina i završilo prije oko 11.000 godina), u kojoj su ljudi živjeli kao lovci-sakupljači, u skupinama od 25–100 osoba povezanih krvnim ili bračnim srodstvom, uz nomadski način kretanja, korištenje kamenog oruđa i oskudno posjedovanje materijalnih dobara. Daljnja pretpostavka evolucijske psihologije glasi da je ljudski um skup mehanizama smještenih u mozgu, namijenjen procesiranju informacija radi rješavanja adaptivnih problema s kojima su se susretali naši preci. Mehanizmi za procesiranje informacija (još se nazivaju “moduli”) psihološke su adaptacije koje su *namjenski specifične*, tj. svaka rješava *jedan* adaptivni problem. Evolucijski psiholozi brane ovu tvrdnju pozivajući se na činjenicu da općenamjenski mehanizmi imaju tek ograničenu vrijednost, a naši se preci nisu susretali s *jednim općim problemom* nego s *nizom međusobno različitih specifičnih problema* (odabir spolnog partnera, izbjegavanje grabežljivaca, odabir hrane itd.). Iz ovih pretpostavki evolucijski psiholozi izvode zaključak da naši “moduli” koji su evoluirali zato jer su uspješno rješavali adaptivne probleme u okolini naših predaka ne izazivaju nužno adaptivno ponašanje u sadašnjosti. Prema autoru: “U našim je glavama mozak ljudi iz kamenog doba i ključ za razumijevanje njegova funkcioniranja je pretpostavka da on nije oblikovan za rješavanje svakodnevnih problema suvremenih ljudi, nego za svakodnevne probleme predaka lovaca-sakupljača.” Naša se okolina, naime, uslijed brzine kulturne evolucije, rapidno i radikalno promijenila i u mnogim se aspektima razlikuje od okoline u kojoj smo stekli većinu naših psiholoških adaptacija koje još uvijek djeluju u “našim glavama”.

U drugom poglavlju (“Izbor spolnog partnera i konflikt među spolovima”) analizira se shvaćanje da su specifične preferencije prema nekim karakteristikama spolnog partnera (muškaraca i žena) evoluirale zato jer su te karakteristike u evolucijskoj prošlosti snažno pridonosile preživljavanju i reprodukciji. Nakon sažetka nekih hipoteza o tome zašto je spolna reprodukcija uopće evoluirala, razmatra se evolucijska važnost preferencija prema karakteristikama spolnog partnera. Upozorava se na sličnost spolnih preferencija i preferencija



prema određenim tipovima hrane: kao što sklonost prema određenom tipu hrane pomaže kvalitetnijoj ishrani i preživljavanju, sklonost prema određenim karakteristikama spolnog partnera pomaže uspješnijem razmnožavanju (evolucijski se proces, kao što je poznato, ne sastoji samo od preživljavanja nego i od razmnožavanja, a za uspješno je razmnožavanje važno moći odabrati kvalitetnog partnera).

Kod žena, navode se sljedeće spolne preferencije: 1. dobra financijska perspektiva partnera; 2. viši socijalni status; 3. stariji muškarci; 4. ambiciozni i produktivni muškarci (sve upućuju na muškarčevo posjedovanje ili sposobnost posjedovanja i zadržavanja vrijednih resursa); 5. pouzdanost i emocionalna stabilnost (nepouzdani i emocionalno nestabilni muškarci skloni su monopoliziranju zajedničkih resursa te ljubomori, nasilju i seksualnim vezama s drugim ženama); 6. atletski izgled (bitan za zaštitu potomstva); 7. dobro zdravlje (bitno i za zdravlje žene i za zdravlje zajedničkog potomstva, ali i za trajnost veze koju neće prekinuti prerana smrt partnera); 8. ljubav (vjernost ili želja da se investira isključivo u ženu i zajedničko potomstvo); 9. spremnost da se ulaže u djecu. Kod muškaraca su dvije najčešće preferencije: 1. Mlađe žene (mladost je pouzdan znak reproduktivne vrijednosti) i 2. određeni fizički izgled (tjelesni je izgled bio najpouzdaniji pokazatelj ženina zdravlja i reproduktivne vrijednosti). Prikaz gornjih preferencija popraćen je podacima kros-kulturalnih testova i analogijama sa spolnim ponašanjem ostalih primata, što sve skupa treba ukazivati da u podlozi naših spolnih preferencija postoji jedna, doduše nesvjesna i skrivena, ali ipak aktivna adaptivna logika naslijeđena od naših pleistocenskih predaka.

Prema autoru, “s velikom sigurnošću možemo reći da je naša seksualna psihologija prilagođena reproduktivnom sustavu koji je dominantno, ali ne isključivo monogaman, u kojem su muškarci skloniji poligamiji nego žene i u kojem oba roditelja puno ulažu u potomstvo.” Naoko trivijalna činjenica koja je bitno utjecala na oblikovanje takvog reproduktivnog sustava je činjenica *skrivenosti ovulacije* kod žena. Za razliku od čimpanzi, kod kojih fazu estrusa (fazu ovulacije i maksimalne seksualne prijemljivosti) prati mnoštvo vidljivih znakova, kod žena je ovulacija nevidljiva, a seksualna se aktivnost odvija tijekom cijelog ovulacijskog ciklusa. Evoluciju skrivene ovulacije nastoje objasniti tri hipoteze: (1) skrivena je ovulacija omogućavala ženskom

spolu zamjenu seksa za hranu, tj. da seks neprestano, a ne samo u vrijeme estrusa, mijenjaju za određene resurse; (2) ovulacija je skrivena samo muškarcima, ne i ženama, što im omogućuje da stupe u izvanbračni odnos samo s onim muškarcem kojeg smatraju reproduktivno kvalitetnijim, a istodobno zadrže roditeljsku brigu i stalno ulaganje partnera uvjerenog u svoje biološko oćinstvo; i (3) hipoteza nazvana "tata kod kuće", prema kojoj je skrivena ovulacija adaptacija koja stalnog partnera odvraća od kompetitivne poligamije i niskog ulaganja u potomstvo i usmjerava ih prema monogamiji i visokom ulaganju. Do kraja poglavlja prikazuje se slično, evolucijskom logikom protkano objašnjenje sklonosti kratkotrajnim vezama kod žena i muškaraca, zatim objašnjenje ljubomore i na koncu objašnjenje postojanja menopauze kod žena.

Treće poglavlje ("Konflikti i nasilje u obitelji") bavi se primjenom adaptacionističke logike na područje konflikata, nasilja i ubojstava unutar obitelji. U tome se, dakako, krije paradoks. Prema Hamiltonovoj "teoriji ukupne reproduktivne uspješnosti", obitelj i srodnički odnosi područje su u kojem očekujemo *manju* količinu agresivnosti odnosno veću sklonost altruizmu i suradnji. Ali, kako ističe autor, uz izuzetak vojske i policije, obitelj je najnasilnija društvena skupina. Neki evolucijski scenariji su sljedeći: Najčešće žrtve ubojstava u obitelji su braćni partneri, između kojih nema genetske povezanosti. Njih, dakako, veže interes podizanja zajedničkog potomstva, ali protiv harmoničnog ostvarivanja tog interesa djeluje mogućnost dodatne reprodukcije s drugim partnerom i partnerov nepotistički interes za dobrobit kolateralnih srodnika. Drugi tip nasilja u obitelji je nebriga za ili ubojstvo djece od strane njihova nebiološkog roditelja (dakle, kada genetska povezanost također ne postoji). Prema autoru, raspoloživi podaci ukazuju da će nebiološki roditelj češće zlostavljati djecu, te se procjenjuje da djeca u SAD, koja žive s jednim ili oba nebiološka roditelja, imaju sto puta veću vjerojatnost da će biti fatalno zlostavljana nego djeca iste dobi koja žive s biološkim roditeljima.

Razmatra se i problem infanticida. U životinjskom svijetu, mužjaci ubijaju potomstvo drugih mužjaka kako bi utjecali da ženka brže uđe u fazu estrusa i s njima ima potomstvo. Kod ljudi se infanticid, premda rijetko, ipak javlja. Prema Triversovoj teoriji konflikta između roditelja i potomstva, između nas i naše djece postoji snažno natjecanje za resurse te je

infanticid tijekom većeg dijela naše evolucijske povijesti vjerojatno bio adaptivna strategija. Zbog pretpostavljene niske plodnosti i visokoga mortaliteta djece u lovačko-sakupljačkim zajednicama, podizanje defektne djece (za koju nije sigurno da će doseći spolnu zrelost) zacijelo se smatralo nečim što je suprotno reproduktivnim interesima žene. Predviđa se da će infanticid opadati sa starošću majke, jer se s godinama smanjuje njena reproduktivna vrijednost. U istome kontekstu se nastoji objasniti i tzv. postporođajnu depresiju, koju neki istraživači smatraju psihološkom adaptacijom koja majkama u lošim životnim okolnostima ili sa slabom kvalitetom potomstva olakšava infanticid. Dok su glavni razlozi za infanticid kod majke loše životne okolnosti i slaba kvaliteta potomstva, kod oca je glavni razlog infanticida sumnja u očinstvo odnosno briga za vlastitu reproduktivnu uspješnost. Do kraja poglavlja prikazano je istraživanje prema kojemu broj ubojstava vlastite djece opada s povećanjem njihove reproduktivne vrijednosti (od rođenja prema adolescenciji) te pokušaj reinterpretacije Edipova kompleksa u skladu s evolucijskim načelima.

U posljednjem poglavlju ("Umjesto zaključka") s pravom se oprezno naglašava da se pojedinci ne ponašaju uvijek prema adaptacionističkoj logici opisanoj u prethodnim poglavljima. Prikazana istraživanja, naime, govore o *prosječnom ponašanju* velikog broja pojedinaca, ne iznoseći predviđanja kako će se svaki pojedinac u određenoj situaciji obavezno ponašati. Prema autoru, psihološke adaptacije nisu dostupne našoj svijesti, niti su sva ponašanja adaptacije, tako da bi bilo pogrešno svaki mogući aspekt ljudskog ponašanja objašnjavati udaljenim evolucijskim razlozima. Na kraju knjige nalazi se objašnjenje ključnih pojmova i rječnik, preporučena literatura, popis korisnih Internet stranica i korištena literatura.

Spomenimo zaključno i neke prigovore koji bi se knjizi mogli uputiti. Na početku knjige sugerira se da je Darwinova teorija evolucije teorija koja najbolje objašnjava nastanak života na Zemlji. No donekle je neoprezno govoriti o Darwinovoj teoriji kao teoriji koja objašnjava *nastanak* života, budući da je kod Darwina osnovni problem bio problem *specijacije* ili *postanka novih vrsta*, a ne problem postanka života kao takvog. Nadalje, kada se u istom kontekstu ističe da je evolucija gradualni proces u kojem nema skokova, to je svakako *received view* koji podržava većina biologa, ali se moglo spomenuti i vrlo utjecajnu kritiku takvog shvaćanja koju

su 1972. iznijeli Gould i Eldredge u svojoj teoriji isprekidanih ravnoteža (*punctuated equilibria*). Eventualno se moglo spomenuti i (Popperov) prigovor da “preživljavanje najpodobnijih” (*survival of the fittest*) predstavlja tautologiju, a teorija evolucije neopovrgljivu teoriju, tim više što se taj prigovor i danas sporadično javlja u raspravama o metodološkom statusu sociobiologije i evolucijske psihologije.

Knjiga ima propedeutičko-popularni karakter i ne može obuhvatiti previše građe, ali možda se u razmatranju recipročnog altruizma moglo ukratko spomenuti teoriju igara, čiji modeli “Zatvorenikove dileme” i “Ponovljene zatvorenikove dileme” predstavljaju neizostavne segmente teoretskog razmatranja evolucije altruizma u populacijama nesrodnika. Ozbiljniji prigovor koji bi se mogao uputiti je neuvrštavanje barem kratkog razmatranja brojnih ozbiljnih *metodoloških* kritika sociobiologije i evolucijske psihologije. Vjerujem, naime, da je u knjizi trebalo spomenuti (makar u preporučenoj literaturi) poznati članak Goulda i Lewontina “The Spandrels of San Marco and the Panglossian Paradigm” (1979).

Na koncu, terminologija. Teško je pisati o disciplini koja tek ulazi u naše govorno područje, jer se mora ne samo korektno izložiti njene osnovne tvrdnje i argumente, nego se također treba “skovati” mnoštvo novih tehničkih izraza. Autor je u tom pogledu napisao jasan i čitak tekst u kojem je svaki termin adekvatno objašnjen. Eventualni prigovori: Mjestimično korištenje riječi “pojedinci” za englesku riječ “individuals” bilo bi možda bolje riješeno riječju “jedinke”, budući da “pojedinač” snažno asocira na *ljudsku* jedinku (muškog spola!), dok je “jedinka” neutralno i s obzirom na pripadnost vrsti i s obzirom na spol. Prevođenje “fitness” s “reproduktivna uspješnost” odnosno “inclusive fitness” s “ukupna reproduktivna uspješnost” je, doduše kontekstualno jasno, no možda ipak donekle nezgrapno te se možda moglo uzeti u obzir termine “podobnost” i “inkluzivna podobnost” (koje, primjerice, koristi Polšek u zborniku spomenutom na početku ovog prikaza).

Ovi prigovori, treba napomenuti, nisu krucijalni i ne umanjuju vrijednost knjige. Autoru treba čestitati na dobroj knjizi koja će biti korisna svim društveno-humanističkim znanstvenicima željnim interdisciplinarnog povezivanja različitih znanstvenih pristupa.

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## 2.1. TRANSLATION OF THE SOURCE TEXT 1

### IGOR KARDUM: EVOLUTION AND HUMAN BEHAVIOR

The author of the book *Evolution and Human Behavior*, as we find out from its cover, is an associate professor at the Department of Psychology at the Faculty of Humanities and Social Sciences in Rijeka, where he lectures courses in Evolutionary Psychology, Emotions and Motivation, and the History of Psychology. The book serves as an introduction to evolutionary psychology and basic models through which it explains some specific types of human behavior. Furthermore, the book's value lies in complementing a scarce selection of thematically similar publications in the Croatian language (it is worth mentioning a useful proceedings of *Sociobiology*, which was edited by Darko Polšek for the same publisher in 1997). The format and style of the four chapters in the book suggest that it is a propedeutical-popular reading that wants to familiarize readers with contemporary ideas of fusing the theory of evolution and psychology in an understandable way and to encourage further exploration.

Chapter one ("Introduction to Evolutionary Psychology") outlines a standard understanding of the theory of evolution (which requires variation, inheritance and selection) and warns to the non-teleological character of the evolutionary process and its gradual unfolding. The author mentions three issues that the theory of evolution has faced since its earliest days: (1) the problem of inheritance, (2) the problem of altruistic behavior, and (3) the problem of the existence of characteristics that appear to be impediments to successful survival. Problem (1) was solved thanks to Mendel's discovery of the law of inheritance. Two complementary solutions to problem (2) were offered by Hamilton (the theory of *total reproductive efficiency* which predicts the evolution of altruism in a population of close relatives) and Trivers (the theory of *reciprocal altruism*, which predicts the evolution of altruism in a non-relative population if there are several specific conditions that render non-altruistic behavior non-adaptive). Problem (3) - the existence of characteristics that appear to be adaptive impediments (a classic example is a peacock's tail that impedes movement and flight

from predators) – is solved by rehabilitation of *theory of sexual selection*, that is, Trivers' *differential parental investment theory* which claims that females are more selective when choosing a sexual partner because of their greater investment in progeny (fertilization takes place in her body, she goes through pregnancy and breastfeeding, has a limited number of sex cells, etc.) Due to the increase in female pickiness, there is also an increase in male competition to win a sexual partner and masculine features like peacock's tail evolve to *signal* to females that their wearer is a good, strong and a desirable sexual partner that is worth accepting as a father to their progeny.

Biology and psychology are scarce with fruitful contacts. The viewpoint that there is no need to know the evolution of our species for understanding human behavior dominates in the history of psychology. Darwinism was especially opposed by behaviorism, in which behavior was thought to be primarily the result of *the environment or learning* and that there is no greater impact of the inherited mechanisms. There came a resistance to behaviorism in 1960s that was greatly influenced by the development of ethology and a discipline entirely devoted to the study of the adaptive behavior of animals and humans called sociobiology, the dissemination (codification) of which is especially credited to E. O. Wilson with his book *Sociobiology: The New Synthesis* (1975). The book caused sharp criticism, most notably because of its claim that many *higher* characteristics of people are can be explained through evolutionary mechanisms. Sociobiology later grows (or is transformed) into evolutionary psychology, whose representatives (the most famous of which are Leda Cosmides and John Tooby) delve into traditional psychology and social sciences, naming them the *standard social science model* or SSSM.

SSSM considers social phenomena autonomous and explainable only through other social phenomena. An individual is considered to be exclusively a product of their culture, while biological factors are irrelevant because they are outweighed by the *capacity for culture*. Evolutionary psychologists consider many SSSM views to be *wrong*: for example, the view that only the socialization effect can explains certain psychological characteristics that have not been present since birth; the view that environmental and genetic factors are mutually

exclusive sets of influences, and the view that capacity for culture is a *general-purpose mechanism* that allows us to learn everything we require during socialization.

A more detailed introduction to evolutionary psychology begins with the consideration of Homo sapiens' evolution: by presenting the *multiregional model*, according to which Homo sapiens originated in parallel in different parts of the world from archaic Homo sapiens, and the *monogenetic model*, according to which modern humans originated in Africa from where they spread to other continents. Bearing this in mind, evolutionary psychologists point out the essential difference between the environment in which we have evolved and the environment in which we live today. We evolved in an environment called the Pleistocene (the epoch that began about 1.8 million years ago and ended about 11,000 years ago) in which people lived as hunter-gatherers, in groups of 25-100 people related by blood or marriage, with nomadic means of movement, the use of stone tools and with scarce possession of material goods. A further assumption of evolutionary psychology is that the human mind is a set of mechanisms located in the brain, designed to process information to solve the adaptive problems encountered by our ancestors. Information processing mechanisms (also known as *modules*) are *purpose-specific* psychological adaptations, which means that each solves just *one* problem. Evolutionary psychologists defend this claim by referring to the fact that general-purpose mechanisms have a limited value, and our ancestors did not encounter a single *general problem* but a series of *mutually different specific problems* (choosing a sexual partner, avoiding predators, choosing food, etc.). From these assumptions evolutionary psychologists conclude that our *modules*, which have evolved because they have successfully addressed adaptive problems in the environment of our ancestors, do not trigger necessarily adaptive behavior in the present. According to the author: "In our head there is a Stone Age human's brain and the key to understanding how it works is the premise that it is not designed to solve the everyday problems of modern humans, but for the everyday problems of our hunter-gatherer ancestors." Due to the speed of cultural evolution, our environment has changed rapidly and radically, and in many respects is different from the environment in which we have acquired most of our psychological adaptations that still work in *our heads*.



Chapter two ("Choosing a sexual partner and gender conflict") analyzes the notion that specific preferences for some characteristics of sexual partners (male and female) evolved because these characteristics have strongly contributed to survival and reproduction in the evolutionary past. After summarizing some of the hypotheses as to why sexual reproduction has evolved at all, the evolutionary importance of preferences according to the characteristics of a sexual partner is considered. Attention is drawn to the similarity of gender preferences and preferences for certain types of food: for example, a preference for a particular type of food assists in better nutrition and survival, a preference for certain characteristics of a sexual partner assists in a more successful reproduction (the evolutionary process, as it is known, consists not only of survival but also of reproduction, and it is important to choose a quality partner for successful reproduction).

In women, the following gender preferences are stated: 1. good financial perspective of the partner; 2. higher social status; 3. older men; 4. ambitious and productive men (all point to a man's possession or ability to own and retain valuable resources); 5. reliability and emotional stability (unreliable and emotionally unstable men tend to monopolize shared resources and tend to be jealous, violent and have sexual relationships with other women); 6. athletic appearance (important for protecting their offspring); 7. good health (important both for woman's health and for the health of their offspring, but also for the durability of the relationship which will not be broken by the premature death of the partner); 8. love (faithfulness or the desire to invest solely in his woman and their offspring); 9. readiness to invest in children. The two most common preferences in men are: 1. younger women (youth is a reliable sign of reproductive value) and 2. a certain physical appearance (physical appearance was the most reliable indicator of a woman's health and reproductive value). The presentation of the above preferences is accompanied by cross-cultural test data and analogies with the sexual behavior of other primates, which all must point to the fact that there is one, admittedly unconscious and hidden, yet active, adaptive logic inherited from our Pleistocene ancestors.

According to the author, "we can say with great certainty that our sexual psychology is adapted to the reproductive system, which is predominantly, but not exclusively, monogamous,

in which men are more prone to polygamy than women and in which both parents invest heavily in offspring. A seemingly trivial fact which significantly influenced the formation of such a reproductive system is the fact that ovulation is concealed in women. Unlike chimpanzees, in which the estrus phase (the phase of ovulation and maximal sexual receptivity) is accompanied by many visible signs, a woman's ovulation is concealed and sexual activity takes place throughout the ovulation cycle. Three hypotheses seek to explain the evolution of concealed ovulation; (1) concealed ovulation allowed the female sex to trade sex for food, or rather the ability to incessantly, and not just during estrus, trade sex for certain resources; (2) ovulation is concealed only for men and not for women, which allows them to get involved in an extramarital affair only with the man that they consider to be of higher reproductive quality, while simultaneously maintaining the parental care and ongoing investment of a partner who is convinced of their biological fatherhood; and (3) a hypothesis titled *dad at home*, according to which concealed ovulation is an adaptation that distracts a permanent partner from competitive polygamy and low investment in offspring and directs them toward monogamy and high investment. By the end of the chapter, a similar, evolutionary-logic-interwoven-explanation is presented for the tendency of short-lived relationships in women and men, followed by an explanation of jealousy, and finally an explanation for the existence of menopause in women.

Chapter three ("Conflicts and domestic violence") deals with the application of adaptationist logic to the area of conflict, violence and murder within families. Therein, of course, lies a paradox. According to Hamilton's *theory of total reproductive performance*, family and kinship relations are an area in which we expect less aggression, or greater tendency for altruism and cooperation. But, as the author points out, with the exception of the military and the police, the family is the most violent social group. Some evolutionary scenarios are as follows: Most common family homicide victims are spouses, between which exists no genetic linkage. They are, of course, bound by the interest in raising a common offspring, but the possibility of additional reproduction with other partners and the partner's nepotistic interest in the welfare of collateral relatives acts against the harmonious realization of that interest. Another type of domestic violence is when a non-biological parent lacks care for or murders

their child (therefore, again there is no genetic linkage). According to the author, available data indicates that non-biological parents are more likely to abuse children and it is estimated that children in the United States who live with one or both non-biological parents are a hundred times more likely to be fatally abused than children of the same age who live with their biological parents.

Also discussed is the problem of infanticide. In the animal kingdom, males kill another male's offspring in order to influence the female to enter the estrous phase faster and have offspring with them. In humans, infanticide, although rare, does occur. According to Trivers' theory of *parent-offspring conflict*, there is a strong competition for resources between us and our children and infanticide has probably been an adaptive strategy throughout much of our evolutionary history. Due to the presumed low fertility and high mortality of children in hunter-gatherer communities, raising defective children (who are not certain to reach sexual maturity) was certainly considered to be contrary to the reproductive interests of women. Infanticide is predicted to decline as the mother ages, because her reproductive value also decreases with age. In the same context, the author attempts to explain the so-called postpartum depression, which some researchers consider to be a psychological adaptation that facilitates infanticide for mothers in poor life circumstances or with poor offspring quality. While the main reasons for infanticide in mothers are poor living conditions and poor offspring quality, in fathers the main reason for infanticide is a doubt over paternity, or the concern for one's own reproductive performance. By the end of the chapter, the author shows a research according to which the number of children's homicides decreases when increasing their reproductive value (from birth to adolescence) and attempts to reinterpret the Oedipus complex in accordance with evolutionary principles.

In the last chapter ("Instead of a conclusion") the author rightly points out that individuals do not always behave according to the adaptationist logic described in the previous chapters. The research presented here deals with the average behavior of a large number of individuals, without making predictions about how each individual will behave in a particular situation. According to the author, psychological adaptations are not accessible to our

consciousness, nor are all behavioral adaptations, and therefore it would be wrong to explain every possible aspect of human behavior through distant evolutionary reasons. At the end of the book there is an explanation of key terms and vocabulary, recommended literature, a list of useful websites and source literature.

To conclude, we should mention some complaints that might be directed to this book. At the beginning of the book, the author suggests that Darwin's theory of evolution is the theory which best explains the origin of life on Earth. It is somewhat reckless to talk of Darwin's theory as the theory that explains the *origin* of life, since Darwin's fundamental problem was the problem of *speciation* or the *emergence of new species*, not the problem of life originating as such. Furthermore, the author points out that evolution is a gradual process in which there are no jumps, which is certainly a received view supported by most biologists, but one could also mention the very influential criticism of such a view made in 1972 by Gould and Eldredge in their theory of punctuated equilibrium (also called *punctuated equilibria*). Also mentioned could have been the (Popper's) objection that *survival of the fittest* is a tautology and that the theory of evolution presents an irrefutable theory, especially since this objection is still sporadically raised in discussions of the methodological status of sociobiology and evolutionary psychology.

The book has a propedeutical-popular character and as such it cannot cover too much material, but perhaps, while considering reciprocal altruism, the author could have briefly mentioned the game theory whose models of *Prisoner's Dilemmas* and *Repeated Prisoner's Dilemmas* represent indispensable segments when considering the evolution of altruism in non-relative populations. A more serious criticism could be made to the absence of at least a brief account of a number of serious methodological critiques of sociobiology and evolutionary psychology. I believe that the book should have mentioned (at least in the recommended literature) the famous article by Gould and Lewontin *The Spandrels of San Marco and the Panglossian Paradigm* (1979).

Lastly, the terminology. It is difficult to write about a discipline which is still in the process of entering our mainstream language, as not only its basic statements and arguments

must be properly presented, but also a number of new technical terms have to be coined. Bearing this in mind, the author has written a clear and straightforward text in which each term is explained adequately. Possible complaints: Occasional use of the word *pojedinici* for the English word *individuals* whereas it might be better had the author used the word *jedinke*, since *pojedinici* is strongly associated with the (male!) human individual, while *jedinke* is neutral both in terms of species and gender. Translating *fitness* with *reproduktivna uspješnost* or *inclusive fitness* with *ukupna reproduktivna uspješnost* is, albeit contextually clear, somewhat cumbersome. Perhaps the author could have considered terms such as *podobnost* and *inkluzivna podobnost* (which are, for example, used by Polšek in the proceedings mentioned at the beginning of this review).

It should be noted that these critiques are not crucial and do not detract from the value of the book. The author should be congratulated on a good book which will be useful to all socio-humanist scholars eager for the interdisciplinary integration of different scientific approaches.

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## 2.2. COMMENTARY AND ANALYSIS

### EVOLUTION AND HUMAN BEHAVIOR

**1. genre:** book review, scientific

**2. source:** article in Prolegomena: Journal of Philosophy

**3. audience:** socio-humanist scholars, biologists, evolutionary biologists, scientific community, general audience interested in the book

**4. purpose of writing:** to express opinion on the book *Evolution and Human Behavior*, to give constructive criticism, and to inform the audience about the aforementioned work

**5. authenticity:** original article, review written by Tomislav Bračanović who works at the University Department of Croatian Studies

**6. style:** using field specific terminology, albeit clear and comprehensible

**7. level of formality:** formal

**8. layout:** the text starts with the title which mentions the title of the book being reviewed, its author and the publisher. The review is written in 17 paragraphs which vary in their size. Information about the author is provided at the end of the text.

**9. content:** the first paragraph serves as an introduction in which the author provides information about Igor Kardum, his book and his former works. The following paragraphs discuss the content found in the four chapters of *Evolution and human behavior*, starting with the definition of the theory of evolution, the problems that the theory faces, brief history of psychology, standard social science model, evolutionary biology, evolution of sexual preferences, conflicts and violence in family. To conclude his review, the author provides some constructive criticism and additional literature to further explore this topic.

**10. cohesion:** the author creates a lexical cohesion through the use of field related jargon

**11. sentence patterns:** the review is written in the present tense and the author often uses long and complex sentences.

**12. terminology of the subject:** use of terms such as: *total reproductive efficiency*, *reciprocal altruism*, *adaptive impediments*, *multiregional model*, *monogenetic model*, *punctuated equilibria*

In order to retain the original meaning of the text, I had to provide accurate sense-for-sense translation, which was challenging due to the terminology and sentence structure. This meant that I had to research different terms and concepts related to the topic of evolutionary biology in order to provide accurate translations.

For example, to translate *zakon nasljeđivanja*, I had to research Gregor Mendel's inheritance theory, also known as *Mendelian inheritance*. I followed the same process for terms such as the theory of *total reproductive efficiency* by Hamilton or the theory of *reciprocal altruism* by Trivers. The text contains many similar theories and models which had to be researched in order to accurately translate them to the English language.

Also problematic were some phrases such as *adaptivne smetnje*. In the context of the sentence, this phrase relates to the features evolved by some species which, to some extent, hinder their chance of survival. I couldn't find any similar term used in the English language, so I opted for *adaptive impediments*, a phrase which provides a similar meaning in the context of the sentence.

The term *skrivena ovulacija* was a completely new term for me and it also required research in order for it to make sense in the English language. Through an article which discusses monogamy in humans, I have found that the correct way of translating this was *concealed ovulation* or *hidden estrus*. Both terms imply the lack of any perceptible change in women while ovulating.

Another term which was somewhat harder to translate was *postanak novih vrsta*. While researching, I concluded that it would be wrong to translate it as *origin of new species*, because species diverge from their common ancestor and evolve through processes spanning millions of

years so it is hard to determine the exact point when a new species originated. Also, in English language it is common to use the word *origin* when discussing the origin of life, a one-time event which started the whole process of speciation. Bearing this in mind, I opted to translate *postanak novih vrsta* as *emergence of new species*, in order to avoid using the word *origin*.

While commenting on the second chapter, the author mentions that “*Do kraja poglavlja prikazuje se slično, evolucijskom logikom protkano objašnjenje sklonosti kratkotrajnim vezama (...)*” In order to retain the word *protkano*, I had to approach this sentence from a different angle, so I had to provide a more creative solution. Ultimately I chose to translate *evolucijskom logikom protkano objašnjenje* with hyphens in order to retain the same sense, while still maintaining a similar style to the source text. In the end, I opted to translate the sentence as “*By the end of the chapter, a similar, evolutionary-logic-interwoven-explanation is presented for the tendency of short-lived relationships (...)*”.



### 3. SOURCE TEXT 2

#### ELEMENTI I ELEMENTARNE TVARI

NENAD RAOS

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##### Sažetak

Rad se bavi razvojem pojma elementa od antičkih vremena (Empedoklo, Aristotel) preko razdoblja alkemije i rane kemije (Paracelsus, Petar Bono, Boyle) te početaka moderne kemije (Lavoisier, Mendeljejev) do suvremenih shvaćanja utemeljenih na atomskoj teoriji. Pokazuje se da pojam elementa ima dva značenja, elementarne (jednostavne) tvari i elementa u užem smislu; dok se prvi pojam razvijao prateći napredak metoda kemijske analize, za razumijevanje drugog pojma, pojma elementa, bilo je nužno steći dublji uvid u narav kemijskih promjena.

##### Ključne riječi

Nastava kemije, povijest kemije, filozofija kemije, periodni sustav elemenata

##### Uvod

Pojam elementa i elementarne tvari novijeg je datuma; točnije rečeno, riječ "element" nekoć je pokrivala oba značenja.<sup>1</sup> Tako primjerice srednjoškolski udžbenik iz 1942. godine kaže o elementu ovo:

*Takve jednostavne tvari, koje se ne mogu dalje rastavljati na još jednostavnije, zovu se **počela ili elementi** (lat. počela).*

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<sup>1</sup> "In certain languages, a clear distinction is made between the term 'element' and 'elementary substance'. In English it is not customary to make such a nice distinction, and the word 'atom' is sometimes also used interchangeably with element or elementary substance. Particular care should be exercised in the use and comprehension of these terms." (ref. 26). Latinska riječ elementa (množina od elementum) isprva je značila slova, prvi nauk u čitanju i pisanju, no isto tako početak, izvor i uzrok u drugim stvarima. Tek kasnije poprima značenje grčke riječi stoicheion – prirodna sila, stihija (elementarna nepogoda): vatra, voda, zemlja, zrak.

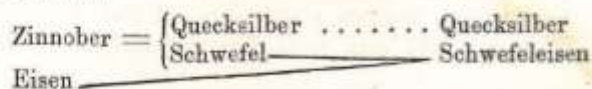
Stoga bi navedena definicija “počela ili elementa” više odgovarala suvremenom pojmu elementarna tvar. Wiberg pak u sveučilišnom udžbeniku daje tri definicije “elementa”:

- *Za razliku od hidrargirum-oksida tvori živa i oksigen ne mogu se dalje rastaviti nikakvim uobičajenim fizikalnim i kemijskim metodama. Takve se tvori nazivaju “**elementi**” za razliku od “**spojeva**” kao što je hidrargirum-oksid, koji se može dalje rastaviti (str. 10).*
- *Elementi: molekule su izgrađene od jedne jedine vrsti atoma (str. 21).*
- *Na pređašnjim stranicama prikazana nauka o građi atomskih jezgara omogućuje sada nešto egzaktnije formuliranje pojma elementa: Element je tvar koje svi atomi imaju isti naboj jezgre (str. 655).*

Iako se posljednja definicija, “egzaktnije formuliranje pojma elementa”, donekle približava pojmu elementa, sve one zapravo govore o elementarnoj tvari. No isto tako vidimo da za pojam elementa, u smislu elementarne tvori, nije nužna atomska teorija, dapače nikakva teorija o građi tvori, jer je riječ o čisto empirijskom pojmu (slika 1). Tako, primjerice, sveučilišni udžbenik anorganske kemije iz 19. stoljeća izričito kaže da je jednostavnost “tijela” (čiste tvori) relativna (*Es ist daher die Einfachheit der Körper nur ein relativer Begriff...*), jer ovisi o tome koliko su kemičari uspješni u analizi. Pritom navodi primjer kalijeva hidroksida (Kali), za koji se mislilo da je “jednostavno tijelo” sve dok ga Davy nije 1807. elektrolizom rastavio na još jednostavnija “tijela”, naime na kisik i dotad nepoznat metal – kalij. Prije toga istu su sudbinu doživjeli “elementi” zrak i voda: zrak je prestao biti elementom otkrićem plinova (kisika, dušika, ugljikova dioksida), a voda analizom (elektrolizom) i sintezom iz elemenata. Da je autor mogao zaviriti u budućnost, vidio bi da su i kemijski elementi “složene tvori” jer se mogu rastaviti na protone, neutrone i elektrone a ovi opet – prema standardnoj teoriji – na šest kvarkova i šest leptona, pa stoga pojam elementa ovisi o snazi analitičke metode ili, točnije, o snazi reagensa kojim znanost raspolaze (toplina, kiselina, baza, elektron...). Toga su bili svjesni i pisci modernijih udžbenika, pa naglašavaju razliku između kemijskih i fizičkih metoda rastavljanja:

*Elementi dolaze kao sastavni dijelovi složenih tvori, i u slobodnom stanju stvaraju proste tvori, koje se ne mogu kemijski rastaviti niti dobiti spajanjem.*

Bereits weiter oben wurde erwähnt, dass die Bestandtheile derjenigen chemischen Verbindung, die wir Zinnober nennen, Schwefel und Quecksilber seien. Wenn wir mit Zinnober unter geeigneten Bedingungen Eisen in Berührung bringen, so wird der Zinnober zersetzt, d. h. der Schwefel desselben vereinigt sich mit dem Eisen, da er zu diesem eine stärkere Verwandtschaft besitzt als Quecksilber, und letzteres wird daher in Freiheit gesetzt:



Zinnober und Eisen geben sonach einen Körper, der Schwefeleisen heisst, und Quecksilber.

Slika 1 – Shema analize i sinteze živina i željezova oksida iz elementarne tvari (ref. 3, str. 35)

Fig. 1 – Scheme of the analysis and synthesis of mercury and iron oxide from simplesubstances (Ref. 3, p. 35)

*Živu i kiseonik ne možemo više hemiskim putem rastaviti u jednostavnije (prostije) materije (supstancije). Takve supstancije zovemo hemiskim elementima.*

Tim definicijama, a još više onoj Wibergovoj (“nikakvim uobičajenim fizikalnim i kemijskim metodama”) ipak bismo mogli zamjeriti na cirkularnosti jer iz njih proizlazi da su “uobičajene metode” i “hemiski putevi” upravo oni postupci kojima se elementi ne mogu rastaviti na još jednostavnije tvari.

### Element kao nositelj svojstava

Ima jedna misao koja se provlači kroz nebrojne kemijske udžbenike, a to je da je otac teorije o elementima grčki filozof Empedoklo (oko 450 pr. Kr.) iz Akragasa na Siciliji. Prema njemu, postoje četiri elementa (*stoiheia*) – vatra, voda, zemlja i zrak – koji su nenastali, neuništivi i nepromjenjivi, no beskonačno djeljivi. Njih čas prijateljstvo (*filia*) spaja, čas neprijateljstvo, svađa (*neikos*) razdvaja. No sa zaključcima ipak ne treba ići predaleko. Empedoklova teorija daleko je od suvremene, atomističke teorije o elementima. To je prije svega zbog toga što grčki filozof negira postojanje praznog prostora, pa stoga i postojanje atoma (nedjeljivih čestica); spajanje (miješanje) elemenata objašnjava postojanjem pora:

*Oni koji su postavljali hipotezu o porama, znamo da ih nisu zamišljali praznima, nego punima neke tjelesne tvari sastavljene od finijih čestica, kao što je zrak. U tome su se naime razlikovali od onih koji su pretpostavljali postojanje praznoga.*

Usto treba reći da je Empedoklo bio sljedbenik Pitagore, pa je Empedoklova teorija prirode opterećena mistikom brojeva njegova učitelja. Četiri elementa nisu izabrana zato što bi to najviše odgovaralo prirodnom stanju stvari (kineska alkemija poznaje primjerice pet elemenata: voda, zemlja, vatra, drvo i metal), nego zbog broja četiri, Pitagorina svetog broja (koji je, prema Jungu, arhetip cjelovitosti). Štoviše, Empedoklo daje svojim elementima mitska imena, identificirajući ih s božanstvima: Zeus (vatra), Hera (zemlja), Had (zrak) i Nestis (voda).<sup>9</sup> No u učenju se grčkog filozofa nazire ideja povezivanja četiriju elemenata s četirima kvalitetama (toplo, hladno, suho i vlažno), koju će potom Aristotel dovesti do zrele teorije o naravni tvari.

Za Aristotela četiri elementa – voda, zemlja, vatra i zrak – nisu konkretne tvari, njegov zrak nije zrak koji udišemo niti je Aristotelova voda ona voda koju pijemo. Bit njegove teorije materije je shvaćanje elemenata kao apstraktnih nositelja kvaliteta. Elemente tog grčkog filozofa stoga ne trebamo shvaćati u modernom smislu, kao nešto od čega je sve sastavljeno ili nešto na što se sve može rastaviti, nego kao definirana stanja materije. Materija (*hyle*) je za Aristotela ono u prirodi što daje mogućnost (grč. *dynamis*, lat. *potentia*) preobrazbe. Drugim riječima, materija je ono što pruža mogućnost da se nešto preobrazi u nešto drugo – baš kao što se od drvene građe (što je osnovno značenje riječi *hyle*) može sagraditi bilo koji i bilo kakav brod, premda drvena građa sama po sebi nije brod. No da bi materija prešla iz potencijalnosti u aktualnost, mora poprimiti odgovarajući oblik (grč. *morphe*, eidos, lat. *forma*).<sup>2</sup> Aristotel pronalazi četiri temeljne, opipljive forme, temeljna svojstva svake tvari: toplo, hladno, vlažno i suho. Poprimi li materija svojstva topline i suhoće, postaje vatrom, poprimi li pak svojstva topline i vlažnosti, postaje zrakom, dok kombinacija hladnoga i suhoga daje zemlju, a hladnoga i vlažnoga vodu.

Elementi za Aristotela nisu, kao za Empedokla, nepromjenjivi. Oni prelaze jedan u drugi promjenom forme (npr. voda u zrak promjenom hladnoga u toplo). Elementi, kao i tvari, nastaju

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<sup>2</sup> Materija i forma su, uz svrhu i načelo kretanja, Aristotelovi uzroci (*causa materialis*, *causa formalis*, *causa finalis* i *causa efficiens*).

združivanjem materije i forme, oblikovanjem one prve posve bezlične materije, pratvari, koju je Aristotel zvao *prote hyle* (prva tvar), a njegovi srednjovjekovni sljedbenici *materia prima*. No za grčkog filozofa *materia prima* kao takva ne postoji u prirodi, jer ništa ne može postojati a da nema neko svojstvo, neku formu. (Po tome se razlikovao od alkemičara koji su upravo u pratvari vidjeli tvar koja najlakše poprima formu zlata.) Za Aristotela je *prote hyle* samo apstrakcija, ono neopipljivo što leži u korijenu svega opipljivoga. Stoga bi pratvar – a ne Aristotelovi elementi – bila bliža pojmu elementa kako ga danas shvaćamo. Element je ono što omogućuje tvari da bude ono što jest.

Aristotelova je teorija postala temeljem alkemije, ali ne u smislu njezina doktrinarnog prihvaćanja, nego u preuzimanju stava da je tvar nositelj kvaliteta – element je nositelj osnovnih, da ne kažem elementarnih svojstava. Stoga, arapsku teoriju da se svi metali sastoje od žive i sumpora, ne smijemo shvaćati naivno, tj. u modernom smislu, naime tako da se spajanjem žive i sumpora može dobiti bakar ili željezo (alkemičari su se jamačno mogli i sami uvjeriti da to tako ne ide). Ono što se živino-sumpornom teorijom htjelo reći je da se metali razlikuju od drugih tvari po taljivosti i zapaljivosti, tj. mogućnosti oksidacije, ovapnjenja (kalcinacije). Živa je nositelj svojstva taljivosti (jer je stalno rastaljena i ne može se skrutnuti), a sumpor nositelj svojstva zapaljivosti, jer je to tvar koja se najlakše pali i najviše dimi. I Paracelsusova teorija o tri principa ili korijena tvari (*tria prima*) slijedi tu logiku: živa je princip žitkog i hlapljivog, sumpor upaljivog i gorivog a sol krutog i vatrostalnog.

Svojevrsnu razradu živino-sumporne teorije vidimo u djelu *Pretiosa margarita novella* (Skupocjeni novi biser) istarskog liječnika Petra Bona (Petrus Bonus), koje je napisano u Puli 1330. godine, no tiskano je istom u 16. stoljeću.<sup>12</sup> Prema Bonu ne postoji jedan sumpor, nego dva, vanjski i unutarnji. Vanjski je sumpor nečist, gust i zapaljiv, dok je unutarnji fin i nesagoriv te se nikada ne odvaja od žive. Ta mu je pretpostavka bila nužna kako bi živino-sumpornu teoriju uskladio s učenjem o kamenu mudraca. Djelovanje tog “kemijskog reagensa” svodi se na čišćenje metala od vanjskog sumpora, da bi se potom unutarnji sumpor i živa sjedinili – budući da se slično spaja sa sličnim – i pretvorili u zlato. Iz toga slijedi zaključak: vanjski sumpor je (elementarna) tvar, a živa i unutarnji sumpor principi, dakle elementi.

## Element kao elementarna tvar

Shvaćanje elementa kao elementarne tvari dolazi nam s kemijom, točnije s prvim modernim kemijskim udžbenikom, Lavoisierovim *Treité élémentaire de chimie*, izdanim 1789. godine (str. 506 – 511). U njemu nalazimo “tablicu jednostavnih tvari” (*Tableu des substances simples*), u kojoj autor navodi 35 tvari koje se ne mogu razložiti na jednostavnije (slika 2).

	Noms nouveaux.	Noms anciens correspondans.	
Substances simples qui appartiennent aux trois règnes - fr quo'on peut regarder comme les élémens des corps.	Lumière .....	Lumière.	
	Calorique .....	Chaleur.	
		Principe de la chaleur.	
	Oxygène .....	Fluide igné.	
		Feu.	
		Matière du feu & de la chaleur.	
		Air déphlogistique.	
		Air vital.	
	Azote .....	Base de l'air vital.	
		Gaz phlogistique.	
Mofète.			
Hydrogène .....	Base de la mofète.		
	Gaz inflammable.		
Substances simples non métalliques & acidifiables.	Soufre .....	Base du gaz inflammable.	
		Soufre.	
	Phosphore .....	Phosphore.	
	Carbone .....	Charbon pur.	
	Radical muriatique ..	Inconnu.	
	Radical fluorique ..	Inconnu.	
	Radical boracique ..	Inconnu.	
	Antimoine .....	Antimoine.	
	Argent .....	Argent.	
	Arsenic .....	Arsenic.	
	Bismuth .....	Bismuth.	
	Cobalt .....	Cobalt.	
	Cuivre .....	Cuivre.	
	Etain .....	Etain.	
	Fer .....	Fer.	
	Substances simples métalliques & acidifiables.	Manganèse .....	Manganèse.
		Mercure .....	Mercure.
Molybdène .....		Molybdène.	
Nickel .....		Nickel.	
Or .....		Or.	
Platine .....		Platine.	
Plomb .....		Plomb.	
Tungstène .....		Tungstène.	
Zinc .....		Zinc.	
Substances simples & acidifiables terreuses.		Chaux .....	Terre calcaire, chaux.
	Magnésie .....	Magnésie, base du sel d'épsum.	
	Baryte .....	Baryte, terre pesante.	
	Alumine .....	Argile, terre de l'alun, base de l'alun.	
Silice .....	Terre siliceuse, terre vitrifiable.		

Slika 2 – Tablica elemenata (jednostavnih tvari) iz Lavoisierova udžbenika *Treité élémentaire de chimie*, 1789.

Fig. 2 – Table of the elements (simple substances) from Lavoisier's textbook *Traité élémentaire de chimie*, published 1789.

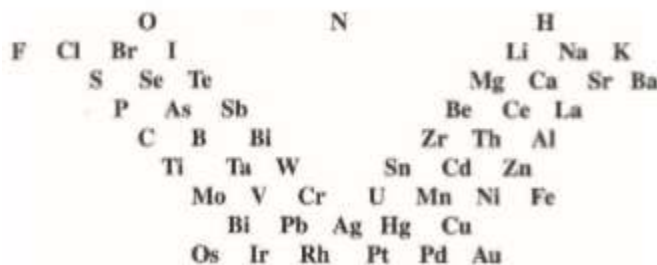
Uz 23 tvari koje danas smatramo elementarnim – kisik (*oxygène*), vodik (*hydrogène*), dušik (*azote*) uz sumpor (*soufre*), fosfor (*phosphore*), željezo (*fer*), srebro (*argent*), zlato (*or*) te druge metale i nemetale – nalazimo svjetlost (*lumière*) i toplinu (*calorique*) te tvari koje su očito kemijski spojevi. To su “zemljaste tvari od kojih se mogu prirediti soli” (*substances simples salifiables terreufes*). Riječ je o oksidima još nepoznatih elemenata: magnezija (*magnésie*), barija (*baryte*), aluminijska (*alumine*) i silicij (*silice*). Tu su još i “radikali” kiselina – klorovodične, fluorovodične i borne – dakle kiselina nemetala koji još nisu izdvojeni u elementarnom stanju. Lavoisier je bio svjestan privremenosti svoje tablice, njezine čisto empirijske naravi. “Te su tvari očito sastavljene, iako se još ne zna narav principa (=elementa) koji je u njima spojen”, jasno je napisao.

Iz navedenog bi se moglo zaključiti da se francuski kemičar ne bavi elementom kao principom, nevidljivim nositeljem svojstava tvari. No nije baš tako. Njegova izvorna teorija gorenja pretpostavlja postojanje kisika (*oxygène*) kao “jednostavne tvari”, no samo postojanje plina u kojem tvari gore brže nego u zraku ne objašnjava proces gorenja. Plinoviti, reaktivni kisik sastoji se naime od “baze zraka” (*base de l'air*) 13 otopljen u “tvari vatre” (*matière de fu*), koja se oslobađa kemijskom reakcijom u obliku fluida svjetlosti i topline (kalorika), dok se “baza zraka” spaja s gorivom tvari. Stoga bismo mogli reći da je “baza zraka” element, a kisik (*oxygène*) elementarna tvar.

No kada se do kraja Lavoisierova “opća teorija gorenja” iščita do kraja, ne može se reći drugo nego da se tumačenje gorenja kao spajanja s kisikom temelji na vaganju i mjerenju, dakle na eksperimentu, dok je uvođenje “tvari vatre” i kemijskih elementa bez mase (svjetlosti i kalorika) samo pokušaj objašnjenja zašto se u kemijskoj reakciji oslobađa energija. Pri tome se Lavoisier oslanjao na tadašnje fizičke teorije, posebice teorije plinova pa je i sâm objašnjavao njihovu elastičnost i malu gustoću postojanjem “tvari vatre”. No pritom je očito bio nesvjestan činjenice da baš tako uvodi, na mala vrata, flogistonsku teoriju koju je svojom novom teorijom gorenja pobijao.

## Element i periodni sustav

Otkriće periodnog sustava elemenata izazvalo je mnoge kontroverze, ne samo zbog rivalstva Germana (Julius Lothar Meyer) i Slavena (Dmitrij Ivanovič Mendeljejev) – iako su oba kemičara za to otkriće dobila Davyjevu medalju 1882. godine – nego i zbog mnogo istraživača koji su bili na tragu velikog otkrića (slika 3). Iako američki povjesničar znanosti Eric R. Scerri navodi čak šest suotkrivača periodnog sustava (A. E. Béguyer de Chancourtois, J. Newlands, W. Odling, G. Hindricks, uz spomenuta dva kemičara) te upravo u periodnom sustavu vidi primjer kolektivnog otkrića koje razvija znanost kroz evoluciju a ne revoluciju (opirući se tako tezi Thomasa Kuhna), ipak priznaje da je za otkriće periodnog sustava najzaslužniji Mendeljejev. Nije to samo zato što je ruski kemičar bio najuporniji u razvijanju i propagiranju periodnog sustava, niti zato što je predvidio postojanje dotad nepoznatih elemenata (galija, germanija i skandija), nego prije zbog toga jer je postavio teorijske temelje periodnog zakona. Te je temelje izložio u osam točaka, od kojih je možda najvažnija ona peta (str. 746): “Veličina atomske težine određuje narav elementa, baš kao što veličina molekule određuje narav složenoga tijela (kemijskog spoja).”



Slika 3 – Prva preteča periodnog sustava: Gmelinovo razvrstavanje elemenata, 1843.

Fig. 3 – The first forerunner of the periodic system: Gmelin's system of the elements, 1843

No bez obzira na navedene činjenice, pa čak i na eksplicitno formuliranje periodnog zakona,<sup>3</sup> Scerri ističe kako je Mendeljejev došao do periodnog sustava zahvaljujući lucidnom razlikovanju

<sup>3</sup> Свойства простых тел, также формы и свойства соединений элементов, находятся в периодической зависимости (или, выражаясь алгебраически, образуют периодическую функцию) от величины атомных весов элементов. (Svojstva jednostavnih tijela, a također forme i svojstva spojeva elemenata, nalaze se u periodičkoj ovisnosti (ili, izrazivši se algebarski, čine periodičnu funkciju) o veličini atomskih težina elemenata.)



pojmovna elementa i elementarne tvari. Za ruskog kemičara element nije tvar, fizičko biće, nego unutarnja bit elementarne tvari. Zbog važnosti te teze ona zavrjeđuje citiranje u cijelosti, onako kako je objašnjena u Mendeljevjevom udžbenku:

*Prikladno je u tom smislu napraviti jasnu razliku između pojma elementa, kao **izdvojene** homogene tvari, i kao **materijalnog** no nevidljivog dijela spoja. Živin oksid ne sadržava dva jednostavna tijela, plin i metal, nego dva elementa, živu i kisik, koji, kada su slobodni, jesu plin i metal. Niti se živa kao metal niti kisik kao plin nalaze u živinom oksidu; on sadržava samo supstanciju elemenata, baš kao što para sadržava supstanciju leda, ali ne i sam led, ili kao što zrno sadržava supstanciju sjemena iako nije sjeme.*

Jasno razlikovanja elementa (“nevidljivog dijela spoja”) od elementarne tvari (“izdvojene homogene tvari”) omogućila je Mendeljejevu da postavi čvrst temelj periodnom sustavu. Jer periodni sustav nije sustav elementarnih tvari, nego baš elemenata – čija se “supstancija” očituje upravo u fizičkim i kemijskim svojstvima spojeva. (Živa je u živinom oksidu nevidljiva, baš kao što je željezo nevidljivo u oksidu željeza, no dva se oksida ipak razlikuju po svojstvima – upravo zbog različite naravi njihove metalne “supstancije”.)

## **Zaključak**

Razlikovati element od elementarne tvari iz gledišta atomske teorije nije lako. Kažemo li, jednostavno, da je elementarna tvar tvar sastavljena od istovrsnih atoma, dolazimo do (pre)široke definicije koja ne definira ništa drugo osim rezultata elementne analize. Ozon se vrlo razlikuje od molekularnog kisika (O<sub>2</sub>), da ne govorimo o bezbrojnim alotropskim modifikacijama ugljika (grafit, dijamant, grafen, fulereni, nanotubule...), za koje bismo mogli reći da otvaraju jedno novo i vrlo bogato područje kemije. Uključimo li u elementarne tvari još i atomske ione, jer i oni se sastoje od jedne vrste atoma, postaje nam jasnije čime su određena kako kemijska tako i fizička svojstva čiste tvari bez obzira na sastav. Očito je da svojstva i elementarne tvari i kemijskog spoja ne ovise samo o vrsti ili vrstama atoma od kojih su izgrađeni nego i o kemijskoj vezi među atomima ili – preciznije – o molekularnoj ili kristalnoj strukturi. No unatoč tome, “materijalni no nevidljivi dio” tvari (da citiramo Mendeljejeva) ostaje nepromijenjen. Taj “materijalni no nevidljivi dio” je upravo atom, ili – točnije – njegova jezgra. Na to upućuje i

službena, IUPAC-ova definicija kemijskog elementa: “1. Vrsta atoma; svi atomi s istim brojem protona u atomskoj jezgri (1. A species of atoms; all atoms with the same number of protons in the atomic nucleus)”, iako puna definicija uključuje i značenje “elementa” kao elementarne tvari.<sup>4</sup>

O naboju jezgre (protonskom broju) ovisi konfiguracija elektronskog omotača, a o elektronskoj konfiguraciji ovise pak sva kemijska i fizička svojstva atoma. Stoga bi prava definicija elementa bila “materijalna no nevidljiva” valna funkcija atoma određenog protonskog broja. Ili, drugim riječima, elementarna tvar je čista tvar homogenog sastava, dok pojam elementa ukazuje na mogućnost kemijskog spajanja. Time se moderna definicija elementa približava aristotelovskom pojmu materije (*hyle*), kao mogućnosti prihvaćanja (aktualizacije) forme. Da budem konkretniji a time i jasniji, reći ću da *hyle* Na može poprimiti *forme* Na<sub>2</sub>, NaCl, NaH, NaHCO<sub>3</sub> i još mnoge druge, no *potencija* Na ipak je ograničena njegovom elektronskom konfiguracijom, pa se stoga ne može aktualizirati u obliku NaO<sub>5</sub> ili NaFCl. Postoji dakako materija koja ima veću “sposobnost ostvarenja” od atoma natrija: od samo tri vrste materije – protona, neutrona i elektrona – mogu se napraviti atomi svih kemijskih elementa i dakako sve njihove kombinacije, svi kemijski spojevi. Mogli bismo reći da fizika danas teži onome čemu su težili alkemičari: pronaći pratvar (*materia prima*), materiju koja će se moći aktualizirati u svakoj formi. To bi bila interpretacija suvremene znanosti iz perspektive Aristotelove filozofije prirode (fizike).

Na kraju ovog članka treba reći da razlikovanje elementa od elementarne tvari nema samo praktično nego, još više, načelno, pravo rečeno filozofsko značenje. Stoga bi razmatranje tih pojmova na satu kemije bio dobar uvod u filozofiju znanosti, posebice filozofiju kemije, područja analitičke filozofije koje se tek počelo razvijati. Ujedno bi mogao biti dobar primjer kako je teško postavljati definicije u kemiji i prirodnim (egzaktnim) znanostima općenito. Strogo govoreći, definicije su moguće samo u matematici (apodiktički sudovi), ali ne i u empirijskim znanostima, znanostima koje se temelje na asertornim sudovima: labud je bijela ptica dok se ne pojavi crni labud. Definicije u znanosti podložne su stalnim promjenama budući da moraju biti u

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<sup>4</sup> A pure chemical substance composed of atoms with the same number of protons in the atomic nucleus. Sometimes this concept is called the elementary substance as distinct from the chemical element as defined under 1, but mostly the term chemical element is used for both concepts.” Tu su definiciju međutim kritizirali Portada i Stilinović (ref. 23) smatrajući da bi se pojam elementa trebao ograničiti na prvu definiciju.

skladu s novim spoznajama, novim otkrićima. S obzirom na sve veći broj molekula sve raznolikije strukture umjesno je upitati se imaju li pojmovi kemijskog elementa i elementarne tvari onaj smisao, a posebice važnost za kemičara kakvu su imali u 19. stoljeću, kada su nastali. (Je li prikladna definicija elementarnih tvari kao “supstancija koje se ne mogu kemijskim putem rastaviti na jednostavnije komponente”, ako znamo da se kisik i ozon mogu rastaviti na atome, atomski kisik?) Ne bi li umjesto “spojevi” i “elementarne tvari” bilo primjerenije govoriti homogeni i heterogeni spojevi (molekule, ioni)?

### 3.1. TRANSLATION OF THE SOURCE TEXT 2

#### ELEMENTS AND ELEMENTARY SUBSTANCES NENAD RAOS

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##### **Abstract**

This paper deals with the development of the term *element* since the ancient times (Empedocles, Aristotle) through the period of alchemy and early chemistry (Paracelsus, Petrus Bonus, Boyle) and the beginnings of modern chemistry (Lavoisier, Mendeleev) to modern understandings based on atomic theory. The term element is shown to have two meanings, elementary (simple) substance and element in the narrow sense. While the first term developed by following the advancement of chemical analysis methods, in order to understand the second term, element, it was necessary to gain a deeper insight into the nature of chemical change.

##### **Key words**

Chemistry education, history of chemistry, philosophy of chemistry, periodic table of elements

##### **Introduction**

The term element and elementary substance is a recent addition; more specifically, the word *element* once covered both meanings.<sup>5</sup> So, for example, this is what a 1942 high school

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<sup>5</sup> In certain languages, a clear distinction is made between the term 'element' and 'elementary substance'. In English it is not customary to make such a nice distinction, and the word 'atom' is sometimes also used interchangeably with element or elementary substance. Particular care should be exercised in the use and comprehension of these terms. Latin word *elementa* (plural of *elementum*) at first meant letters, the first study of reading and writing, but also beginning, source, and cause in other things. Later it takes on the meaning of the Greek word *stoicheion* – the force of nature, *stoicheía* (natural disaster): fire, water, earth, air.

textbook says about the element: Such simple substances, which cannot be further broken down into simpler ones, are called **elements** or *lat. počela*.

Therefore, the aforementioned definition of *elements* or *počela* would be more appropriate with the modern term elementary substance. Wiberg, however, provides three definitions of the term *element* in his university textbook:

- Unlike hydrargyrum oxide, mercury and oxygen cannot be further separated by any conventional physical or chemical methods. Such substances are called **elements** as opposed to **compounds** such as hydrargyrum oxide, which can be further separated (p. 10).
- *Elements*: molecules are made up of a single type of atom (p.21).
- *Knowledge of the structure of atomic nuclei presented earlier enables us to formulate a more precise definition of an element: An element is a substance in which all atoms have the same nucleus charge*

Although the previous definition which ‘formulates a more precise definition of an element’ comes somewhat close to defining the term element, all aforementioned definitions are actually about the term elementary substance. We can also see that the concept of an element, in terms of elemental substance, does not require atomic theory. Furthermore it requires no theory of the structure of the substance, because it is a purely empirical term (fig. 1). Thus, for example, a 19th-century university textbook of inorganic chemistry explicitly states that the simplicity of a *body* (pure substance) is relative (Es ist daher die Einfachheit der Körper nur ein relativer Begriff...) because it depends on the quality of the chemists’ analysis. He cites the example of potassium hydroxide (*Kali*) which was thought to be a *simple body* until Davy separated it into even simpler *bodies* (oxygen and previously unknown metal – potassium) through the process of electrolysis. Previously, the *elements* of air and water suffered the same fate: air ceased to be an element with the discovery of gasses (oxygen, nitrogen, carbon dioxide) and water through analysis (electrolysis) and synthesis from elements. If the author could have peered into the future, he would have seen that chemical elements are also *complex substances* because they can be separated into protons, neutrons and electrons, and

these again - according to standard theory - to six quarks and six leptons, and therefore the concept of an element depends on the power of the analytical method or, more precisely, on the power of the reagent available to science (heat, acid, base, electron...). The authors of more modern textbooks are aware of this, so they emphasize the difference between chemical and physical methods of separation:

*Elements come as constituents of complex substances, and in free state create simple substances, which cannot be chemically separated or obtained by coupling.*

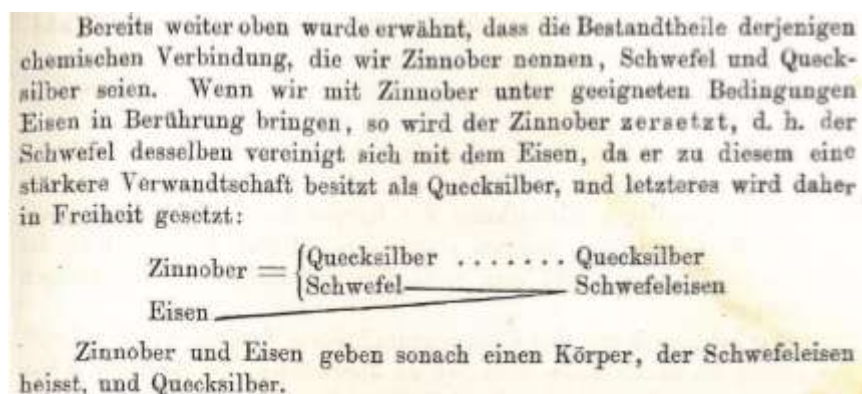


Fig. 1 – Scheme of the analysis and synthesis of mercury and iron oxide from simple substances (Ref. 3, p. 35)

*Mercury and oxygen cannot be further separated through chemical reactions into simpler matter (substances). Such substances are called chemical elements.*

These definitions, and more so Wiberg's ("by any conventional physical or chemical methods"), can be accused for circularity, since they state that *conventional methods* and *chemical reactions* are precisely the processes through which elements cannot be separated into more simpler substances.

### Element as a carrier of properties

There is a notion which runs through countless chemistry textbooks, stating that the father of the theory of elements is the Greek philosopher Empedocles (circa 450 BC) from Akragas, Sicily. According to him, there are four elements (stoiheia) - fire, water, earth and air - which are non-

creatable, indestructible and immutable, but infinitely divisible. They are sometimes united by friendship (*philia*) and separated by enmity or strife (*neikos*). But, we shouldn't rush to conclusions. Empedocles' theory is far from the contemporary, atomic theory of the elements. This is first and foremost due to the Greek philosopher's denial of the existence of empty space and therefore the existence of atoms (indivisible particles); he explains the combining (mixing) of elements through the existence of pores:

*We know that those who hypothesized pores did not imagine them empty, but full of some body matter made up of finer particles, such as air. That is how they differed from those who assumed the existence of emptiness (fr. 87).*

It should be noted that Empedocles was Pythagoras's follower, so Empedocles's theory of nature is laden with the mysticism of his teacher's numbers. Four elements were not chosen because they best described the natural state of affairs (Chinese alchemy, for example, distinguishes five elements: water, earth, fire, wood and metal) but because of the number four, Pythagoras' sacred number (which is, according to Jung, the archetype of wholeness). Moreover, Empedocles gives his elements mythical names, identifying them with deities: Zeus (fire), Hera (earth), Hades (air) and Nestis (water). The idea of pairing the four elements with the four qualities (warm, cold, dry and moist) starts to emerge in the teachings of the Greek philosopher, which Aristotle later led to a more mature theory of natural matter.

For Aristotle, the four elements - water, earth, fire and air - are not concrete substances, his air is not the air we breathe, nor is Aristotle's water the water we drink. The essence of his theory of matter is understanding the elements as abstract carriers of quality. Therefore, the elements of this Greek philosopher are not to be understood in the modern sense, as something of which everything is comprised of, or as something that everything can be separated into, but rather as defined states of matter. For Aristotle, matter (*hyle*) is that which gives the possibility of (Greek *dynamis*, Latin *potentia*) transformation in nature. In other words, matter is the thing which provides the ability to transform something into something else - just as any kind of timber (which is the basic meaning of the word *hyle*) can be built into any and all kinds of ships, though timber itself is not a ship. But matter must take an appropriate form (Greek *morphe*, *eidos*,

Latin *forma*) in order to pass from potentiality to actuality.<sup>6</sup> Aristotle differentiates four fundamental, tangible forms, the fundamental properties of each substance: warm, cold, moist and dry. Should the substance acquire properties of heat and dryness, it becomes fire, but if it acquires properties of heat and humidity, it becomes air. The combination of cold and dry produces earth while cold and moist produce water.

Contrasting Empedocles, Aristotle views the elements as not immutable. They change from one to another through the change in form (e.g. water turns into air by changing coldness to warmth). Elements, as well as substances, are created by uniting matter and form, molding that first entirely impersonal matter, prime matter, which Aristotle called *prote hyle* (the first matter), and his medieval followers *materia prima*. But for the Greek philosopher *materia prima* as such does not exist in nature, because nothing can exist without having some property or form. (That is where he differed from alchemists who saw prime matter as a substance which can easily take the form of gold.) For Aristotle, *prote hyle* is merely an abstraction, the intangible that lies at the root of all that is tangible. Therefore, prime matter would be closer to the concept of an element as we understand it today, not Aristotelian elements. Element is what allows a substance to be what it is.

Aristotle's theory became the basis of alchemy, but not in terms of its doctrinal acceptance, rather in accepting the view that the substance is a carrier of qualities - element is the carrier of basic, not to say elemental properties. Therefore, the Arabic theory which states that all metals are composed of mercury and sulfur should not be taken naively, i.e. in the modern sense, namely the statement that we can combine mercury and sulfur to produce copper or iron (alchemists could certainly see for themselves that that is not how it goes). Mercury-sulfur theory wanted to say that metals differ from other substances in their melting point and combustibility, i.e. the possibility of oxidation, calcination. Mercury has the property of melting (because it is constantly molten and cannot be solidified), and sulfur has the property of combustibility, because sulfur is a substance which is easily ignited and produces a lot of smoke. Paracelsus' theory of the three primes or root substances (*tria prima*) also follows this

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<sup>6</sup> Matter and form, along with purpose and principle of motion, are Aristotle's causes (*causa materialis*, *causa formalis*, *causa finalis* and *causa efficiens*).



logic: mercury is volatile and exists between the liquid and solid state, sulfur is inflammable and combustible, while salt is solid and fireproof.

Istrian physician Petrus Bonus further elaborated of mercury-sulfur theory in his work *Pretiosa margarita novella (Precious New Pearl)* which was written in Pula in 1330, but printed in the 16th century. According to Bonus, there exists not just one kind of sulfur, but two, external and internal. External sulfur is unclean, dense and flammable, while internal sulfur is fine, non-combustible and never separates from mercury. That assumption was necessary in order to harmonize the mercury sulfur theory with the teachings of the philosopher's stone. The purpose of this *chemical reagent* is to clean the metal from the external sulfur, so that the internal sulfur can bind with mercury – since similar things bind – and turn to gold. This leads to the conclusion: external sulfur is a (elementary) substance, and mercury and internal sulfur are primes, therefore, elements.

### **Element as elementary substance**

Understanding the element as an elementary substance comes from chemistry, more specifically from the first modern chemistry textbook, Lavoisier's *Treité élémentaire de chimie*, published in 1789 (p. 506 - 511). It contains a *table of simple substances (Tableau des substances simples)*, in which the author lists 35 substances which cannot be separated into simpler ones (Figure 2).

	Noms nouveaux.	Noms anciens correspondans.
Substances simples qui ap- partiennent aux trois ré- gnes. Et qu'on peut regarder comme les élé- mens des corps.	Lumière .....	Lumière.
	Calorique.....	Chaleur.
		Principe de la chaleur.
	Oxygène .....	Fluide igné.
		Feu.
		Matière du feu & de la chaleur.
Air déphlogistique.		
Air empiréal.		
Azote.....	Air vital.	
	Base de l'air vital.	
	Gaz phlogistique.	
Hydrogène.....	Mofete.	
	Base de la mofete.	
Substances simples non métalliques oxidables & acidifiables.	Gaz inflammable.	
	Base du gaz inflammable.	
	Soufre.....	Soufre.
	Phosphore.....	Phosphore.
	Carbone.....	Charbon pur.
	Radical muriatique.	Inconnu.
	Radical fluorique..	Inconnu.
	Radical boracique..	Inconnu.
	Antimoine.....	Antimoine.
	Argent.....	Argent.
	Arsenic.....	Arsenic.
	Bismuth.....	Bismuth.
	Cobalt.....	Cobalt.
Cuivre.....	Cuivre.	
Substances simples métal- liques oxidables & acidifi- cables.	Étain.....	Étain.
	Fer.....	Fer.
	Manganèse.....	Manganèse.
	Mercure.....	Mercure.
	Molybdène.....	Molybdène.
	Nickel.....	Nickel.
	Or.....	Or.
	Platine.....	Platine.
	Plomb.....	Plomb.
	Tungstène.....	Tungstène.
	Zinc.....	Zinc.
Substances simples salifi- cables terreuses.	Chaux.....	Terre calcaire, chaux.
	Magnésie.....	Magnésie, base du sel d'epsom.
	Baryte.....	Baryte, terre pesante.
	Alumine.....	Argile, terre de l'alun, base de l'alun.
Silice.....	Terre siliceuse, terre vitrifiable.	

Fig. 2 –Table of the elements (simple substances) from Lavoisier’s textbook *Traité élémentaire de chimie*, published 1789.

With 23 substances considered elementary today - oxygen (*oxygène*), hydrogen (*hydrogène*), nitrogen (*azote*) with sulfur (*soufre*), phosphorus (*phosphore*), iron (*fer*), silver (*argent*), gold (*or*) and other metals and non-metals - we find light (*lumière*) and heat (*calorique*) and substances that are obviously chemical compounds. These are *salt-forming substances* (*substances simples salifiables terreuses*), or oxides of still unknown elements: magnesium (*magnésie*), barium (*baryte*), aluminum (*alumine*), and silicon (*silice*). There are also acid radicals - hydrochloric, hydrofluoric and boric - acids of non-metals which have not been

separated in their elementary state. Lavoisier was aware of the temporality of his table and its purely empirical nature. He clearly states that “these substances are obviously compounds, although the nature of their primes (= elements) is still unknown.”

From this it could be concluded that the French chemist does not deal with the element as a prime, the invisible carrier of substance’s properties. But that’s not exactly the case. His original theory of combustion assumes the existence of oxygen (*oxygène*) as a *simple substance*, but the mere existence of a gas in which a substance burns faster than it does in the air does not explain the process of combustion. Gaseous, reactive oxygen consists of *air base* (*base de l'air*) dissolved in *fire substance* (*matière de fu*), which is released through a chemical reaction in the form of fluids of light and heat (caloric), while *air base* fuses with the flammable substance. Therefore, we could say that *air base* is an element, and oxygen (*oxygène*) is an elementary substance.

But, when you are done reading Lavoisier's *theory of combustion*, you can only say that the interpretation of burning as binding with oxygen is based on weighing and measuring, or an experiment, while the introduction of *fire substance* and massless chemical elements (light and caloric) is merely an attempt to explain why energy is released in a chemical reaction. In doing so, Lavoisier relied on physical theories of his time, especially gas theories, so he explained their elasticity and low density through the existence of the *fire substance*. But he was clearly oblivious to the fact that he was introducing, through the back door, the phlogiston theory which he refuted in his new theory of combustion.

### **Element and the periodic table**

Discovery of the periodic table of elements caused much controversy, not only because of the rivalry between Germanic people (Julius Lothar Meyer) and Slavs (Dmitry Ivanovich Mendeleev) - although both chemists received the Davy Medal in 1882 for that discovery - but also because of many researchers who were on a path to great discovery (Figure 3). Although American science historian Eric R. Scerri lists as many as six co-founders of the periodic table (A. E. Béguyer de Chancourtois, J. Newlands, W. Odling, G. Hindricks, and the two aforementioned chemists), and he sees the periodic table as an example of collective discovery which develops

science through evolution rather than revolution (thus resisting Thomas Kuhn's thesis), he acknowledges that Mendeleev should take most of the credit for the discovery of the periodic table. That is not only because the Russian chemist was most persistent in developing and propagating the periodic system, or because he predicted the existence of previously unknown elements (gallium, germanium and scandium), but rather because he laid the theoretical foundations for the periodic law. He presented these foundations in eight points, the most important of which is the fifth (p. 746): "Atomic mass determines the nature of an element, just as the size of a molecule determines the nature of a complex body (chemical compound)."

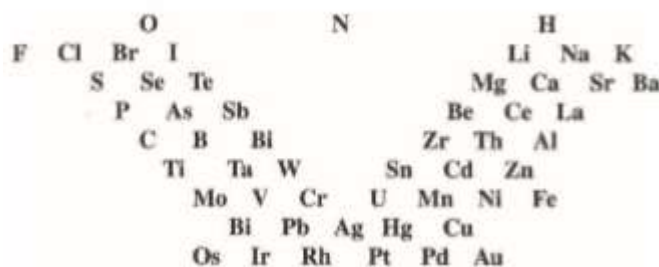


Fig. 3 –The first forerunner of the periodic system: Gmelin's system of the elements, 1843

But, regardless of these facts, or even the explicit formulation of the periodic law, Scerri points out that Mendeleev developed the periodic table because he clearly knew the distinction between the terms element and elementary substance.<sup>7</sup> Due to the importance of this thesis, it is worth quoting it in its entirety, as explained in Mendeleev's textbook:

*It is appropriate therefore to make a clear distinction between the term element, as a **separated** homogeneous substance, and as a **material**, albeit invisible part of a compound. Mercury oxide does not contain two simple bodies, gas and metal, but two elements, mercury and oxygen, which, when free, are gas and metal. Neither mercury as metal, nor oxygen as gas are contained in mercury oxide; it contains only the substance of elements, just as steam contains*

<sup>7</sup> Свойства простых тел, также формы и свойства соединений элементов, находятся в периодической зависимости (или, выражаясь алгебраически, образуют периодическую функцию) от величины атомных весов элементов. The properties of simple bodies, as well as the forms and properties of compound elements, are periodically dependent (or, algebraically speaking, constituting a periodic function) on the atomic mass of the elements.

*the substance of ice, but not the ice itself, or as a grain contains the substance of seed, even though it is not a seed.*

Clearly distinguishing the element (*invisible part of the compound*) from the elementary substance (*separated homogeneous substance*) allowed Mendeleev to lay a firm foundation for the periodic table. The periodic table is not a system of elementary substances, but of elements - whose *substance* is manifested precisely in the physical and chemical properties of compounds. (Mercury is invisible in mercury oxide, just as iron is invisible in iron oxide, but the two oxides still differ in properties - precisely because of the different nature of their metallic *substance*)

## **Conclusion**

It is not easy to differentiate element from elementary substance from the view of atomic theory. If we were to say that an elementary substance is a substance composed of the same atoms, we come to a (too) broad definition which defines nothing but the results of elemental analysis. Ozone is vastly different from molecular oxygen (O<sub>2</sub>), not to mention the myriad of allotropic carbon modifications (graphite, diamond, graphene, fullerenes, nanotubes...) which, we could say, open a new and very rich field of chemistry. If we also include atomic ions in elementary substances, since they too are composed of one type of atoms, it becomes clearer to us what determines chemical and physical properties of a pure substance, regardless of its composition. It is obvious that properties of both elementary substances and chemical compounds depend not only on the type or types of atoms from which they are comprised, but also on the chemical bond between the atoms or - more precisely - on the molecular or crystal structure. Nevertheless, the "material, albeit invisible part" of a compound (to quote Mendeleev) remains unchanged. This "material, albeit invisible part" is the atom, or - more precisely - its nucleus. The official IUPAC definition of a chemical element also points in that direction: 1. *A species of atoms; all atoms with the same number of protons in the atomic*

*nucleus*, even though the full definition also includes the meaning of *element* as elementary substance.<sup>8</sup>

Electron configuration depends on the charge of the nucleus (proton number), and all other chemical and physical properties depend on the electronic configuration of that atom. Therefore, the true definition of an element would be the "material, albeit invisible" wave function of an atom of a certain proton number. Or, in other words, an elementary substance is a pure substance of homogeneous composition, while the term element indicates the possibility of chemical coupling. This brings the modern definition of an element closer to the Aristotelian notion of matter (*hyle*), as a possibility of accepting (actualizing) the form. To be more specific and thus clearer, I will say that *hyle* Na can take the form of Na<sub>2</sub>, NaCl, NaH, NaHCO<sub>3</sub> and many more, but the potency of Na is still limited by its electronic configuration, and therefore cannot be actualized in the form of NaO<sub>5</sub> or NaFCl. There is, of course, matter which has a greater *realization capacity* than sodium atoms: only three types of matter - protons, neutrons and electrons - can make all atoms of all chemical elements and of course all of their combinations, all chemical compounds. We could say that physics today aspires to what the alchemists aspired to: finding prime matter (*materia prima*), a substance which could be actualized in any form. That would be the interpretation of modern science from the perspective of Aristotle's philosophy of nature (physics).

At the end of this article, it should be stated that differentiating an element from elementary substance has not only practical but, more so, fundamental and true philosophical meaning. Therefore, considering these concepts in chemistry classes would be a good introduction to the philosophy of science, especially the philosophy of chemistry, an area of analytical philosophy which is just beginning to develop. It could also serve as a good example of how difficult it is to define things in chemistry and natural (exact) sciences in general. Strictly speaking, definitions are possible only in mathematics (apodictic law), but not in empirical sciences, sciences based on asertorian law: A swan is a white bird until a black swan appears. Definitions in science are

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<sup>8</sup> "2. A pure chemical substance composed of atoms with the same number of protons in the atomic nucleus. Sometimes this concept is called the elementary substance as distinct from the chemical element as defined under 1, but mostly the term chemical element is used for both concepts." However, this definition was criticized by Portada and Stilinović, saying that the term element should be confined to the first definition.

subject to constant change as they must be in line with new insights, new discoveries. Because the number of molecules with more diverse structure increases, it is appropriate to ask whether the concepts of chemical element and elementary substance have the same sense, and especially importance as they had for a 19<sup>th</sup> century chemist, as when they were created. (Is it appropriate to define elementary substances as "substances which cannot be chemically separated into simpler components" if we know that oxygen and ozone can be separated into atoms, atomic oxygen?) Would it be more appropriate to use homogeneous and heterogeneous compounds (molecules, ions) instead of *compounds* and *elementary substances*?

## 3.2. COMMENTARY AND ANALYSIS

### ELEMENTS AND ELEMENTARY SUBSTANCES

1. **genre:** professional paper, scientific article

2. **source:** article in a chemistry journal - *Kemija u industriji : Časopis kemičara i kemijskih inženjera Hrvatske*

3. **audience:** chemists, chemistry teachers, people interested in scientific and professional papers in the field of chemistry, history of chemistry and its development

4. **purpose of writing:** discussing the term of an element, its meaning and how the notion developed through scientific breakthroughs in chemistry

5. **authenticity:** original work, professional paper written by Nenad Raos

6. **style:** informative, scientific, clear sentences

7. **level of formality:** formal

8. **layout:** bold title followed by the name of the author and an abstract. The text is divided into five parts: *Introduction*, *Element as a carrier of properties*, *Element as elementary substance*, *Element and the periodic table* and *Conclusion*. The author occasionally uses pictures to further illustrate his points.

9. **content:** in the abstract, the author summarizes his professional paper, stating that he will discuss the development of the term *element* since the ancient times up until the modern understandings based on atomic theory. The *Introduction* paragraph serves to introduce the reader with the notion of a chemical element and provides several definitions. The part, *Element as a carrier of properties*, deals with the ancient understandings of an atom, mainly Aristotle's four elements – water, earth, fire and air. *Element as elementary substance* discusses the understanding of the term atom since the advent of modern chemistry, and the following part, *Element and the periodic table*, discusses the same term in regards to the periodic table.



**10. cohesion:** the cohesion is achieved through discussing the same term throughout the text with the use of field specific terminology

**11. sentence patterns:** the author mainly uses clear and concise sentences and often provides additional definitions, quotes and references

**12. terminology of the subject:** use of many chemical elements, compounds and chemistry concepts. The author also uses terms to describe ancient concepts such as *materia prima* and *prote hyle*

One of the challenges while translating this text was finding the right English (or Latin) variants of names such as *Petar Bono*, *Empedoklo* and *Mendeljejev* in order for them to be recognizable to an English reader. The same process applies for terms which the author uses to describe ancient concepts and practices. In one particular sentence the author provides a definition from a 1942 textbook which states that *jednostavne tvari, koje se ne mogu dalje rastavljati na još jednostavnije, zovu se počela ili elementi (lat. počela)*. Here I had trouble translating the word *počela*, and researching the word provided no useable results. The author states in parentheses that *počela* is a latin word, so I decided to leave it as such.

Another challenge was finding the right names for chemical compounds. For example, I had to research compounds such as *hidrargirum-oksidi* and *kalijev hidroksid*, find the elements they were made from and then find the name of their combinations in English language. For the compound *hidrargirum-oksidi* I found that chemists use *mercury (II) oxide*, but sometimes also *hydrargyrum oxide*. In order to stay true to the source text, I have opted for the latter. Similarly, one sentence mentions a few allotropes of carbon (*grafen, fulereni, nanotubule*) which I had to research in order to provide accurate translations. The author also mentions the work of Lavoisier, or rather his *opća teorija gorenja*. In order to translate the theory I had to research Lavoisier's work and I concluded that the proper translation of the mentioned theory is Lavoisier's theory of combustion.

It is worth mentioning the sentence which states that *Paracelsusova teorija o tri principa ili korijena tvari (tria prima) slijedi tu logiku: živa je princip žitkog i hlapljivog, sumpor upaljivog i*

*gorivog a sol krutog i vatrostalnog*. In order to provide the most accurate translation, I had to research the *tria prima* theory. I found that Paracelsus' theory relies upon the three primes of alchemy and, bearing this in mind, the word *princip* cannot be translated just as *principle*, rather it had to be translated as *prime* to make sense and to be as accurate as possible.

Many terms follow a similar process, for example, words such as *rastavljanje* or *tjelesne tvari* can easily be translated into English language, but if I were to translate *rastavljanje* as disassembly it wouldn't be appropriate given the context. In chemistry, when discussing the atoms and their bonds, *rastavljanje* is best translated as *separation*. The same applies to *tjelesne tvari*. It would be inappropriate to translate it as *bodily substances* while discussing atoms, so I opted for *body matter*.

Some sentences I found to be especially problematic due to the way they are written. They make sense in Croatian, but word-for-word translation into English often provides an unintelligible sentence. For example, while discussing Empedocles theory, the author states that elements *čas prijateljstvo (filia) spaja, čas neprijateljstvo, svađa (neikos) razdvaja*. I had difficulty finding the best solution for this sentence, so I opted for inversion: *They (elements) are sometimes united by friendship (filia) and separated by enmity or strife (neikos)*. Another sentence that ended up feeling clunky in the target language is *Da budem konkretniji a time i jasniji, reći ću (...)*, which I found hard to translate while keeping the same style, but ended up choosing *To be more specific and thus clearer, I will say (...)*, as the best possible option.

#### 4. SOURCE TEXT 3

### ZAŠTO TREBA UPOZNATI UMJETNIČKU GLAZBU?

Mia Mucić, učiteljica glazbene kulture  
OŠ Zrinskih, Nuštar i gimnazija M. A. Reljkovića, Vinkovci

#### Sažetak:

Oduvijek je glazba prisutna u čovjekovu životu - od najranijih vremena pa do danas. Ljudi su s vremenom počeli uočavati da ih glazba smiruje, nadahnjuje, motivira, inspirira... U ovom se članku govori o tome na koji način glazba djeluje na čovjeka, tj. govori se o psihofizičkim utjecajima. Iznosimo i rezultate ankete koja je provedena među učenicima petih i osmih razreda (N=80) s ciljem utvrđivanja kako oni doživljavaju glazbu. Izlazni podatci pokazuju da učenici vole slušati glazbu jer ih opušta i zabavlja. Učenicima je bliža popularna glazba, no pravilnim prezentiranjem, uz trud učitelja glazbene kulture, oni su u stanju prihvatiti i zavoljeti umjetničku glazbu. Također govorimo o djelovanju umjetničke glazbe kao „okidaču“ kreativnosti, motivacije, energije i njezinu terapijskom djelovanju.

**Ključne riječi:** glazbeni ukus, nastava glazbe, učenici, umjetnička glazba

#### Uvod

Puno puta, pogotovo u srednjoj općeobrazovnoj školi, učenici se pitaju zašto treba polaziti nastavu glazbene umjetnosti i zašto treba upoznati umjetničku glazbu. U ovom članku iznosimo kratak pregled na koji način glazba utječe na čovjeka i činjenice koje idu u prilog slušanju umjetničke glazbe.

Na samom ćemo početku razjasniti porijeklo i značenje riječi glazba/muzika, odgoj, kultura i pedagog. Riječ glazba dolazi od slavenske riječi glas + ba (jednačenje po zvučnosti), dok je riječ muzika svjetskih razmjera, te njezino podrijetlo treba tražiti iz vremena starih Grka. Riječ muzika dolazi od grč. μουσική τέχνη (mousiketechnē), a znači umjetnost muza. Od izvorne se riječi zadržala samo jedna, μουσαίη, a znači muza. Muze su bile zaštitnice pjesništva, umjetnosti i

znanosti. Riječ odgoj ima svoj korijen u glagolu gojiti, što bi značilo pomoći nekome da raste i živi i odnosi se na živo biće. Značilo bi još i njegovati, hraniti, brinuti se, tj. Podizati čovjeka. Riječ kultura dolazi od lat. colere, a znači nastanjivati, uzgajati, štititi, štovati. Riječ pedagogija dolazi od grč. "paidagogos" (παιδαγωγός). U grčkom jeziku, riječ paidos znači dijete, a glagol ago znači voditi, pratiti. Iz toga proizlazi da je pedagog osoba koja vodi, prati, brine se za dijete. Ako povežemo sve ove riječi i pokušamo odrediti zadaću učitelja/ pedagoga glazbe, onda bi njegova zadaća bila voditi, usmjeravati, približiti glazbu djetetu/učeniku. No, zašto se onda često postavlja pitanje važnosti upoznavanja umjetničke glazbe, kao i pohađanja nastave iste? Zašto se u današnjem vremenu toliko malo pozornosti posvećuje umjetnosti (likovnoj, književnosti, kazalištu...)? Je li nas brzi životni tempo udaljio od onog iskonskog u nama, onoga što je od početka u nama samima?

## **Glazba i čovjek**

Muzikalnost se razvija u prvih devet godina života. Dojenčad reagira na šumove, a u drugoj godini djeca počinju spontano proizvoditi glazbu. Već su u vrtićkoj dobi sposobni otpjevati pjesme koje su čula, bolje shvaćaju melodije te mogu razlikovati zvukove i ponoviti jednostavne ritmove. S devet godina djeca su u stanju raspoznati dvoglasje i kadence, a u dobi od dvanaest do sedamnaest godina sposobna su smisljeno te emotivno doživljavati glazbu (Krafft i Semke, 2008).

Nekoliko je razloga zašto treba njegovati glazbu. Ono što većina autora ističe psihičko je, fizičko, estetsko i terapeutsko svojstvo glazbe.

Mnogi su se filozofi još od antičkog vremena bavili proučavanjem glazbe. Prema Platonu, nedostatak muzikalnosti vodi u nedostatak iskustva lijepoga. Isto tako, smatra da je glazba odgoj za dušu (a gimnastika odmor za tijelo). U svojoj drugoj knjizi Zakona, Platon govori o tzv. Zborskom plesu, u kojem je predstavljen cijeli odgoj, tj. povezanost gimnastike i glazbe. U prvom dijelu, Zborski je ples povezan s glasom, odnosno melodijom koja se sastoji od ritmova i harmonije („ono od glasa što prodre do duše je krepost“, Platon), dok je drugi dio povezan s jednakim ritmovima kao i prvi dio, ali uz pokrete tijela (Barbarić i Šegedin, 2010).

„*Slušamo glazbu svojim mišićima.*“ Filozof Nietzsche bio je veliki pobornik i obožavatelj umjetnosti. Bavio se proučavanjem veze između čovjekove psihe i glazbe te je govorio o sposobnosti glazbe da pobudi živčani sustav. Govorio je o tzv. „dinamičkim“ sposobnostima glazbe, koje se najbolje odražavaju u plesu, jer ples kao takav objedinjuje pokret i glazbu. Glazba ima sposobnost da izazove, pokrene i regulira pokret (Sacks, 2012).

Važnija znanstvena istraživanja koja su željela istražiti kako glazba utječe na mozak započela su 1977. godine, kada su MacDonald Critchely i R. A. Henson objavili knjigu „*Music and the brain*“. G. Schlang i njegovi suradnici s Harvarda također su se bavili istraživanjima na ovome području (Sacks, 2012.). Koristeći u svom radu MRI morfometriju, usporedili su veličine različitih moždanih struktura. Svoj su rad objavili 1955. godine. Zaključak je bio da je *corpus caliosup* (splet živaca koji povezuje dvije hemisfere mozga) kod ljudi koji se bave glazbom povećan, te da se *planum temporale* (dio slušnog korteksa) asimetrično poveća kod ljudi s apsolutnim sluhom. Također su otkrili da je kod takvih osoba povećana količina sive tvari u motoričkim, slušnim i vizuospacijalnim dijelovima korteksa i malom mozgu.

Osim neurološkog učinka, glazba pozitivno djeluje i na čovjekovo tijelo. Utječe na rad srca i ritam disanja, te na taj način utječe na promjenu raspoloženja. Sporija će glazba usporiti puls srca, smiriti disanje pa tako smiriti i čovjeka. Glazba često služi i kao motivacijsko sredstvo u radu, npr. za teže fizičke poslove jer svojom motoričnošću i pravilnom strukturom kretanja, omogućuje čovjeku lakše gibanje u prostoru. Djeluje pozitivno i na športaše. Sacks (2012) u svojoj knjizi „*Muzikofilija - priče o glazbi i mozgu*“ iznosi primjer plivača koji je tijekom plivanja slušao klasičnu glazbu. Ona mu je opuštalala mišiće i tako mu omogućila lakše kretanje u vodi. Glazba služi i kao sredstvo koje povezuje ljude (druženje na koncertima, razgovori o glazbenim ukusima...), a to je u današnjem vremenu otuđenosti važna značajka. Postoji još nekoliko zanimljivih pojava vezanih uz glazbu, kao što je na primjer sinestezija (osobe vide boje pri slušanju glazbe), zatim glazba kao mnemotehničko sredstvo (lakše se pamte činjenice i pojmovi uz glazbu). Također se koristi kod kontrole različitih neuroloških i psihičkih bolesti (Parkinsonova bolest, autizam..), glavobolje, porođaja...

Oliver Sacks (2012) u svojoj knjizi „Muzikofilija - priče o glazbi i mozgu“ govori i o terapijskom djelovanju glazbe. Pritom se ne misli da glazba čudotvorno liječi ljude od teških bolesti, već pomaže ljudima kontrolirati kretanje, strahove, osjećaje. Terapiju melodijskom intonacijom 1973. godine proveli su Martin Albert i njegovi suradnici. Terapija se sastojala u tome da su pacijenti koji su imali problema s govorom, naučili pjevati lake fraze, npr. “Kako si danas?”. Postupno su izuzimali glazbene elemente, sve dok nisu došli do običnog govora. Ova se terapija pokazala vrlo učinkovitom. Opće je poznato da osobe koje mucaju mogu pjevati bez ikakvih problema. Darwin se pitao je li to zbog toga što je možda pjesma/ glazba (ma kakva god primitivna bila) prethodila govoru. Isto tako, dokazano je da slušanje glazbe ili njezino zamišljanje (bez pokreta tijela) aktivira motorički korteks i subkortikalne motoričke sustave.<sup>9</sup>

Takvo zamišljanje glazbe može biti jednako važno kao i njezino stvarno slušanje (Sacks, 2012). Sacks govori o utjecaju glazbe na psihičku sferu čovjeka te iznosi brojna svjedočanstva i pisma svojih pacijenata. Također smatra da glazbeni potencijal za svoj razvoj treba i stimulaciju. Iz toga proizlazi da je, osim na roditeljima, koji mogu svojoj djeci pružiti potrebnu stimulaciju i motivaciju, još veća odgovornost na stručnjaku – nastavniku glazbe.

Jensen (2003) daje prijedlog da se glazba uvede i u neglazbene predmete kako bi bolje stimulirala i motivirala učenike. Tako preporuča baroknu glazbu kao pozadinsku glazbu za smirenje (Vivaldi, Bach, Händel...); klasicističku glazbu za poticanje kreativnosti, pričanje priča, predavanja, a također kao pozadinsku glazbu (Mozart, Haydn, Beethoven); romantičku glazbu za poticanje emocija (Schubert, Čajkovski, Wagner, Dvorak...).

On nudi i konkretne primjere:

- pozadinska glazba (*Četiri godišnja doba; Muzika na vodi; Brandenburški koncerti...*)

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<sup>9</sup> Chen, Zatorre i Penhune bavili su se proučavanjem držanja tempa, a pri tome su se koristili slikovnim prikazima mozga kako bi uočili promjene koje se događaju. Pronašli su da se motorički korteks i subkortikalni sustav aktiviraju u baznim ganglijama i u malom mozgu i to dok su ispitanici pokretima različito reagirali na glazbu (Sacks, 2012)

- kreativno rješavanje problema (*Chopinove etide; Claire de Lune; Labuđe jezero...*)
- smirujuća glazba (*Claire de Lune; Trois Gymnopédies...*)
- slavlja (*Marš iz Aide; Aleluja iz Mesije...*)
- glazba koja pokreće (*Bolero; Mađarski plesovi; Bachov preludij u D-duru...*)
- testovi i kvizovi (*Barokna glazba*).

Posebno mjesto u proučavanju glazbe i njezinom djelovanju na čovjeka zauzima fenomen poznat pod nazivom *Mozart efekt*. Gordon Shaw tvrdi da Mozartova glazba može „zagrijati“ mozak. „Pretpostavljamo da složena glazba pomaže određenim složenim neuronskim obrascima koji sudjeluju u višim moždanim aktivnostima kao što su matematika ili šah. S druge strane, jednostavna glazba, kao i glazba čiji se elementi ponavljaju, mogla bi imati suprotan učinak“ (Shaw, 1995 prema Campbell, 2005, 24).

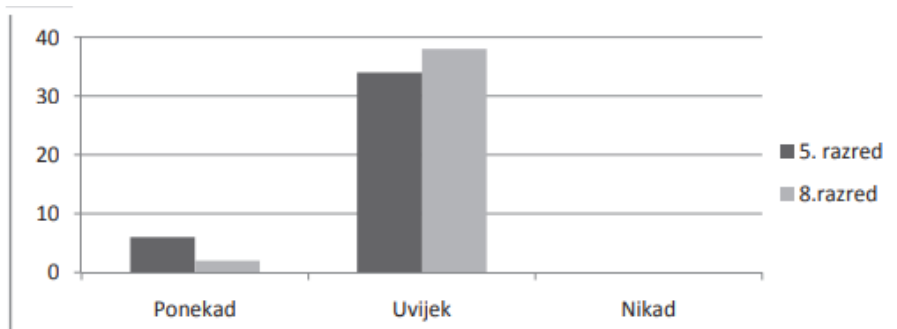
Ovaj fenomen (mogućnost utjecanja glazbe na preobražaj čovjekove psihe) naziva se *Mozart efekt* zato što se pokazalo da njegova glazba ima najdulji i najdjelotvorniji učinak zbog svoje čistoće i jednostavnosti zvuka. „Nedvojbeno je da ritmovi, melodije i visoke frekvencije Mozartove glazbe stimuliraju i pobuđuju kreativna i motivacijska područja mozga“ (Campbell, 2005, 35).

### **Istraživanje**

Anketno istraživanje provedeno je školske godine 2012./2013. među učenicima petih i osmih razreda OŠ Zrinskih, Nuštar. U navedenim razredima nastava glazbene kulture sadržajno je različito koncipirana. U petom razredu prevladavaju aktivnosti pjevanja i slušanja glazbe, no nisu zanemareni sviranje i ples. U osmom razredu naglasak je na upoznavanju glazbenih vrsta i stilskih razdoblja putem slušanja različitih glazbenih primjera. Cilj ove ankete bio je uočiti kako učenici doživljavaju glazbu te kako ona na njih djeluje. Od ukupno deset postavljenih pitanja, izdvojili smo najzanimljivije. Ukupan broj ispitanika je N= 80 (četrdeset učenika petih razreda i četrdeset učenika osmih razreda).

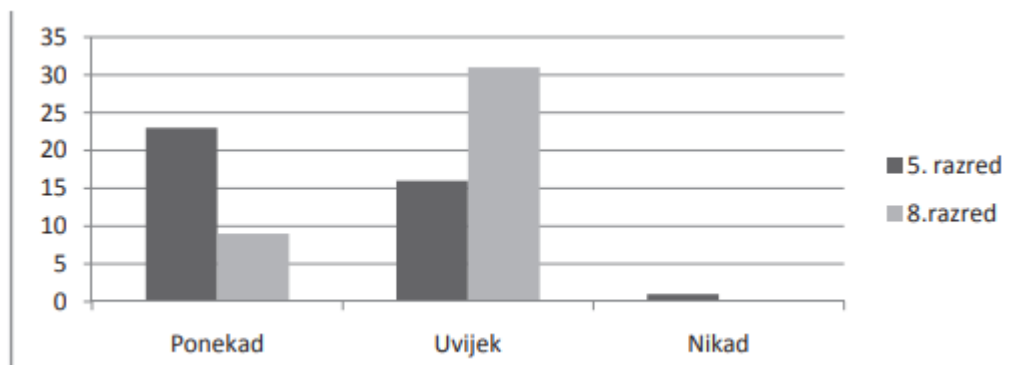
## Rezultati

Kao što se može vidjeti na slici 1., najveći broj učenika voli slušati glazbu. Uspoređujući učenike petih i osmih razreda, vidimo da je glazba svakodnevno prisutna u njihovim životima. U petim razredima 34 učenika se opredijelilo za odgovor uvijek, dok je u osmim razredima taj broj još veći (N=38). Zanimljivo je da se prema učeničkoj anketi ni jedan učenik se nije opredijelio za odgovor nikad. Taj nam podatak pokazuje da glazba ima veliku i važnu ulogu te da ju učenici vole slušati.



Slika1. Učestalost slušanja glazbe kod učenika petih i osmih razreda

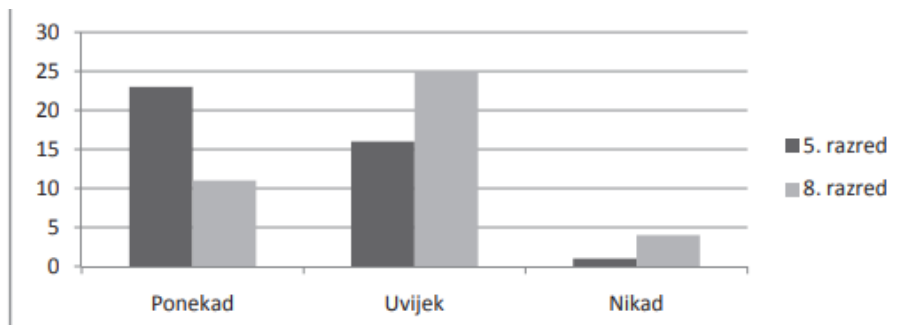
Na slici 2. prikazano je u kojoj mjeri glazba djeluje kao sredstvo opuštanja. Usporedbom petih i osmih razreda, vidimo da je broj učenika na koje glazba pozitivno djeluje veći u osmim razredima (N=31). Jedan učenik petog razreda izjasnio se da ga glazba ne opušta. Kod ostalih učenika takvo je djelovanje glazbe vjerojatno uvjetovano situacijom u kojoj se nalaze.



Slika2. Glazba kao sredstvo opuštanja



Slika 3. nam pokazuje učestalost utjecaja glazbe na raspoloženje učenika. Iz tablice je vidljivo da glazba u većoj mjeri utječe na raspoloženje učenika osmih razreda (N=25) u odnosu na učenike petih razreda (N=16). Vrlo mali broj učenika smatra da glazba ne utječe na njihovo raspoloženje (u petim razredima N=1, u osmim razredima N=4).



Slika 3. Utjecaj glazbe na raspoloženje učenika

Jedno od anketnih pitanja odnosilo se na zastupljenost slušanja umjetničke glazbe kod kuće. Nešto manje od polovice učenika petih razreda nema razvijenu naviku slušanja umjetničke glazbe kod kuće (N=17), dok je kod osmih razreda taj broj još veći (N=24).

Kao što je vidljivo iz tablica, velika većina učenika voli glazbu. Učenici vole slušati glazbu (čak 95 % učenika osmih razreda), smatraju da ih opušta te djeluje na njihovo raspoloženje, no isto tako, očekivano, vrlo mali postotak učenika kod kuće sluša umjetničku glazbu. Unatoč tome, učenici vole biti na nastavi glazbene kulture jer ona djeluje pozitivno na njih, odmara ih, stimulira i, ne manje važno, njima je zabavno na nastavi glazbene kulture.

<b><i>Peti razred</i></b>	DA	NE	NE ZNAM
Smatraš li glazbu bitnim dijelom svog života?	30	3	7
Smatraš li umjetničku glazbu „kvalitetnom glazbom“?	24	3	13
Smatraš li nastavu glazbene kulture kvalitetnom?	36	0	4
Smatraš li da umjetnička glazba pozitivno utječe na razvoj cjelovite tvoje osobnosti?	24	0	16

Slika 4. Utjecaj i kvaliteta glazbe/ glazbene nastave kod učenika petih razreda

<u>Osmi razred</u>	DA	NE	NE ZNAM
Smatraš li glazbu bitnim dijelom svog života?	33	2	5
Smatraš li umjetničku glazbu „kvalitetnom glazbom“?	14	8	18
Smatraš li nastavu glazbene kulture kvalitetnom?	32	0	8
Smatraš li da umjetnička glazba pozitivno utječe na razvoj cjelovite tvoje osobnosti?	16	5	19

Slika 5. Utjecaj i kvaliteta glazbe/ glazbene nastave kod učenika osmih razreda

Kod učenika petih razreda glazba zauzima veoma važno mjesto u životu (N=30), umjetničku glazbu smatraju kvalitetom, iako im je puno bliža popularna glazba. Među učenicima osmih razreda glazba je također vrlo važna u životu (N=33), dok se ovdje veći broj učenika opredijelio za ne znam u pitanju o kvaliteti umjetničke glazbe.

### Zaključak

„Glazba je prirodni peacemaker“ (Campbell, 2005, 71)

Brža glazba djeluje tako da nam srce brže kuca i, obratno, sporija glazba nas smiruje, usporava rad srca, te na taj način smanjuje stres i napetost. Također, glazba smiruje i mišićnu napetost, poboljšava pokrete tijela, koordinaciju, utječe na tjelesnu temperaturu.

Nastava glazbene kulture u prvom redu treba biti mjesto gdje će učenici polako, ali sigurno ući u svijet umjetničke glazbe, u nepresušni izvor ljepote. Učitelji glazbe trebali bi kod učenika razvijati osjećaj za lijepu glazbu. U današnjem svijetu u kojem smo okruženi glazbom upitne kvalitete, jako je teško to postići. Melodije lakih nota, jednostavnih refrena, poput „muzičkog crva“ uvlače se pod našu kožu i u glavu. Takve su melodije vrlo smišljeno napravljene jer novac i dobra prodaja u prvom su planu kapitalističkog svijeta. Ova se opaska prije svega odnosi na modernu popularnu glazbu. Učitelji glazbe trebaju učenicima otkriti njima nepoznat svijet umjetničke glazbe. Učenici nastavu glazbene kulture prije svega doživljavaju kao lijep, opuštajući sat. Sat bez stresa i napora. I to bi tako trebalo biti. Učenici su dovoljno opterećeni nastavnim planom i programom ostalih predmeta koji traže učenje napamet informacija, bez imalo kreativnosti. Učenici bi trebali biti kreativni, uzimati od nastave ono najbolje.

Od uvođenja HNOS-a (Hrvatski nacionalni obrazovni standard) 2006. godine, učitelji imaju slobodu koncipiranja nastave prema svojim i učeničkim željama i mogućnostima u nastavi glazbene kulture. Integrativni („svaštarski“) model nastave je napušten, a učitelj je taj koji će u suradnji s učenicima odrediti koju aktivnost njegovati (pjevanje, sviranje ili stvaralaštvo). Ono što je važno, slušanje je glazbe te usvajanje određene količine glazbenih pojmova. Kod ovog zadnje navedenog zadatka, često čujem pitanje s početka našeg članka, pogotovo u 8. razredu gdje učenici upoznaju različita glazbeno-stilska razdoblja. Odgovor je vrlo jednostavan. Poznavati najpoznatije skladbe iz svijeta umjetničke glazbe te znati tko ih je skladao pitanje je opće kulture. U skladu s tim, svakom obrazovanom pojedincu trebalo bi biti poznato da je L. Van Beethoven napisao devet simfonija te da je „Vltavu“ skladao B. Smetana. Isto vrijedi i za, npr. kemijske simbole u nastavi kemije (povlačim smiješnu, ali logičnu paralelu). Ljudi se od ostalih živih bića razlikuju po tome što imaju slobodu, volju i kulturu.

Platon je rekao: „Što je u državi bolja glazba, bolja će biti i država“. Ova njegova izreka se itekako može primijeniti na današnje stanje popularne glazbene scene. Zato nam je potrebna glazbena kultura.

## 4.1. TRANSLATION OF THE SOURCE TEXT 3

### WHY MUST ONE GET ACQUAINTED WITH ART MUSIC?

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#### **Abstract:**

Music has always been present in our lives – from the earliest time to the present day. Over time, humans began to notice that music calms them, stimulates them, motivates them, inspires them... This article discusses how music influences people, that is, the psychophysical effects of music. Also presented are results of a survey conducted between fifth and eighth grade students (N = 80) in order to determine how they perceive music. The data shows that students like to listen to music because it relaxes and entertains them. Students are more acquainted with popular music, but they are able to accept and fall in love with art music if a music teacher puts in the effort to present it properly. Also discussed is the effect of art music as a "trigger" for creativity, motivation, energy and its therapeutic effect.

**Keywords:** music taste, music class, students, artist music

#### **Introduction**

Often, especially in high school, students ask themselves why should they take music classes and why should they get acquainted with art music. This article will give a brief overview of how music influences people and the facts which support the listening of art music.

Firstly, we shall clarify the origin and meaning of the words *glazba*<sup>10</sup>/ *music*, *odgoj* (*education*), *culture* and *pedagogue*. The word *glazba* comes from the Slavic word *glas* (voice) + *ba* (suffix), while the word *music* is found worldwide, so its origin should be traced back to the time of ancient Greeks. Music comes from Greek word μουσική τέχνη (*mousikētéchnē*) which means art of

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<sup>10</sup> Croatian word for music

the *Muses*. Only μουσική was retained from the original word, which means *Muse*. Muses were patrons of poetry, art and science. The word *odgoj* (*education*) has its root in the verb *gojiti* (*to cultivate*), which relates to a living being and means to help someone grow and live. It also means nourishing, feeding, caring for, or raising a human. The word *culture* comes from Latin *colere*, which means to inhabit, cultivate, protect, worship. The word *pedagogy* comes from Greek *paidagogos* (παιδαγωγία). In Greek, the word *paidos* means child, and the verb *ago* means to guide, to follow. From this we can conclude that a pedagogue is a person who leads, keeps track of and cares for a child. If we combine all these words and try to determine the role of a music teacher/pedagogue, then his task would be to guide, direct, bring music closer to a child/student. But why then do people so often ask where is the importance of getting acquainted with art music and taking music classes? Why do we pay so little attention to (fine, literature, theater...) art today? Has the fast pace of life distanced us from that which is primordial within us, that which has been within us all along?

### **Music and man**

Musicality is developed in the first nine years of life. Infants react to noises and in the second year children begin to produce music spontaneously. When in preschool age, they are already able to sing songs which they have heard, better understand melodies, and are able to distinguish sounds and repeat simple rhythms. At the age of nine, children are able to discern diaphony and cadences, and at the age of twelve to seventeen they are able to experience music meaningfully and emotionally (Krafft and Semke, 2008).

There are several reasons why music should be cherished. Most authors emphasize the psychological, physical, aesthetic and therapeutic qualities of music.

Many philosophers have been studying music since ancient times. According to Plato, the lack of musicality leads to the lack of experiencing beauty. Likewise, he considered music to be the education for the soul (and gymnastics a rest for the body). In his second book, *Laws*, Plato talks about the so-called Choral dance, in which the whole education, i.e. the connection of gymnastics and music, is presented. In the first part, Choral dance is associated with a voice, that is, a melody consisting of rhythms and harmony ("when the sound of the voice penetrates

the soul, we took that to be an education in virtue”, Plato) while the second part is associated with the same rhythms as the first part, but with body movements. (Barbarić and Šegedin, 2010).

“We listen to music with our muscles.” The philosopher Nietzsche was a great supporter and admirer of the arts. He studied the connection between the human psyche and music and spoke of the music’s ability to excite the nervous system. He spoke of the so-called *dynamic* abilities of music, which are best reflected in dance, because dance as such unites movement and music. Music has the ability to induce, initiate and regulate movement (Sacks, 2012).

Important scientific research which sought to explore how music affects the brain began in 1977, when MacDonald Critchely and R. A. Henson published the book *Music and the brain*. G. Schlang and his Harvard associates also did research in this area (Sacks, 2012). Using MRI morphometry in their work, they compared sizes of different brain structures. They published their work in 1955. They concluded that *corpus callosum* (set of nerves connecting the two hemispheres of the brain) was larger in people who practiced music, and that *planum temporale* (part of the auditory cortex) increased asymmetrically in people with perfect pitch. They also found that the amount of gray matter in the motor, auditory and visuospatial parts of the cortex and cerebellum was increased in such individuals.

In addition to its neurological effect, music has a positive effect on the human body. It affects the heart rate and the breathing rhythm, and thus can change the listener’s mood. Slower music will slow the heart rate, calm the breathing, and thus calm the listener. Music is often used as a motivational tool while working, e.g. in more difficult physical jobs, because of its rhythmic repetition and proper structure of movement, it enables people to move more easily. It has a positive effect on athletes as well. Sacks (2012) in his book *Musicophilia: Tales of Music and the Brain* gives an example of a swimmer who listened to classical music while swimming. It relaxed his muscles, allowing him to move more easily in the water. Music also serves as a means to connect people (socializing at concerts, discussing musical tastes ...), which is an important feature in this time of alienation. There are several other interesting phenomena related to music, such as synesthesia (people seeing colors while listening to music), and then

music as a mnemonic device (making it easier to remember facts and concepts). It is also used for controlling various neurological and psychiatric disorders (Parkinson's disease, autism...), headaches, giving birth, etc.

Oliver Sacks (2012) also discusses the therapeutic effects of music in his book, *Musicophilia: Tales of Music and the Brain*. In doing so, he does not mean that music miraculously cures people from serious illnesses, rather it helps people in controlling their movements, fears, emotions. The Melodic Intonation Therapy was conducted by Martin Albert and his associates in 1973. During the therapy, patients with speech disorders were taught to sing short phrases such as "How are you today?" They gradually eliminated the musical elements until they were left with ordinary speech. The therapy has proven to be very effective. It is widely known that people who stutter can sing without any problems. Darwin wondered whether that was because song/music (however primitive) might have preceded speech. Likewise, it has been proven that listening to music or imagining it (without body movement) activates the motor cortex and subcortical motor systems.<sup>11</sup> Imagining music can be just as important as actually listening to it (Sacks, 2012). Sacks discusses the impact of music on a human's psychological sphere and provides numerous testimonies and letters from his patients. He also believes that music's development potential requires stimulation. From this, we can conclude that, in addition to parents who can provide their children with the necessary stimulation and motivation, there is an even greater responsibility on the expert - the music teacher.

Jensen (2003) suggests that music should also be introduced into non-musical subjects in order to better stimulate and motivate students. He recommends *baroque music* as calming background music (Vivaldi, Bach, Händel...); *classical music* to foster creativity, for storytelling, lectures and also as background music (Mozart, Haydn, Beethoven); *romantic music* to stimulate emotions (Schubert, Tchaikovsky, Wagner, Dvořák...).

He also offers specific examples:

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<sup>11</sup> Chen, Zatorre and Penhune studied how people maintained tempo, using pictorial representations of the brain to note the changes that were taking place. They found that the motor cortex and the subcortical system were activated in the base ganglia and in the cerebellum while subjects responded differently to music (Sacks, 2012)

- Background music (*The Four Seasons; Water Music; Brandenburg Concertos...*)
- Creative problem solving (*Chopin's Études; Claire de Lune; Swan Lake...*)
- Calming music (*Claire de Lune; Trois Gymnopédies...*)
- Celebrations (*Triumphal March from Aida; Hallelujah from Messiah...*)
- Music which entices movement (*Boléro; Hungarian Dances; Bach's Prelude in D major...*)
- Tests and quizzes (*Baroque music*).

Phenomenon known as the *Mozart effect* holds a special place in the study of music and its effects on humans. Gordon Shaw claims that Mozart's music can *warm up* the brain. "We assume that complex music helps certain complex neural patterns which participate in higher brain activities such as math or chess. On the other hand, simple music, as well as music with repeated elements, could have the opposite effect" (Shaw, 1995 in Campbell, 2005, 24).

This phenomenon (music's ability to transform the human psyche) is called the Mozart effect because his music has been shown to have the longest and most efficient effect due to its purity and simplicity of sound. "Undoubtedly, the rhythms, melodies and high frequencies found in Mozart's music stimulate and excite the creative and motivational areas of the brain" (Campbell, 2005, 35).

## Research

The survey was conducted during the school year 2012/2013 among the fifth and eighth grade students of the elementary school Zrinski, Nuštar. In the aforementioned classes, music classes are conceptualized differently. Activities such as singing and listening dominate in the fifth grade, but activities like playing music and dancing are not neglected. In the eighth grade, the emphasis is on familiarizing students with musical forms and periods by listening to different examples of music. The aim of this survey was to observe how students perceive music and how it affects them. We have selected the most interesting out of the ten questions asked. The total number of respondents is N = 80 (forty students from the fifth grade and forty students from the eighth grade).



## Results

Most students love to listen to music, as seen in Figure 1. By comparing the fifth and eighth grade students, we can see that music is present in their everyday lives. In the fifth grade, 34 students opted for the answer *always*, while in the eighth grade this number was even higher (N = 38). Interestingly, not one student chose the option *never*. This information shows us that music plays a big and important role and that students love to listen to it.

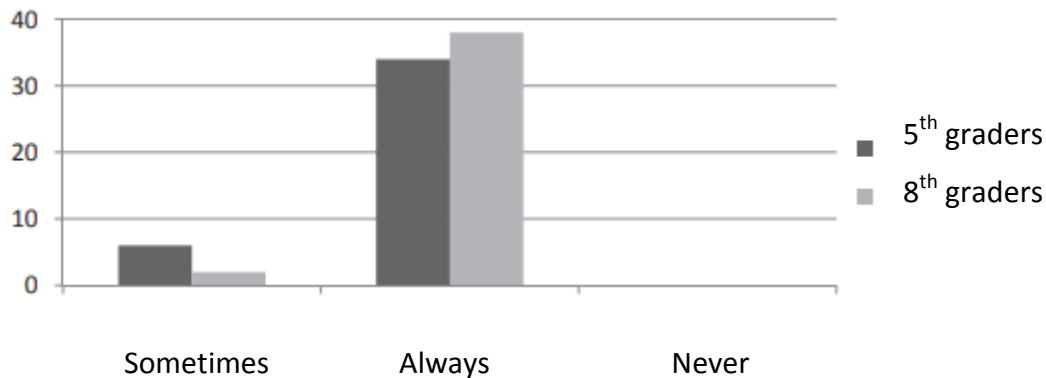


Figure 1. Frequency of music listening in fifth and eighth grade students

Figure 2. shows the extent to which music acts as a means of relaxation. Comparing fifth and eighth graders, we see that the number of students who are positively influenced by music is higher than eighth grades (N = 31). One fifth grade student said that music does not relax him. This effect of music is probably conditioned by the situation in which other students find themselves.

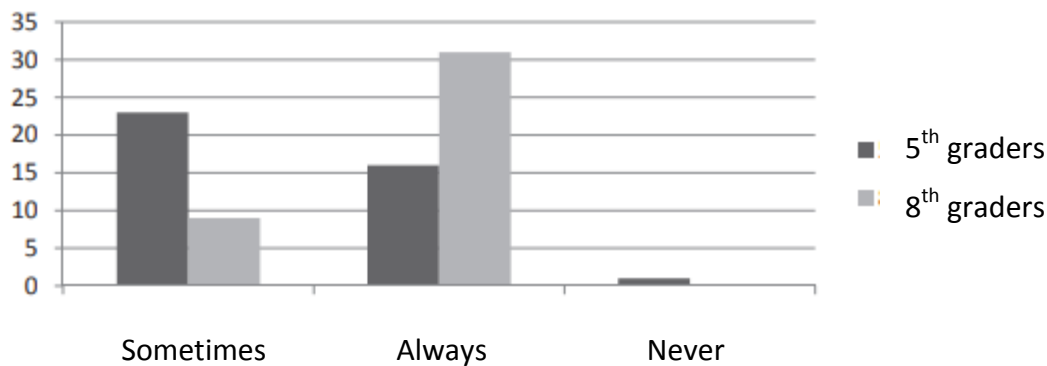


Figure 2. Music as a means of relaxation

Figure 3. shows the frequency of music influencing students' moods. We can see that music has a greater influence on the mood of eighth grade students (N = 25) than fifth grade students (N = 16). A small percentage of students said that music does not affect their mood (N = 1 in fifth graders, N = 4 in eighth graders)

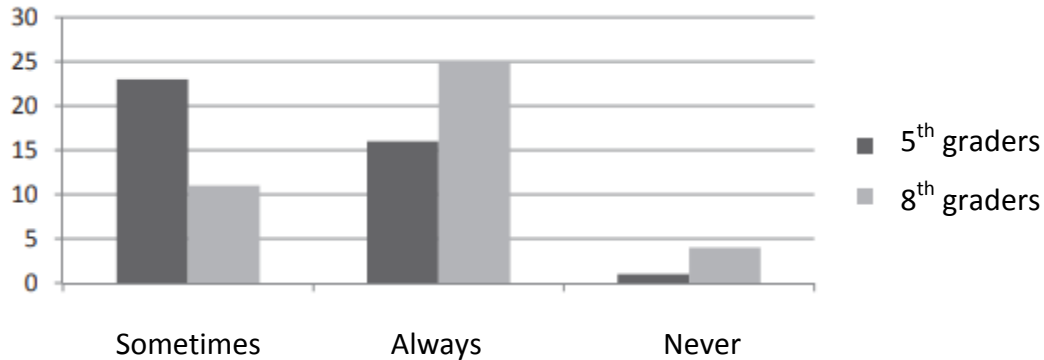


Figure 3. Influence of music on a students' mood

One survey question regarded the representation of listening to art music at home. Less than half of fifth grade students have no habit of listening to art music at home (N = 17), and that number is even higher (N = 24) among eighth graders.

A large majority of students love music, which can be seen from the tables. Students love listening to music (as much as 95% of eighth grade students), they find it relaxing and affecting their mood. As expected, a very small percentage of students listen to art music at home. Nevertheless, students love being in music classes because music has a positive effect on them, it relaxes and stimulates them. Last but not least, they find music classes fun.

<b><u>Fifth grade</u></b>	YES	NO	I DON'T KNOW
Do you consider music an essential part of your life?	30	3	7
Do you consider art music as 'quality music'?	24	3	13
Would you say that your music class has good quality?	36	0	4
Do you think that art music has a positive impact on the development your personality?	24	0	16

Figure 4. Influence and the quality of music/music classes among fifth graders

<b><i>Eighth grade</i></b>	YES	NO	I DON'T KNOW
Do you consider music an essential part of your life?	33	2	5
Do you consider art music as 'quality music'?	14	8	18
Would you say that your music class has good quality?	31	0	8
Do you think that art music has a positive impact on the development your personality?	16	5	19

Figure 5. Influence and the quality of music/music classes among eighth graders

Music has a very important place in the lives of fifth graders (N = 30). They consider art music to be of quality, although they are much more familiar with popular music. Music is also very important among eighth grade students (N = 33). A larger percentage of eighth grade students have opted for the *I don't know* option when asked about the quality of art music.

### **Conclusion**

*"Music is a natural pacemaker" (Campbell, 2005, 71)*

Faster music makes our heart beat faster and, conversely, slower music calms us down, slows our heart rate, reduces stress and tension. Furthermore, music eases muscle tension, improves body movements, coordination, affects the body temperature.

Music classes should, first and foremost, be a place where students slowly but surely enter the world of art music, the inexhaustible source of beauty. Music teachers should develop a sense for beautiful music in students. That is a difficult achievement in a world where we are surrounded by music of questionable quality. Like a "music worm", catchy tunes and simple choruses get under our skin and into our heads. Such tunes are deliberately made because money and good sales are at the forefront in the capitalist world. This remark refers mostly to modern popular music. Music teachers should familiarize students with the unfamiliar world of art music. Students primarily experience music classes as nice, relaxing lessons. A lesson

without stress and strain, which is how it should be. Students are already burdened with other subjects' curriculum, forcing them to learn by heart, leaving no room for creativity. Students should be creative and should take only the best from their classes.

Since the introduction of HNOS (Croatian National Educational Standard) in 2006, teachers have been free to conceptualize music classes according to their own and their students' desires and opportunities. The integrative ("all-round") model of teaching has been abandoned and the teacher, in collaboration with their students, determines which activity to nurture (singing, playing, or creating). Listening to music and learning a certain amount of musical concepts is what matters. Regarding that last task, I often hear the question from the beginning of our article, especially among eighth graders, when students learn about different music styles. The answer is pretty simple. Knowing the most famous art music compositions and their composers is a matter of general knowledge. Accordingly, every educated individual should be aware that L. Van Beethoven wrote nine symphonies and that "Vltava" was composed by B. Smetana. The same is true of, e.g., chemical symbols in chemistry classes (I draw a ridiculous but logical parallel). Humans differ from other living beings because they have freedom, will and culture.

Plato stated: *"The better the music, the better the nation"*. His saying can be applied to the current state of popular music scene as well. That is why we need music classes.

## 4.2. COMMENTARY AND ANALYSIS

### WHY MUST ONE GET ACQUAINTED WITH ART MUSIC?

1. **genre:** scientific article

2. **source:** article in *Life and School: Journal for the Theory and Practice of Education*

3. **audience:** general audience, music teachers, pedagogists

4. **purpose of writing:** to highlight the importance of teaching music culture in schools, informing students on various music genres and benefits which different styles provide

5. **authenticity:** original work, professional paper written by Mia Mucić

6. **style:** informative, clear, cohesive

7. **level of formality:** formal

8. **layout:** bold title followed by the name of the author and an abstract. The text is divided into four parts: *Introduction, Music and man, Research and Conclusion*. The author also provides graphs and tables to further illustrate the results of the research.

9. **content:** the author first introduces the reader to the origin and meaning of Croatian words *glazba/muzika, odgoj, kultura i pedagog*. After her explanation of the aforementioned words, she begins to comment on the connection between humans and music, stating how we can process music from the earliest age. Following this, the author discusses some psychical, physical and therapeutic benefits of music while providing relevant references, literature and research. Also stated are some specific examples of music and their apparent benefits and contextual uses. She also reports on a research done in elementary school Zrinski, among fifth and eighth graders.

10. **cohesion:** cohesion is achieved by following a single theme throughout the article. The whole work revolves around music, its importance and its benefits.

**11. sentence patterns:** the author often uses long sentences, written in active voice. Although the sentences are somewhat longer, they are often clear and easy to understand. Occasionally, the author uses everyday speech or conversation sentences.

**12. terminology of the subject:** this article contains many names of compositions or songs which have to be accurately translated into the target language. There is also occasional use of medical terms for body parts, e.g. *slušni korteks*, in order to scientifically explain a certain claim.

While reading the title of the source text, the first potential problem that came into my mind was how to translate *umjetnička glazba*? My first assumption was *artistic music*, but through researching the Internet, I found that the correct translation should be *art music*, because *art music* is a term used for Western classical music which is considered to be of high value, which is precisely the type of music discussed in this article.

In the abstract, the author mentions that music *nadahnuje, motivira, inspirira*. These synonyms were a bit harder to translate because they essentially mean to motivate or to inspire, so I had to choose whether to omit one word, or provide a word of similar meaning. I opted for the latter, choosing to translate *nadahnuje* as *stimulate*. Although the words *nadahnuje* and *stimulate* aren't the best choice for word-for-word translation, *to stimulate* can be used as a synonym for *to inspire*.

Similarly, there is an instance in which the author discusses the meaning of Croatian words *glazba/muzika*. This problem required a different solution because the word *music* has no adequate synonym in the English language. Instead of omitting one of the words, I have chosen to leave the Croatian word *glazba* in the translated text, and provide a footnote explaining that *glazba* is a Croatian word for music. I applied a similar solution for the sentence "*Riječ odgoj ima svoj korijen u glagolu gojiti*". If the translated sentence was "*The word education has its root in the verb to cultivate*", the similarities between the Croatian words *odgoj* and *gojiti* would be completely lost, and the sentence wouldn't make much sense. To solve this problem, I chose to leave Croatian words in the sentence, while providing their meaning in parentheses.

While discussing the conducted research, the author states that *“Izlazni podatci pokazuju (...)”*. I had trouble understanding the intended meaning of *izlazni podatci*, and if I were to translate it as, for example, *output data*, I was afraid that it wouldn't have the same meaning in the target language. In this particular case, I have opted for omitting the word *output*, and just translating it as *“The data shows (...)”*, because I believe that this has more sense in the English language.

Another sentence which I found ambiguous in meaning is *“Prema Platonu, nedostatak muzikalnosti vodi u nedostatak iskustva lijepoga”*. What exactly does *nedostatak iskustva lijepoga* mean? Offering a word-for-word translation wouldn't produce a meaningful sentence, and sense-for-sense translation is almost impossible because of the ambiguity of the sentence. My solution would be to translate this sentence as such: *“According to Plato, the lack of musicality leads to the lack of experiencing beauty”*. Similarly, phrases such as *melodije lakih nota* and *svaštarski model nastave* needed a more creative approach because they don't really mean much without their context. *Melodije lakih nota* can be translated into *melodies of light (or easy) notes*, but can a melody have light notes? Would an English speaker understand the meaning of such a phrase? In this case I have opted to provide a different phrase which is closer to a native speaker, *replacing melodies of light notes with catchy tunes*.

The author mentions one of Plato's quotes, which states that *“ono od glasa što prodre do duše je krepost”*. The quote itself is linked to the concept known as Choral dance, so in order to translate this as accurately as possible, I searched for the English version of this quote which I found to be *“when the sound of the voice penetrates the soul, we took that to be an education in virtue”*. Another thing which I had to research was *Terapija melodijskom intonacijom*, which is mentioned in the text. The aforementioned procedure was conducted by Martin Albert in 1973, and I have found that the original title of this procedure is *The Melodic Intonation Therapy*. Likewise, terms such as *slušni korteks*, *mali mozak*, *dvoglasje*, *sinestezija*, *mororički korteks* and *subokortikalni motorički sustavi*, as well as the original titles of compositions used in the source text, all had to be researched in order to provide an accurate translation.

## 5. CONCLUSION

Writing this B.A. thesis led me to the realization that the process of translation is a daunting task which requires overcoming a series of challenges and seemingly simple problems to produce a quality translation. To a translator, the source text is like a puzzle which requires extensive research and creative thinking for it to be successfully and accurately reproduced in the target language. Before commencing the translation process, the translator must study the source text, understand it, know its purpose and aimed audience. They also have to be acquainted with the style, jargon, terms and phrases which often times do not translate easily, nor make sense in the target language. Only after completing all these steps can the translator start solving their puzzle.

Producing a proper translation is in no way an easy task. In order to translate any text, the person translating it must be aware of the extralinguistic context surrounding the source text, and also the context and the culture of the audience which the translated text targets. The translator has to bear this in mind at all times in order to produce a translated text which will feel natural to a native speaker.

While translating, I had to make a series of decisions which ultimately impacted on the quality and accuracy of my translation. As a translator, I attempted to solve my puzzle by choosing the best possible option for a given problem, which meant that I sometimes had to modify sentences, invert them, omit words, replace phrases and alter the text in order to produce a quality sense-for-sense translation of the source text. Like a puzzle, every text has its unique problems and solutions, and it is the translator's job to overcome the obstacles and arrive at the correct decision.