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## PROSLOV

*S velikim zadovoljstvom i u ime cijelog uredništva predstavljamo dvobroj 37/38 časopisa Opuscula Archaeologica koji je utemeljen 1956. godine, te s više ili manje poteškoća izlazi više od pet desetljeća. Usprkos trenutnim financijskim poteškoćama pred nama je časopis koji i ovoga puta, i to sa 19 članaka od 25 autora, na preko četiri stotine stranica, objavljuje znanstvene, pregledne i stručne tekstove visoke kvalitete.*

*No, ovaj dvobroj časopisa Opuscula archaeologica se razlikuje od prethodnih izdanja jer se sastoji od dva tematska poglavlja. U prvom poglavlju je jedanaest radova koji su, u skladu s tradicijom našeg časopisa, posvećeni različitim arheološkim problemima koji će kako znanstvenicima, tako i drugima, dati mogućnost dobivanja uvida, ne samo u nepoznatu arheološku građu, nego i mogućnost upoznavanja s najnovijim razmišljanjima o određenim problemima kao i njihovim mogućim rješenjima. Drugi dio broja 37/38 časopisa Opuscula archaeologica nas posebno raduje jer se sastoji od osam radova posvećenih 30-godišnjici smrti uglednog hrvatskog profesora prapovijesne arheologije Stojana Dimitrijevića. Radovi su prezentirani na skupu posvećenom Stojanu Dimitrijeviću na Filozofskom fakultetu u Zagrebu 13.12.2011.*

*Napor koji je uredništvo časopisa uložilo u izlazak ovoga broja nije nas obeshrabrio nego potaknuo da i dalje činimo sve potrebno da bi autori i dalje imali priliku objavljivati članke za koje smatraju da doprinose arheološkoj znanosti. Za kvalitetu objavljenih priloga brinuo se cijeli tim recenzentata, čije je mišljenje i omogućilo da svaki prilog ima onu kvalitetu kakvu naš časopis i zaslužuje. Stoga na kraju svim autorima i suradnicima najsrdačnije zahvaljujemo na priložima tiskanim u ovome broju časopisa Opuscula archaeologica.*

*Glavni i odgovorni urednici*

## PROLOGUE

*We are proud to present a double volume 37/38 of Opuscula archaeologica on behalf of the Editorial board. Since its first volume in 1956, journal Opuscula archaeologica has been publishing scientific articles in the field of archaeology and other historical disciplines. Despite current financial challenges we were able to publish 19 articles by 25 authors on more than 400 pages containing high quality original scientific articles and professional papers.*

*The structure of this double volume differs from previous ones because it is divided into two sections. The first section consisting of 11 articles that are, in the tradition of this journal, facing specific archaeological issues. We hope that these articles will provide information to readers on new, unpublished material and current debates. The second section contains 8 papers dedicated to the 30th anniversary of death of Professor Stojan Dimitrijević, a distinguished professor of Prehistoric Archaeology at the University of Zagreb. These papers were originally presented at the conference organized by the Faculty of Humanities and Social Sciences, University of Zagreb on December 13th 2011.*

*Various challenges presented to us during the preparation of this volume were not discouraging, but, on the contrary, gave us the additional motivation to secure the future of this journal as a platform for publication of quality scientific and professional papers by fellow scholars. Extensive team of domestic and international reviewers is the quality assurance of the published articles, and the journal as a whole.*

*We would like to express our gratitude to all contributors whose articles are published in this double volume.*

*Editors*



Ivor JANKOVIĆ & Tena ŠOJER

## EVOLUCIJA GOVORA I JEZIKA

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### THE EVOLUTION OF SPEECH AND LANGUAGE

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*Rad se bavi tematikom evolucije govora i jezika i pokušava putem multidisciplinarnog pristupa i na temelju različite građe i dostupnih podataka i rezultata istraživanja prokurtiti u pitanja vezana uz pojavu modernog jezika i govora. Od posebnog je interesa pitanje javlja li se moderan jezik saltacijski i zajedno s nekim od ostalih elemenata „moderniteta“ (tzv. „Human revolution model“ ili „Cognitive revolution model“) ili je rezultat dužeg evolucijskog razvoja u kojem se određeni preduvjeti i elementi za razvoj govora i jezika javljaju ranije od drugih. Navedena pitanja pokušalo se razmotriti kroz rezultate komparativnih istraživanja naših najbližih evolucijskih rođaka, čovjekolikih majmuna, putem komparativne anatomije, fosilne građe te arheološke građe sensu stricto, odnosno ostataka materijalne kulture. Na temelju dostupne građe zaključeno je da je suvremeni jezik rezultat dugog evolucijskog razvoja i da se određeni elementi javljaju u različito vrijeme tijekom evolucijske povijesti plemena hominini.*

*Ključne riječi: evolucija govora, evolucija jezika, paleoantropologija, paleolitik, prapovijest, simbolika, umjetnost*

*The paper deals with the topic of the evolution of speech and language and aims to, through a multidisciplinary approach and based on different material and available data and results, answer the question of the appearance of modern language and speech. Especially interesting is the question of whether modern language appeared through the process of saltation or in combination with some other elements of “modernity” (the so called “Human revolution model” or “Cognitive revolution model”) or if it is a result of a longer evolutionary development in which certain conditions and elements necessary for the development of speech and language appeared before others did. The authors attempted to answer these questions through the results of comparative research done on our closest evolutionary cousins, apes, through comparative anatomy, fossil material and archaeological material sensu stricto, that is, through remains of material culture. Based on available material, we conclude that modern language is a result of a long evolutionary development and that different elements appeared at different times during the evolutionary history of the tribe hominini.*

*Key words: evolution of speech, evolution of language, paleoanthropology, Paleolithic, prehistory, symbolism, art*

## UVOD

Jezik je jedna od temeljnih odrednica čovjeka i utkan je u sve domene ljudskosti. Nemoguće je zamisliti ijedno suvremeno ljudsko društvo (kao ni mnoge civilizacije, društva i zajednice u prošlosti) a da se ne dotaknemo pitanja vezanih uz jezik. Stoga ne čudi da se pitanjima o pojavi i razvoju komunikacije, govora i jezika bave mnoge struke. Primjerice, Aristotel je kao jednu od osnovnih razlika između čovjeka i životinjskog svijeta pronalazio u jeziku i našoj sposobnosti prenošenja misli putem ovog medija (vidi Barner 1984). Cilj ovog rada je na temelju odabrane građe (komparativne studije čovjekolikih majmuna, anatomije, fosilne građe, ostataka materijalne kulture, kao i suvremenih genetičkih istraživanja) pokušati proniknuti u pitanje kada se javljaju određeni aspekti onoga što običavamo nazivati „modernim jezikom“. Znanstvenici se uglavnom u razmišljanjima o evoluciji jezika priklanjaju ili modelu prema kojem jezik ima dugu evolucijsku prošlost i prema kojem se određeni aspekti (komunikacijski, govorni i jezični) javljaju u različito vrijeme, te modelu prema kojem se „moderan jezik“ javlja saltacijski, u sklopu evolucijskog paketa „moderniteta“ (koji uključuje i druge aspekte „modernog“ ponašanja, modernu anatomsku građu, te nerijetko u raspravama ima i taksonomski značaj). Stoga je osnovno pitanje kojim ćemo se baviti u radu zapravo suprotstavljanje ovih dvaju pristupa, koje bi, koristeći se rječnikom evolucijske biologije mogli nazvati postupnim, darvinističkim modelom s jedne strane, te saltacijskim modelom, s druge strane. Namjera nam nije bila nije donijeti detaljan pregled svih razmišljanja i teorija o pojavi jezika, niti o pojavi pojedinih jezičnih skupina, kao ni detaljno raspravljati o načinu komunikacije koji je prethodio pojavi vokalne komunikacije kao osnovnog načina jezične komunikacije čovjeka (iako ćemo se nakratko dotaknuti i tih pitanja).

## MATERIJALI I METODE

U radu polazimo od hipoteze da su se svi, ili gotovo svi, aspekti modernog jezika (i govora kao osnovnog modaliteta jezika) javili otprilike u isto vrijeme (u skladu sa saltacijskim modelom). U provjeri navedene hipoteze služiti ćemo se prvenstveno objavljenim rezultatima istraživanja komunikacije i jezičnih sposobnosti naših najbližih evolucijskih rođaka, čovjekolikih majmuna, komparativnom anatomijom morfoloških kompleksa vezanih uz govor i jezik (posebice mozak i vokalni trakt), raspoloživom fosilnom građom plemena hominini (rodovi *Australopithecus* i *Homo*), materijalnom ostavštinom kao

## INTRODUCTION

Language is one of the basic human features and is included into all domains of humanity. It is impossible to imagine a contemporary human society (and many civilizations, societies and communities in the past), without discussing language-related issues. It is not surprising, therefore, that the questions on the appearance and development of communication, speech and language are discussed in many professions. For example, Aristotle, saw language and our ability to transfer thought through this medium as one of the characteristics differentiating us from the animal kingdom (see Barner 1984). The aim of this paper is to, based on selected reading (comparative studies of apes, anatomy, fossil remains, remains of material culture and contemporary genetic research), try and answer the question of when certain aspects of what we tend to call “modern language” appeared. Scientists, discussing the evolution of language, generally lean towards either the model which states that language has a long evolutionary history where certain aspects (communicational, speech-related and linguistic) appear at different times, or the model which states that “modern language” appeared through the process of saltation as part of evolutionary “modernity” (including other aspects of “modern” behavior, modern anatomical built, often of taxonomical significance). The basic question, therefore, is the juxtaposition of these two approaches which could be, using the vocabulary of evolutionary biology, called the Darwinian on the one, and saltation on the other hand. The authors did not mean to write a thorough overview of all thoughts and theories on the emergence of language, nor on the appearance of certain language groups, nor to go into detail about the ways of communication which preceded the appearance of verbal communication as the basic mode of linguistic communication of man (although we will briefly also discuss these issues).

## MATERIALS AND METHODS

The paper starts from the hypothesis that all, or almost all, aspects of moderns language (and speech as the basic mode of language) appeared approximately at the same time (in accordance with the saltation model). Testing this hypothesis, we will primarily use published results of communication and language skill research of our closest evolutionary cousins, apes, comparative anatomy of morphological complexes relating to language and speech (especially the brain and the speech apparatus), the available fossil fund of the tribe hominini (genera

temeljem razumijevanja ponašanja u prošlosti (artefakti, način života, „simboličke“ pojave i sl.) te novijim rezultatima genetičkih istraživanja (primjerice FOXP2 gena) vezanim uz pitanja od interesa za naš rad.

## JEZIK U EVOLUCIJSKOJ PERSPEKTIVI

Svaka mitologija ima svoju priču o postanku jezika, a različita objašnjenja nalaze se i u svetim pismima različitih religija. Darwinova je publikacija *O podrijetlu vrsta* napravila potpuni preokret u promišljanju ljudskih početaka te istovremeno pružila nov pristup ovom problemu, koji je utemeljen na znanstvenom pristupu. Unutar evolucijske perspektive razlikuje se niz teza o razvoju i pojavi jezika, načinu na koji se razvio te modalitetu koji je u početku prevladavao. Tako se s jedne strane pretpostavlja da je jezik rezultat postupne promjene iz životinjskog komunikacijskog sustava u moderni ljudski jezik (vidi npr. Pinker & Bloom 1990; Lieberman 1984; Corballis 2009 i tamo citiranu literaturu), dok drugi autori pojavu modernog jezika vide kao naglu promjenu koja se dogodila tek nedavno u ljudskoj evoluciji i često je vežu uz anatomske moderne ljude i pojavu simbolike i „modernijeg ponašanja“ u vrijeme gornjeg paleolitika (vidi npr. Bickerton 1995; Mithen 1996; Noble & Davidson 1996; Wadley 2001; Mellars 1973, 2005; Klein 1973, 1995 i tamo citiranu literaturu).

Darwin (1871.) je u djelu *O podrijetlu čovjeka* predložio kako je jezik nastao iz imitacije i modifikacije različitih zvukova iz prirode te posebnih ljudskih povika, potpomognut znakovima i gestama i favoriziran prirodnim (spolnim) odabirom. Mnogi se slažu s tom pretpostavkom te ističu prednosti zvučnoga govorenoga jezika kao dokaze vokalnih jezičnih početaka (Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005; Hewes 1973), dok se komparativna istraživanja primata koriste kao temelj gestikularne teorije (Corballis 2009, Armstrong *et al.* 1995; Armstrong i Wilcox 2007; Goldin-Meadow & McNeill 1999).

Prvi i osnovni korak u proučavanju jezika u prapovijesti je definiranje samog pojma *jezik*. Mnogo se znanstvenih disciplina bavi proučavanjem jezika i svaka od njih imati će svoju definiciju već prema vlastitim potrebama. Zajednički je nazivnik svima, međutim, činjenica da je jezik univerzalan i jedinstveno ljudski fenomen. Radi lakšeg snalaženja, u tekstu koristimo radne definicije osnovnih pojmova vezanih uz tematiku rada. Pod pojmom *komunikacija* smatramo svaku interakciju kojoj je svrha prenošenje određene informacije, bez obzira na medij kojim se

*Australopithecus* and *Homo*), and material remains as the basis for understanding past behavior (artifacts, way of life, “symbolic” occurrences and the like) and newer results of genetic research (e.g. the FOXP2 gene) connected to questions we discuss in this paper

## LANGUAGE FROM AN EVOLUTIONARY PERSPECTIVE

Every mythology has its own story on the emergence of language, and holy scriptures of different religions also offer different explanations. Darwin's publication *On the origin of species* marked a complete change of perspective on thinking about human origins and, at the same time, created a new approach to solving this problem, one based on science. The evolutionary perspective consists of several assumptions about the development and emergence of language, the way in which it developed and the modality which was dominant at first. On one hand, language is supposed to be a result of a gradual change from the animal communication system to modern human language (e.g., see Pinker & Bloom 1990; Lieberman 1984; Corballis 2009 and therein cited bibliography), while other authors saw the emergence of modern language as a sudden change which occurred very recently in human evolution and is often connected to anatomically modern humans and the appearance of symbolism and “modern behavior” in the upper Paleolithic (e.g., see Bickerton 1995; Mithen 1996; Noble & Davidson 1996; Wadley 2001; Mellars 1973, 2005; Klein 1973; 1995 and therein cited bibliography).

Darwin (1871), in his book *The Descent of Man*, proposed the idea that language appeared by imitation and modification of different sounds from nature and special human sounds, and that it was supported by gestures and favored natural (sexual) selection. Many agree with his idea and emphasize the advantage of sounded spoken language as proof of vocalized beginnings of language (Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005; Hewes 1973), while comparative studies of primates serve as a basis for the gestural theory (Corballis 2009, Armstrong *et al.* 1995; Armstrong & Wilcox 2007; Goldin-Meadow & McNeill 1999).

The first and basic step in studying language in prehistory is to define the term *language* itself. Many scientific disciplines study language and each of them has its own way of defining it based on its requirements. However, the common denominator of all of them is the fact that language is universal and uniquely a human phenomenon. To avoid confusion, in this paper we will use loose definitions of the ba-

ta informacija prenosi. Primjerice, u jednoj od prvih evolucijskih analiza komunikacije Otte (1974.) stavlja naglasak na signale kao fiziološke, morfološke ili karakteristike ponašanja favorizirane prirodnom selekcijom u svrhu prenošenja informacije drugim organizmima. No, takva definicija je široka i uključuje ne samo ljudsku, već i komunikaciju kod životinja. Pod pojmom *govor* podrazumijevamo jedan od medija prenošenja informacija putem zvuka. Govor je medij specifičan za čovjeka, a ekvivalent je (iako ne u potpunosti, kao što ćemo kasnije vidjeti) životinjskoj vokalnoj komunikaciji (oba sustava se koriste zvukom). No ljudski je govor mnogo složeniji od vokalne komunikacije kod ostalih životinja (barem kod suvremenih ljudi) jer u njegovoj podlozi leži jezik. Pod pojmom *jezik* podrazumijevamo sustav komunikacije koji se koristi zvukom. No ni ova definicija nije dovoljna da opiše neke od najvažnijih značajki ljudskog jezika, budući da uz komunikacijsku funkciju ljudski jezik ima i simboličku – stoga je ljudski jezik i složen simbolički sustav. Nadalje, za razliku od životinjske komunikacije ljudski je jezik otvoren sustav (Bickerton 1990; Dessalles 2007). Suvremen ljudski jezik sastoji se od određenog broja znakova (simbola) koji omogućavaju bezbrojne kombinacije, kao i izražavanje prošlosti, budućnosti, apstraktnih pojmova i ideja i sl. Iako ograničeni našim vokabularom, svatko od nas uz malo truda može izgovoriti (ili napisati) sasvim novu rečenicu, rečenicu koji nitko nikada još nije izrekao. Životinjska komunikacija uglavnom se koristi ograničenim repertoarom koji se u prirodi većinom prenosi genetski, a ne kulturno (učenjem) i kao odgovor na trenutnu situaciju (upozorenje, ritual parenja i sl.). Komunikacijski signali kod životinja nemaju značenje (niti simbolički aspekt), već funkciju (Li 2002).

Važnu ulogu u proučavanju razvoja jezika imala je ideja koju je razvio lingvist Noam Chomsky (1957., 1965., 1986.). Njegova teorija „univerzalne gramatike“ (*universal grammar*) pretpostavlja da sve ljudske populacije posjeduju urođen sustav za usvajanje jezika, odnosno zajedničku strukturalnu bazu koja pruža gramatičke preduvjete, a koja je zajednička svim suvremenim jezicima. Na ovu osnovnu ideju kasnije se nadovezuju znanstvenici koji pretpostavljaju da je osnovna sintaktička sposobnost nastala saltacijski, mutacijom koja je rekonstruirala neuralnu anatomiju unutar mozga (Piatelli-Palmarini 1989; Bickerton 1990; Newmeyer 1991; Burling 1993). Drugi autori pokušavaju sagledati različite aspekte jezika, govora i komunikacije kroz duži evolucijski razvoj i proniknuti u njihove pleziomorfne i apomorfne elemente (Lieberman 1984, 2000). Za komunikacijski sustav koji prethodi pojavi modernog jezika, a od njega se razlikuje nedostatkom

terminologije povezanoj s predmetom. The term *communication* encompasses every interaction conducted in order to transfer certain information, regardless of medium by which the information is transferred. For example, in one of the first evolutionary analyses of communication, Otte (1974) put emphasis on signals as physiological, morphological or behavioral characteristics favored through natural selection with the aim of transferring information to other organisms. However, such a definition is wide and includes not only human, but also animal communication. The term *speech* encompasses one of the media of transferring information by sound. Speech is an exclusively human medium and is the equivalent (although not entirely, as we explain later on) of animal vocal communication (both systems use sound). Human speech is a lot more complex than vocal communication between other animals (at least in modern humans), because language is its basis. The term *language* is defined as a system of communication by sound. However, this definition also insufficiently describes some of the most important features of human language, since apart from the communicative function, human language has a symbolic one – therefore, human language is also a complex system of symbols. Furthermore, unlike animal communication, the human language is an open system (Bickerton 1990; Dessalles 2007). Contemporary human language contains a specific number of signs (symbols) which allows for countless combinations, as well as expressing the past, future, abstract terms and ideas, and the like. Although limited by our vocabulary, each of us, with a little effort, can say (or write) a completely new sentence, a sentence no one had ever said before. Animal communication mostly uses a limited repertoire which is, in nature, mostly transferred genetically, and not culturally (through learning), and is a response to a certain situation (warning, mating ritual, and so on). Animal communicative signals do not have meaning (nor the symbolic aspect), but serve a function (Li 2002).

An important part in the study of language was linguist Noam Chomsky's idea (1957, 1965, 1986). His theory of *universal grammar* was based on the assumption that all human populations have an inherent system for language acquisition, which is a common structural basis which sets grammatical preconditions and is common to all modern languages. This basic idea was later developed by scientists who supposed that the basic syntactic abilities developed through saltation, i.e. through a mutation which reconstructed the neural anatomy within the brain (Piatelli-Palmarini 1989; Bickerton 1990; Newmeyer 1991; Burling 1993). Other authors tried to study different aspects of language, speech and com-

gramatike, različiti autori koriste različite termine. Primjerice Salzman (1998.) koristi termin *predjezik* (*prelanguage*), dok ga ostali autori nazivaju *protojezikom* (Hewes 1973; Bickerton 1990), iako ovaj termin može dovesti do zabune, budući da je istovjetan onom koji lingvisti koriste za jezik iz kojeg se razvijaju ostali suvremeni jezici, odnosno jezične skupine (npr. proto-indo-europski). Pokušamo li proniknuti u različite aspekte i svojstva jezika i njegovog evolucijskog razvoja, potrebno je barem ukratko obratiti pozornost i na moguće razloge zbog kojih je ovaj nov način komunikacije mogao imati selektivnu prednost nad neverbalnim. Miller (1999.) i posebice Deacon (1997.) naglašavaju važnost koju je jezik mogao imati u sve složenijim odnosima unutar zajednice, posebice između spolova. Deacon (1997.) smatra da je takav oblik komunikacije mogao favorizirati i razvoj monogamnih odnosa jer su partneri mogli stvarati jače veze putem socijalne interakcije (vidi i Lovejoy 1981). Dunbar (1993., 1996.) također naglašava važnost jezika u jačanju socijalne strukture i odnosa unutar zajednice i smatra ga ekvivalentom i zamjenom za timarenje, vrlo čestu i socijalno vrlo važnu radnju kod primata (Dunbar 1991; Lehmann *et al.* 2007). Jezik kao zamjena za tjelesni kontakt (timarenje) omogućava brže i efikasnije stvaranje odnosa unutar većih grupa. No iako su navedeni razlozi vrlo vjerojatno imali važnu ulogu u razvoju određenih etapa ili elemenata razvoja jezika i govora, najvjerojatnije su samo dio zagonetke. Vjerojatno, barem u prvim fazama razvoja, govor i jezik započinju kao efikasnija varijanta načina koji služi onoj prvoj i osnovnoj funkciji, komunikaciji. Naravno, sve složenija socijalna organizacija hominina favorizirala je ovakav oblik komunikacije, pogotovo nakon što naši preci započinju svoj sve složeniji kulturni razvoj (proizvodnja oruđa, organizirani lov, širenje u nove geografske prostore s drugačijim okolišnim čimbenicima, pojava neutilitarnih predmeta, izgradnja nastambi, pojave simboličkog razmišljanja, ukapanja pokojnika, razvoj umjetnosti i sl.).

#### KOMPARATIVNE STUDIJE: JEZIČNE SPOSOBNOSTI ČOVJEKOLIKIH MAJMUNA

Budući da je čovjek nastao evolucijom te da pripada redu primata, logično je da je u razvoju ljudske komunikacije, govora i jezika određenu ulogu imao i komunikacijski sustav naših predaka. Stoga će komparativne studije živućih primata imati važnu ulogu u rasvjetljavanju nekih pitanja vezanih uz evoluciju jezika. No, isto tako valja imati na umu da komunikacija kod živućih primata ne predstavlja *a priori* istovjetno stanje u našeg zadnjeg zajedničkog pret-

munication through a longer evolutionary development and to define their plesiomorphic and apomorphic elements (Lieberman 1984, 2000). The communication system which preceded the appearance of modern language, and differs from it due to lack of grammar, is differently defined by different authors. For example, Salzman (1998) uses the term *prelanguage*, while other authors call it *protolanguage* (Hewes 1973; Bickerton 1990), although the term might be misleading since it is the same term used by linguists to define language from which other modern languages, or language groups, developed (e.g. proto Indo-European). If we try to understand different aspects and properties of language and its evolutionary development, it is necessary to at least briefly discuss the possible reasons why this new mode of communication could have had selective advantages over nonverbal communication. Miller (1999) and especially Deacon (1997) highlight the importance language could have had in the increasingly complex relations within the community, especially between the sexes. Deacon (1997) considers that this mode of communication could favor the development of monogamist relations because partners could make stronger connections through social interaction (also see Lovejoy 1981). Dunbar (1993, 1996) also stresses the importance of language for the strengthening of social structures and relations within the community, and sees it as an equivalent and replacement for grooming, a very common and socially important act in primates (Dunbar 1991; Lehmann *et al.* 2007). Language as a replacement for physical contact (grooming) allows for a faster and more efficient creation of relations within larger groups. However, as the listed reason probably had an important role in the development of certain stages or elements of language and speech development, they are most probably only part of the riddle. Most likely, at least in the first developmental stages, speech and language appeared as a more efficient variant of a mode serving the first and basic function of communication. Naturally, an increasingly complex social structure of hominins favored this type of communication, especially because our ancestors went into an increasingly complex cultural development (making tools, organized hunting, appearance of non-utilitarian objects, dwellings, symbolic thinking, art, and the like).

#### COMPARATIVE STUDIES: LINGUISTIC ABILITIES OF APES

Since humans developed through evolution and belongs to the order of Primates, it is logical that the communication system of our ancestors played a part in the development of human communication,

ka te da se evolucijska linija čovjeka i čimpanzi odvojila prije 5-7 milijuna godina (vidi npr. Janković & Karavanić 2009 i tamo citiranu literaturu).

Jednim dijelom, komunikacija čovjeka vrlo je nalik onoj ostalih primata. Komunikacijski sustav primata iznimno je razvijen i složen te se podjednako temelji na vokalizaciji, gestikulaciji, izrazima lica, tjelesnim kretnjama i mirisu pri čemu svaki od ovih modaliteta ima određenu funkciju i prenosi određene informacije (Doty 1981; Macedonia i Stanger 1994; Kirchof i Hammerschmid 2006; DiBetti 1993; Slocombe i Züberbuhler 2006; Pfefferle *et al.* 2008; Slocombe 2010; Corballis 2009). Svi su ovi aspekti komunikacije prisutni i kod ljudi i označavaju se pojmom "neverbalna komunikacija". Neovisno o kulturi iz koje potječu ili jeziku kojeg govore, ljudi mogu na licima drugih prepoznati ljutnju, tugu, prijetnju, znatiželju ili uživanje. Isti izrazi lica, međutim, svojstveni su i čimpanzama (Burling 2005), kao i položaj tijela koji odaje, primjerice, naklonost, zaštitničku nastrojenost, prijetnju ili opuštenost (Eibl-Eibesfeldt 1967). Sve više studija pokazuje da je u ljudskoj komunikaciji izuzetno značajna interakcija osjeta i različitih regija u mozgu, pri čemu je jedan od ključnih osjeta vid, kako u komunikaciji, tako i u akviziciji jezičnih i govornih sposobnosti (vidi Rosenblum 2008, 2010 i tamo citiranu literaturu). Taj fenomen naziva se višeosjetna percepcija govora (*multisensory speech perception*).

Ako želimo proniknuti u prošlost određenih elemenata razvoja ljudskog govora i jezika, jedan od važnih pokazatelja bit će sličnosti i razlike od naših najbližih rođaka, čovjekolikih majmuna. Prva istraživanja jezičnih mogućnosti primata krenula su od pogrešnih pretpostavki i naglasak stavila na govor (Furness 1916; Hayes 1951), što je dovelo do krivog zaključka da ostali primati nemaju kognitivne sposobnosti za usvajanje kompleksnijeg sustava komunikacije poput jezika. Usporedbe anatomskih odlika čovjeka i čovjekolikih majmuna (o čemu će detaljnije biti riječi kasnije u tekstu) jasno pokazuju da postoje razlozi zbog kojih nije za očekivati da će nje ljudi primati usvojiti govor kao osnovni mod komunikacije, no to nam ništa ne govori o ostalim elementima jezika. No, za razliku od ograničenja koja postavljaju razlike u vokalnog traktu, gotovo svi primati imaju vrlo pokretljive šake koje omogućuju vrlo preciznu kontrolu i velik raspon pokreta. Znakovni jezik gluhih u potpunosti ima sve elemente jezika (otvoren je i simboličan sustav), iako je medij kojim se prenosi drugačiji (ne prenosi se zvukom, već gestikulacijom) (vidi npr. Emmorey 2002; Neidle *et al.* 2000). Proučavanja komunikacije primata u prirodi pokazala su veći naglasak na gestikulaciju nego na komunikaciju vokalnim putem (Pollick i de

speech and language. Hence, comparative studies of living primates will have an important role in shedding light on some questions regarding the evolution of language. However, we must have in mind the fact that the communication of living primates is not *a priori* equal to our common ancestors and that the evolutionary line of million years ago and chimpanzees got separated between 5 and 7 million years ago (see Janković & Karavanić 2009 and there cited bibliography).

In part, human communication is very similar to that of other primates. The communication system of primates is very diverse and complex and is almost equally based on vocalization, gesticulation, facial expressions, body movement and smell, whereby each of these modalities has a specific function and transfers certain information (Doty 1981; Macedonia & Stanger 1994; Kirchof & Hammerschmid 2006; DiBetti 1993; Slocombe & Züberbuhler 2006; Pfefferle *et al.* 2008; Slocombe 2010; Corballis 2009). All of these aspects of communication are present in humans and go under the term 'non-verbal communication'. Regardless of culture they come from or language they speak, humans can recognize anger, sadness, threat, curiosity or enjoyment on the faces of other humans. The same facial expressions, however, are also typical of chimpanzees (Burling 2005), as is the position of the body which shows, for example, affection, protective attitudes, threat or relaxation (Eibl-Eibesfeldt 1967). More and more studies show that the interaction between different regions of the brain is extremely important for human communication, where eyesight is one of the key senses for communication, but also for the acquisition of linguistic and speaking abilities (see Rosenblum 2008, 2010 and therein cited bibliography). This phenomenon is called *multisensory speech perception*.

If we want to study the past of certain elements of human speech and language, the similarities and differences from our closest cousins, apes will be one of the main indicators. The first research in primate linguistic abilities were based on the incorrect assumption and put emphasis on speech (Furness 1916; Hayes 1951), which led to the incorrect conclusion that other primates do not have the cognitive abilities necessary to acquire a complex communication system like language. Comparisons of anatomical features of humans and apes (which will be discussed later in the text) clearly show that there are reasons why non-human primates would not accept speech as the basic mode of communication, but it does not say anything about other aspects of language. However, unlike the limitations set by differences in the speech apparatus, almost



Waal 2007). Štoviše, komunikacija gestikulacijama, poput jezika, nije instinktivna i univerzalna, već se uči kulturnom predajom i razlikuje se od populacije do populacije. Tako će skupine iste vrste čimpanzi na različitim područjima razviti vlastiti "dijalektalni" sustav gestikulacije, različit od sustava drugih skupina (McGrew i Tutin 1978.).

Prekretnicu u istraživanju jezičnih sposobnosti ne-ljudskih primata označila su istraživanja bračnog para Beatrix i Alan Gardner sa čimpanzom Washoe. Washoe je odgajana u njihovoj obitelji kako bi u društvenom okruženju prošla prirodan proces usvajanja američkog znakovnog jezika (ASL) nalik onome koji prolaze gluha djeca. U razdoblju od dvije godine Washoe je naučila stotinjak znakova koje je ubrzo počela kombinirati u smislene fraze i imenovati nove stvari kombinirajući poznate pojmove (vidi Gardner *et al.* 1989). Kasnija istraživanja pokazala su da je tempo usvajanja jezika kod čimpanzi i ljudi otprilike isti sve do oko dvije godine starosti, nakon čega čimpanze stagniraju, dok ljudska djeca počinju ubrzan razvoj jezičnih sposobnosti (vidi Lieberman 2000 i tamo citiranu literaturu). Još je važnija činjenica da je Washoe u međuvremenu znakovnom jeziku naučila i usvojenog sina Lolisa (Dunbar 1996), dok je čimpanza Lucy uspješno svoja znanja jezika gluhih prenijela drugim čimpanzama (1989). Nadalje, usvajanje ovakvog načina komunikacije nije dokazano samo na čimpanzama. Gorila Koko pokazala je još zavidnije rezultate i uspješno je koristila gotovo 700 znakova, nerijetko ih upotrebljavajući u kontekstu prošlih i budućih radnji, te izražavanja emocija (Fouts 1997; Patterson 1978).

Drugi veliki pomak u suvremenim jezičnim istraživanjima primata učinila je psihologinja Sue Savage-Rumbaugh s bonobom Kanzijem, s kojim je razvila elaboriran sustav komunikacije temeljen na sustavu leksigrama (Savage-Rumbaugh & Lewin 1996). Kanzi, koji je svoje prve pojmove naučio promatrajući istraživače koji su pokušavali učiti njegovu majku, do svoje je šeste godine naučio oko 200 riječi. Uz to, iznenadio je znanstvenu zajednicu kada je pokazao mogućnost da shvati vrlo specifične naredbe koje dotad nije čuo.

Navedeni rezultati potaknuli su val istraživanja jezičnih mogućnosti čovjekolikih majmuna te pokazali kako njihova komunikacija uistinu može sadržavati sva odredbena obilježja ljudskog jezika. To samo po sebi ne znači da ostali primati imaju jezik niti da je njihova jezična sposobnost jednaka ljudskoj. Razlike su i dalje znatne, no istraživanja su dokazala kako čovjekoliki majmuni u određenoj mjeri posjeduju kognitivne sposobnosti nužne za razumijevanje i produkciju jezika, kao i osnovne elemen-

all primates have very flexible fists which allow for very much control over the movement and a large array of movements. The sign language used by the deaf has all elements of language (it is an open and symbolic system), although the medium it uses is different (it is not transferred by sound, but by gesticulation) (e.g. see Emmorey 2002; Neidle *et al.* 2000). Studies of primate communication in nature pointed to more emphasis being put on gesticulation than on vocal communication (Pollick and de Waal 2007). Furthermore, gestural communication, like language, is not instinctive and universal, but is learned through cultural transmission and is different from population to population. Groups of chimpanzees from different areas will develop their own "dialectal" system of gesticulation, different from the system used by other groups (McGrew and Tutin 1978).

The study the spouses Beatrix and Alan Gardner did on chimpanzee named Washoe were a turning point in the study of linguistic abilities of non-human primates. Washoe was raised in their family in order to go through the natural process of acquiring American sign language (ASL) in a social environment, just like the one deaf children go through. Over two years, Washoe learned around a hundred signs which she soon started to combine into meaningful phrases and to name new things by combining known terms (see Gardner *et al.* 1989). Later research has shown that the pace of language acquisition in chimpanzees and humans is almost identical until the age of two, after which point the chimpanzees stagnate and human children start to develop their linguistic abilities increasingly (see Lieberman 2000 and therein cited bibliography). The fact that Washoe taught sign language to the adopted son Lolis is even more important (Dunbar 1996), while the chimpanzee called Lucy successfully transferred her knowledge of sign language to other chimpanzees. Moreover, the acquisition of this type of communication has not been proven exclusively on chimpanzees. The gorilla Koko displayed even more impressive results and successfully used almost 700 signs, commonly using them when indicating past and future actions and when showing emotion (Fouts 1997; Patterson 1978).

The second great breakthrough in linguistic research on primates was reached by psychologist Sue Savage-Rumbaugh with Kanzi the bonobo, with which she developed an elaborate system of communication based on the system of lexigrams (Savage-Rumbaugh & Lewin 1996). Kanzi, who learned his first concepts by watching researches trying to teach his mother, learned about 200 words by the age of six. Additionally, he surprised the scientific

te „otvorenog sustava“ te osnovne sintaktičke sposobnosti (Pollick & de Waal 2007; Lieberman 2000, vidi tab. 1), što govori u prilog tome da se temeljni preduvjeti za razvoj jezika javljaju relativno rano, prije odvajanja zadnjeg zajedničkog pretka ovih čovjekolikih majmuna i čovjeka, iako valja naglasiti da je razlog pojave, ili prvotna funkcija u tih drevnih hominida mogla biti nevezana uz jezik.

community when he displayed the ability to understand very specific orders he had never heard before. The listed results sparked a line of research on the linguistic abilities of apes in order to show that their communication can truly contain all features of human language. This in itself does not mean that other primates have language or that their linguistic abilities match those of humans. The differences are still

Design feature	Glasanje majmuna i čovjekolikih majmuna/ Vocal Communication (Apes & Monkeys)	Znakovni jezik - čovjekoliki majmuni/Sign Language - Apes	Znakovni jezik - ljudi/ Sign Language - Human	Ljudski govoreni jezik/ Spoken Language
Glavovno-slušni kana/ Vocal auditory channel	Yes	No	No	Yes
Posvudašnji prijam i usmjereni prijenos/ Broadcast transmission	Yes	Yes	Yes	Yes
Zamiranje/ Rapid fading	Yes	Yes	Yes	Yes
Međurazmjernost/ Interchangeability	Yes	Yes	Yes	Yes
Potpuna povratna sprega/ Total feedback	Yes	No	No	Yes
Specijaliziranost/ Specialization	Yes	Yes	Yes	Yes
Semantičnost/ Semanticity	Yes	Yes	Yes	Yes
Arbitrarnost/ Arbitrariness	Yes	Limited	Mostly yes	Yes
Razlučivost/ Discreteness	Yes	Yes	Yes	Yes
Premošćivanje razdaljine/ Displacement	No	Yes	Yes, frequently	Yes, frequently
Produktivnost/ Productivity/Openness	Yes	Limited	Yes	Yes
Kulturni prijenos/ Cultural Transmission	Unknown	Yes	Yes	Yes
Dvostruka raščlanjenost/ Double articulation	Species-dependent	Yes	Yes	Yes
Laž/ Lie	Species dependent, limited	Yes	Yes	Yes
Refleksivnost/ Reflexivity	No	Unknown	Yes	Yes
Učljivost/ Learnability	No	Yes	Yes	Yes

Tablica 1: Usporedba odredbenih obilježja komunikacije kod ljudi i čovjekolikih majmuna prema Hockettu (1996). Podaci prema Fedurek & Slocobe 2011; Dolhinow & Fuentes 1999.

Table 1: A comparison of defining features of communication in humans and apes according to Hockett (1996); data taken from Fedurek & Slocobe 2011; Dolhinow & Fuentes 1999

No iako su osnovne strukture, ili preduvjeti, koje kasnije nalazimo utkane u razvoj govora i jezika postojale već vrlo rano, od svih primata samo čovjek ima sve elemente modernog jezika i samo čovjek služi se govorom kao osnovnim oblikom jezične komunikacije. Razlozi za to očiti su u anatomskim strukturama vezanim uz produkciju govora i jezika koje su vidljive u suvremenih ljudi, a nedostaju, ili se razlikuju od, čovjekolikih majmuna i ostalih primata. Stoga govor i u potpunosti moderan jezik valja tražiti u vremenu

significant, but research has shown that apes, to a certain extent, have the cognitive abilities necessary for the understanding and production of language, as well as basic elements of an “open system” and syntactic abilities (Pollick & de Waal 2007; Lieberman 2000, see tab. 1), which supports the assumption that the basic preconditions for the development of language appeared relatively early, before the last separation of the last common ancestor of these apes and humans, although the reason for the emergence,

nakon odvajanja od ostalih čovjekolikih majmuna, unutar evolucijske prošlosti plemena hominini (počevši prije otprilike 5-6 milijuna godina, za detaljniji pregled suvremene taksonomije vidi Janković & Karavanić 2009) te ga temeljiti na anatomskim struktura vezanim uz kognitivne elemente komunikacije, govora i jezika (neuralne strukture) i izvedbene elemente (prvenstveno anatomija govornog aparata).

## ANATOMIJA GOVORA I JEZIKA

Početak 19. stoljeća bilo je vrlo popularno povezivati određene regije i strukture mozga uz različite aspekte ponašanja – na čemu se temelji (pseudo) znanstvena teorija frenologije. Ekstremni zagovornici tog pristupa idu toliko daleko da pokušavaju tipizirati moralne i druge karakteristike pojedinaca na temelju fenotipskih odlika lubanje. Frenologija je odjek imala i u lingvističkim proučavanjima, posebice na temelju istraživanja i medicinskih zapažanja dvojice liječnika: Paula Broce i Carla Wernickea. Godine 1861. Broca je opisao pacijente s oštećenjem frontalnog dijela neokorteksa (danas poznatom kao Brocina regija) koji su pokazali poteškoće u produkciji jezika. Kod anatomski modernih ljudi Brocinim se područjem nazivaju Brodmanova područja 44 i 45 u čeonom režnju (sl. 1). Ozljeda ovog dijela mozga najčešće rezultira Brocinom afazijom, govornim poremećajem koji se očituje kroz agramatizam i poteškoće u produkciji jezika, ali ne i u njegovoj recepciji. Osobe s Brocinom afazijom tako će savršeno dobro razumjeti tuđi govor ili, primjerice, pročitani tekst. U govoru im, međutim, često nedostaju željene riječi, a rečenice su kratke, jednostavne, isprekidane te najčešće bez gramatičkih riječi poput pomoćnih glagola. Ljudi koji pate od ove afazije imaju potpunu povratnu spregu, što znači da čuju i prepoznaju svoje pogreške te su često frustrirani razlikom između zamišljenog i ostvarenog (Dronkers *et al.* 2000). Iz tog razloga pretpostavlja se kako je Brocino područje zaduženo uglavnom za produkciju jezika te fonološko procesuiranje. O točnoj ulozi Brocinog područja kad je riječ o jeziku postoji mnogo teorija i još je uvijek predmet rasprave. Osim lingvističke uloge, Brocino područje, točnije područje 44 u Brocinom području, zaduženo je i za koordinaciju ruke pri kompleksnim pokretima, senzori-motorno učenje i integraciju (Binkofski & Buccino 2004), a pretpostavlja se da igra određenu ulogu i u snalaženju u vremenu. Zbog motoričkih funkcija koje obavlja, smatra se da se ovo područje razvilo iz motoričkog asocijativnog korteksa (Wilkins 2009). Mozak ostalih primata također pokazuje određenu asimetriju u frontalnom režnju te se pretpostavlja da bi područje označeno kao F5 zbog svoje funkcije

and the primary function of these ancient hominids could have been unrelated to language.

However, although the basic structures, or preconditions, which we later see woven into the development of speech and language, existed very early, only humans display all elements of modern language and only humans use speech as the basic mode of linguistic communication. The reasons for it are apparent in the anatomical structures connected to the production of speech and language visible in modern humans, and are lacking or differ from those of apes and other primates. Hence, speech and completely modern language should be sought for in the periods when the human lineage separated from other apes, within the evolutionary history of the tribe hominini (beginning approximately 5 and 6 million years ago, for a detailed discussion on contemporary taxonomy see Janković & Karavanić 2009), and should be based on anatomical structures connected to the cognitive elements of communication, speech and language (neural structures) and performativity (primarily the anatomy of the speech apparatus).

## THE ANATOMY OF SPEECH AND LANGUAGE

At the beginning of the 19<sup>th</sup> century it was very popular to connect certain regions and brain structures to different aspects of behavior – the basis of the (pseudo)scientific phrenology. Extreme supporters of this approach go so far as to try and typify moral and other characteristics of individuals based on the phenotypic characteristics of their skulls. Phrenology also influenced linguistic studies, especially based on research and medical observations of two doctors: Paul Broca and Carl Wernicke. In 1861, Broca described patients with damage on the frontal part of the neocortex (today known as Broca's region) which displayed difficulties with language production. In anatomically modern humans, Broca's area covers Brodman's regions 44 and 45 in the frontal lobe (fig. 1). An injury to this part of the brain most often results in Broca's aphasia, a speech impairment displayed through agrammatism and difficulties in language production, but not reception. Persons with Broca's agrammatism will be able to perfectly understand someone else's speech or, for example, will be able to read a text. In speech, however, they often lack key words, and their sentences are short, simple, discontinuous and most often without grammatical words such as auxiliary verbs. People suffering from this type of aphasia have complete feedback, which means that they hear and recognize their mistakes and are often frustrated by the difference between what they imagined and what they

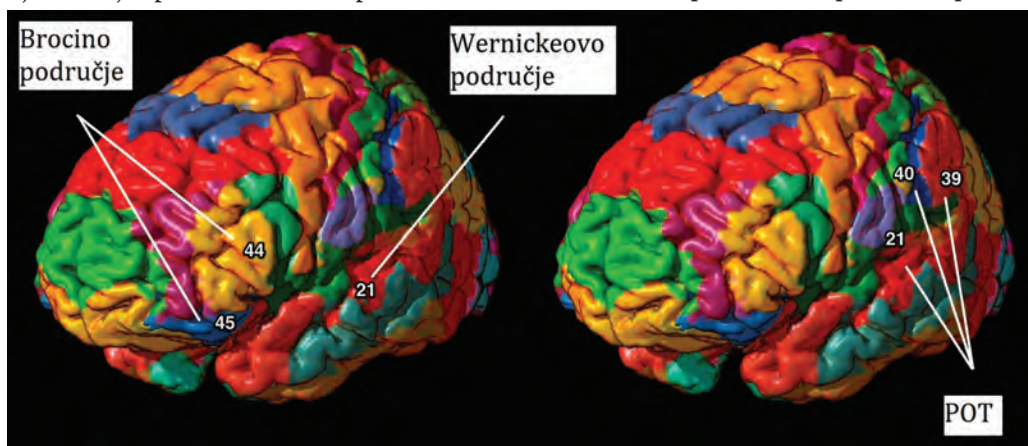
i smještaja moglo biti homologno ili preteča Brocinog područja (Rizzolati & Arbib 1998; Binkofski & Buccino 2004). Posljednja istraživanja pokazala su kako se Brocino područje kod ljudi te područje F5 kod čovjekolikih majmuna posebno aktiviraju pri planiranju pokreta prinošenja ustima (Gentilucci *et al.* 2011). Pritom se i otvaranje prstiju i usta simultano prilagođava veličini predmeta, što predstavlja vrlo istančanu koordinaciju i motoriku. Iz tog razloga, neki autori smatraju kako je upravo taj neuralni mehanizam stvorio temelj za prenošenje motoričkih uzoraka signaliziranja rukama na sustav artikulacije ustima, omogućivši tako funkcionalno prebacivanje komunikacije na vokalni modalitet i formiranje mogućnosti govora (Gentilucci *et al.* 2011). 1874. godine Wernicke je na temelju zapažanja ustanovio da oštećenja na posteriornom dijelu korteksa (danas poznatom kao Wernickeova regija, sl. 1) uzrokuju poteškoće u razumijevanju govora. Wernickeovo područje smješteno je u temporalnom režnju na dijelu Brodmannova područja 22, neposredno do auditornog korteksa. Glavna mu je funkcija procesuiranje i recepcija jezika - bilo govora, znakovnog jezika ili pisma. Ozljeda ovog područja uzrokuje istoimenu afaziju koja se manifestira besmislenim, ali potpuno tečnim, ritmičnim te sintaktički točnim rečenicama. Za razliku od ljudi pogođenih Brocinom afazijom, oni koji pate od Wernickeove često ne mogu percipirati vlastite pogreške u pismu ili govoru niti razumjeti govor drugih (Dronkers *et al.* 2000). Komparativna su istraživanja pokazala kako u temporalnom režnju čovjekolikih majmuna postoji asimetrija koja odgovara lokaciji Wernickeova područja u ljudi (Hopkins *et al.* 1998). Na temelju Brocinih i Wernickeovih zapažanja, postavljen je tzv. Lichtheimov model prema kojem se govor koji čujemo procesuiru u Wernickeovom području, nakon čega informacija putuje do Brocina područja koje služi kao regija za ekspresivnu produkciju jezika (*expressive language output device*). Naravno, ovo je vrlo pojednostavljen model i kasnija istraživanja pokazala su da, iako određene regije mozga imaju važnu ulogu u procesuiranju određenih stimula, ili motoričkoj kontroli, niti jedna regija nije isključivo odgovorna za složeno ponašanje. Novija istraživanja idu u smjeru razumijevanja komunikacije određenih regija koje zajedno čine tzv. funkcionalni neuralni sustav (*functional neural system*, FNS, ili u slučaju jezika funkcionalan jezični sustav, *functional language system*, FLS). Uloga funkcionalnog jezičnog sustava je brzo prenijeti, razumijeti i pohraniti informacije, te ih procesuirati kroz medij jezika (govora). Iako je ljudski mozak vrlo prilagodljiv i prema potrebi može se prilagoditi na drugačij medij jezičnog procesuiranja, njegov osnovni medij je govor. U novije vrijeme, istraživanja su pokazala još jednu regiju koja potencijalno ima važnu ulogu (između

said (Dronkers *et al.* 2000). This is why it is thought that Broca's area is mostly responsible for language production and phonological processing. The precise role of Broca's area when it comes to language is the topic of many discussions and theories. Apart from the linguistic function, Broca's area, or area 44 in Broca's area, is responsible for hand coordination in complex movements, sensory-motoric learning and integration (Binkofski and Buccino 2004), and there is an assumption that it plays a certain part in time management. Due to the motoric functions it does, this area is thought to have developed from the motoric associative cortex (Wilkins 2009.). The brains of other primates also shows certain asymmetry in the frontal cortex and the area noted as F5, due to its function and placement, could be homologue to or a predecessor of Broca's area (Rizzolati and Arbib 1998; Binkofski and Buccino 2004). Latest research has shown that Broca's area in humans and F5 in apes are more active when planning movements bringing something closer to the mouth (Gentilucci *et al.* 2011). The opening of fingers and the mouth are simultaneously in accordance with the size of the object, which requires detailed coordination and motoric abilities. Thus, some authors state that it was precisely this neural mechanism which created the basis for transferring motoric patterns of hand signalization to the system of mouth articulation, allowing for a functional transfer of communication to the vocal mode and the formation of speech ability (Gentilucci *et al.* 2011). In 1874, based on his observations, Wernicke established that damage to the posterior part of the cortex (today called Wernicke's area, fig. 1) causes damage in speech understanding. Wernicke's area is situated in the temporal lobe on part of Brodmann's area 22, right next to the auditory cortex. Its main function is language, whether it is speech, sign language or written language, processing and reception. An injury to this part of the brain causes Wernicke's aphasia, which is manifested through producing meaningless but completely fluent, rhythmic and syntactically correct sentences. Unlike people suffering from Broca's aphasia, those who suffer from Wernicke's aphasia often cannot perceive their own mistakes in writing or speech and cannot understand the speech of others (Dronkers *et al.* 2000). Comparative research has shown that the temporal lobe of apes displays an asymmetry in the region equivalent to Wernicke's area in human (Hopkins *et al.* 1998). Based on Broca's and Wernicke's observations, the so called Lichtheim model was devised, according to which the speech we hear is processed in Wernicke's area, after which information travels to Broca's area which is in fact an *expressive language output device*. Naturally, this is a simplified model and later research has shown that, although certain areas of the brain play an important role in

ostalog) u razvoju jezičnih sposobnosti, a nalazi se u području parijetalno-okcipitalno temporalnog spojišta (POT). Područje POT najudaljenije je od svih senzornih podražaja te obuhvaća Brodmannova područja 39, 40 te dio područja 22, na kojem se nalazi i Wernickeovo područje (sl. 1). Kod anatomski modernih ljudi to je najrazvijenije asocijacijsko područje, zaduženo za interpretaciju podražaja te usko povezano s jezičnom kognicijom i ponašanjem, kako receptivnim, tako i produktivnim. Mozak ostalih primata ne pokazuje nikakve naznake proširenja u ovom dijelu mozga koji bi mogli odgovarati POT-u (Wilkins 2009). Kako se razvilo posljednje, nakon odvajanja od posljednjeg zajedničkog pretka, pretpostavlja se da se razvilo kao odgovor na neke nove potrebe koje u ranijih primata nisu bile prisutne.

processing certain stimuli or motoric control, no single area is exclusively responsible for complex behavior. Recent research focuses on understanding communication between certain areas which, together, make up the *functional neural system*, FNS, or, in case of language, the *functional linguistic system*, FLS. The role of the functional linguistic system is to quickly transfer, understand and store information and process them through the medium of language (speech). Although the human brain is very flexible and can, if needed, adapt to a different medium of language processing, its basic medium is speech.

Recently, research has shown another area which potentially has an important role (among other things) in the development of linguistic abilities, and is situated in the parietal-temporal-occipital association



Slika 1: Položaj Brocine, Wernickeove, POT regije i Brodmanovih područja koje se spominju u tekstu (modificirano prema Montreal Neurological Institute).

Figure 1: The positions of Broca's, Wernicke's, and PTO areas and Brodmann's areas mentioned in the text (modified from the Montreal Neurological Institute).

Kada je riječ o evoluciji jezika, jedna od važnijih tema rasprava vodi se oko pitanja je li pojava ljudskog jezika u svojim samim počecima bila vokalne ili gestikularne prirode (Arbib 2005; Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005; Hewes 1973). Iako komparativna istraživanja djelomično podržavaju oba stajališta, vokalizacija i govorni jezik imaju nekoliko bitnih prednosti. Ponajprije, zvučni signal u slučaju opasnosti mnogo je učinkovitiji i privlači više pozornosti na govornika, a vokalna komunikacija omogućava istovremenu interakciju s više članova grupe čak i u uvjetima koji su iznimno nepovoljni za komunikaciju gestama, poput mraka, velike udaljenosti između sugovornika te fizičkih ili društvenih prepreka (Fedurek & Slocombe 2011). Anatomija koja omogućava govor stoga je iznimno bitna u proučavanju evolucije jezika.

Fizička produkcija govora započinje disanjem, što je glavno pokretačko sredstvo vokalizacije. Kod anatomski modernih ljudi u procesu disanja glavnu ulogu

area (PTO). PTO is an area furthest from all sensory stimuli and includes Brodmann's areas 39, 40 and part of area 22, including Wernicke's area (fig. 1). In anatomically modern humans, this is the most developed association area, responsible for stimuli interpretation and closely related to linguistic cognition and behavior, both receptive and productive. The brains of other primates do not show traces of widening in this part of the brain which would be equivalent to PTO (Wilkins 2009). As it developed last, after the last common ancestor separation, it is supposed to have developed as a reaction to some new needs earlier primates did not have.

When it comes to language evolution, one of the important discussions revolves around the question of whether the emergence of human language in its beginnings was vocal or gestural in nature (Arbib 2005; Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005; Hewes 1973). Although comparative research partially supports both standpoints, vocali-

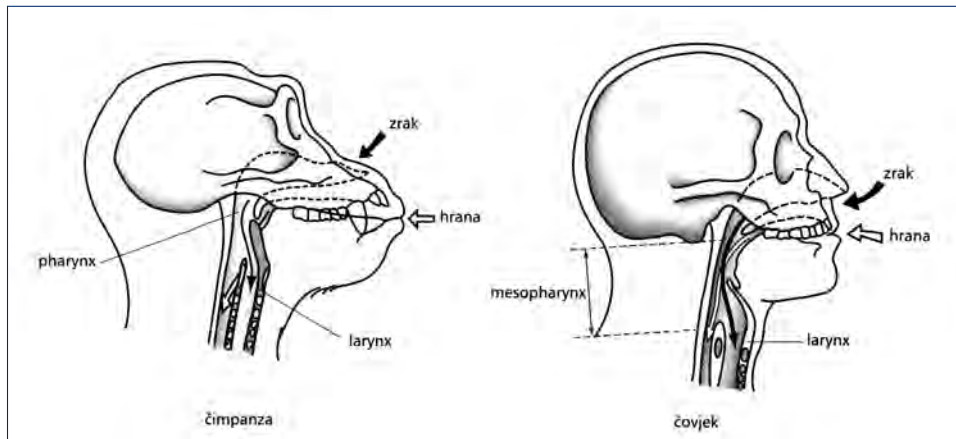
gu imaju interkostalni mišići koji svojom kontrakcijom šire prsnu šupljinu. Kontrola interkostalnih mišića ujedno je i kontrola subglotalnog pritiska koji omogućava izgovor dužih nizova riječi ili rečenice u jednom izdisaju kao i naglašavanje pojedinih jedinica govora te kontrolu intonacije, što su iznimno bitne karakteristike ljudskog govornog jezika. Upravljanje interkostalnim mišićima vrši se preko kralježnične moždine, točnije, sive tvari u kojoj se nalaze glavni projekcijski neuroni – motoneuroni - čiji se aksoni pružaju do svih poprečnoprugastih mišića, među ostalim i interkostalnih (Krmptić-Nemanić & Marušić 2004). Veličina vertebralnog kanala izravno je povezana s debljinom kralježnične moždine (MacLarnon & Hewitt 1995), a relativna debljina kralježnične moždine s količinom sive tvari u građi (MacLarnon 1993). Manja količina sive tvari tako znači i manju kontrolu nad poprečnoprugastim mišićima.

Akustička energija koja se stvara disanjem prvo prolazi kroz supralaringalni vokalni trakt koji kontinuirano mijenja svoj oblik stvarajući tako različite obrasce zvukova. Supralaringalni vokalni trakt sastoji se od usne i nosne šupljine, ždrijela i grkljana (sl. 2). U usnoj šupljini nalazi se jezik čiji se zaobljeni kraj lagano spušta u šupljinu ždrijela (Fitch 2000). Ždrijelo je postavljeno okomito na usnu šupljinu i kod anatomski modernih ljudi podjednake je dužine s njom (Lieberman 2007). Grkljan anatomski modernih ljudi ponešto je spušten te se proteže od gornjeg ruba četvrtog do donjeg ruba šestog vratnog kralješka. Kod ne-ljudskih primata, kao i kod ljudske novorođenčadi larinks je smješten visoko u grlu (vidi Lieberman & McCarthy 1999), što omogućava istovremeno disanje i gutanje – što je važno za sisavce. No to ograničava raspon glasova koji se mogu producirati. Tijekom rasta i razvoja, kod ljudi se larinks pomiče prema dolje i dostiže svoj konačan položaj između 3 i 4 godine starosti (Sasaki *et al.* 1977; Fitch 2000; Nishimura *et al.* 2008). U kombinaciji s visokim nepcem tako spušten grkljan omogućava produkciju najvećeg mogućeg broja glasova. Mogućnosti artikulacije suglasnika uvelike određuje položaj jezične kosti, spojene na hrskavičnu potporu grkljana. Na nju se vežu tri mišića (*m. genioglossus*, *m. palatoglossus* i *m. mylohyoideus*) čija je uloga pomicanje jezika u usnoj šupljini tijekom žvakanja, gutanja i govora. Tijekom odrastanja jezična kost se kod ljudi znatno spušta u odnosu na nepce, dok kod ostalih primata ostaje relativno visoko u grlu. Takav položaj rezultira drugačijim izgledom navedenih mišića i njihovih hvatišta, a samim time i drugačijim mogućnostima. Oblik i položaj jezične kosti kod čovjekolikih majmuna ograničava fleksibilnost jezika te rezultira većom udaljenosti između korijena jezika i prednjeg predjela usne šupljine,

zation and verbal language have several important advantages. Firstly, a sound signal in case of danger is more efficient and attracts more attention to the speaker, and vocalized communication enables for a contemporaneous reaction of more group members even in conditions which are extremely bad for gestural communication, e.g. darkness, great distances between speakers and physical or social barriers (Fedurek & Slocombe 2011). The anatomy which allows for speech to exist is, therefore, extremely important in the study of language evolution.

The physical production of speech starts with breathing, the main motivator of vocalization. In anatomically modern humans, the process of breathing is made possible by intercostal muscles which, by contracting, help open the chest cavity. The control of intercostal muscles is also the control of the subglottic pressure which allows for saying longer lines of words or sentences in a single breath, as well as for accentuating certain units of speech and speech intonation, all extremely important characteristics of human spoken language. Intercostal muscle control is achieved through the brain stem, that is, gray matter where the main projection neurons, motoneurons, are situated. Their axons reach all striated muscles, including the intercostal ones (Krmptić-Nemanić & Marušić 2004). The size of the vertebral canal is directly connected to the thickness of the brain stem (MacLarnon & Hewitt 1995), and the brain stem thickness is connected to the amount of gray matter (MacLarnon 1993). Smaller amounts of grey matter, therefore, mean less control over striated muscles.

The acoustic energy created by breathing first travels through supralaryngeal vocal tract which continually changes its shape creating different sound patterns. The supralaryngeal vocal tract includes the oral and nasal cavities, the pharynx and the larynx (fig. 2). The oral cavity contains the tongue. The curved end of the tongue goes down into the pharynx (Fitch 2000). The pharynx is perpendicular to the oral cavity and is, in anatomically modern humans, equal in length (Lieberman 2007). The larynx of anatomically modern humans is somewhat lower and stretches from the upper part of the fourth to the lower part of the sixth vertebra. In nonhuman primates, as well as in human infants, the larynx is placed high in the throat (see Lieberman & McCarthy 1999), which allows for contemporaneous breathing and swallowing – important for mammals. However, this reduces the span of sounds which can be produced. During growth and development in humans, the larynx moves downwards and reaches its final span between the age of 3 and 4 (Sasaki *et al.* 1977; Fitch 2000; Nishimura *et al.* 2008). In combination with the high



Slika 2: Položaj grkljana kod čimpanze i čovjeka (preuzeto iz Krmpotić-Nemanić & Marušić 2004:276).

Figure 2: The position of the larynx in chimpanzees and humans (taken from Krmpotić-Nemanić & Marušić 2004: 276).

što onemogućava da jezik dopre do svih mjesta u usnoj šupljini. Ovo ograničenje u pomicanju jezika ujedno znači i da jezik ne dopire do mjesta na kojima se tvore određeni konsonanti u ljudskom jeziku (Duchin 1990).

Kod odraslih čimpanza i ostalih neljudskih primata grkljan se nastavlja neposredno na meko nepce, a farinks je mnogo kraći u odnosu na usnu šupljinu (Negus 1949, Laitman i Reidenberg 1993: sl. 2). Tijekom sazrijevanja grkljan se donekle spušta u odnosu na nepce i tako relativno produžuje ždrijelo (Flügel i Rohen 1991). Istovremeno se, međutim, razvija i prognatizam lica zbog čega se dodatno produžuju usna šupljina i jezik, što ponovno rezultira većom razlikom u duljini ždrijela i usne šupljine (Nishimura *et al.* 2006). Ovakav anatomski ustroj onemogućuje križanje probavnog i dišnog puta te eliminira mogućnost aspiracije hrane ili tekućina (Böe *et al.* 2002), ali također uvelike ograničava produkciju glasova i mogućnosti vokalne komunikacije. Čovjekoliki majmuni imaju znatno užu torakalni vertebralni kanal od anatomske modernih ljudi. Ne čudi onda što se glasanje i disanje primata pri glasanju uvelike razlikuju od ljudskoga govora. Pri disanju neljudski primati koriste abdominalne mišiće i dijafragmu kako bi upravljali disanjem pri glasanju, dok interkostalni mišići uglavnom nemaju aktivnu ulogu. Kako interkostalni mišići ne sudjeluju aktivno u procesu, vokalizacija je u primata uglavnom kratka i nedomulirana (MacLarnon & Hewitt 1999).

## TEMELJI RAZUMIJEVANJA GOVORA I JEZIKA U PROŠLOSTI

### FOSILNA GRAĐA

Budući da se jezik ne fosilizira te sve do pojave pisma ne ostavlja izravan trag, naš uvid u ranu evolucijsku prošlost jezika (i govora) bit će prilično ogra-

palate, such a lowered larynx enables the production of the largest possible number of sounds. The ability to articulate consonants is affected by the position of the hyoid bone, connected to the cartilage support of the larynx. It includes three muscles (*m. genioglossus*, *m. palatoglossus* and *m. mylohyoideus*) which help move the tongue in the oral cavity during chewing, swallowing and speaking. As people grow up, the hyoid bone is significantly lowered in relation to the palate, and in other primates it remains relatively high in the throat. Such a position results in different appearance of the listed muscles and their bases, which means different abilities. The shape and position of the hyoid bone in apes limits tongue flexibility and results in a greater distance between the root of the tongue and the front part of the oral cavity, which is why the tongue cannot reach all parts of the oral cavity. This limitation in tongue movement also means that the tongue cannot reach the places where certain consonants are produced (Duchin 1990).

In grownup chimpanzees and other nonhuman primates, the larynx is directly connected to the soft palate, and the pharynx is significantly shorter related to the oral cavity (Negus 1949, Laitman and Reidenberg 1993: fig. 2). During maturing, the larynx is somewhat lowered in relation to the palate and relatively elongates the pharynx (Flügel & Rohen 1991). At the same time, however, face prognathism develops, additionally elongating the oral cavity and the tongue, again resulting in a greater difference in larynx and oral cavity length (Nishimura *et al.* 200.). This anatomical feature disables the crossing of the digestive path and the airway and eliminates the ability to inhale food or liquids (Böe *et al.* 2002.), but also greatly limits sound production and the ability for verbal communication. Apes have a significantly narrower thoracic vertebral canal than anatomically modern humans. Therefore, it is not surprising that the sounds and breathing while making sounds in primates is very different from human speech.

ničen. Kao jedan od najboljih pokazatelja poslužit će nam fosilna građa. Budući da smo u prethodnom poglavlju odredili dio anatomskih regija vezanih uz jezične sposobnosti i produkciju govora, ovdje ćemo na temelju dostupnih fosilnih nalaza pokušati vidjeti kada se u ljudskoj evolucijskoj prošlosti ti elementi javljaju. Pažnju ćemo posebno obratiti na kranijalni kapacitet (odnosno povećanje istog), morfološke odlike Brocinog i Wernickeovog područja, no i na ostale anatomske detalje koje je moguće vezati uz neke od elemenata govora ili jezičnih sposobnosti.

Imajući na umu raznolike funkcije Brocinog i Wernickeovog područja te funkcije područja iz kojih su se specijalizacijom razvila, ne čudi što su u određenoj mjeri bila prisutna već prije pojave plemena hominini. Prethodnici anatomske modernih ljudi, ali i ostalih živućih primata, morali su imati sposobnosti poput snalaženja u vremenu i prostoru, dobru kontrolu nad pokretima te mogućnost interpretacije zvučnih signala te poruka i informacija koje su primali od drugih pripadnika svoje vrste. Evolucija je tako iskoristila ove postojeće djeliće anatomije i prilagodila ih produkciji jezika kada se za to ukazala potreba. Samo postojanje ovih područja ili njihovih preteča u zadnjeg zajedničkog pretka, međutim, ne svjedoči o njihovoj razvijenosti i ulozi u komunikaciji, niti o njihovom evolucijskom putu. Odgovor na ta pitanja treba potražiti u fosilnim ostacima plio-pleistocenskih hominina.

O anatomiji i organizaciji mozga više se može saznati iz vrlo rijetkih prirodnih endokasta ili umjetnih odljeva napravljenih pomoću očuvanih lubanja (vidi Holloway *et al.* 2004). Još 1972. godine Holloway (1972) je analizirao posebno dobro očuvan endokast vrste *Australopithecus robustus* u potrazi za anatomske karakteristika koje bi mogle upućivati na jezične sposobnosti. Njegove su analize pokazale kako se već kod ovog ranog hominina javlja reorganizacija mozga, očitovana u većem i zaobljenijemu predjelu Brocinog područja te znatnom povećanju u temporalnom režnju na mjestu gdje se kod anatomske modernih ljudi nalazi Wernickeovo područje.

Nalazi pripisani vrsti *Homo habilis* pokazuju reorganizaciju mozga u smjeru anatomske modernih ljudi. Prisutna je cerebralna asimetrija te se u manjoj mjeri javljaju područja koja odgovaraju Brocinom, Wernickeovu području te POT-u (Tobias 1998), a kranijalni kapacitet nešto je veći u odnosu na ranije hominine (Deacon 1997), što se povezuje s relativnom veličinom neokorteksa i mogućnosti kompleksnih društvenih interakcija te povećanja zajednice (Dunbar 2003; Mithen 1999). Wilkins i Wakefield (1995) proširili su istraživanje Brocinog područja analizom njegovih izvanjezičnih funkcija, posebice neuralne kontrole palca, vezanom uz uporabu i proizvodnju

While breathing, nonhuman primates use abdominal muscles and the diaphragm to control breathing while making sounds, while the intercostal muscles mostly do not play an active part in that. Since the intercostal muscles do not play an active role in the process, primate vocalization is mostly short and non-modulated (MacLarnon & Hewitt 1999).

## THE BASIS FOR UNDERSTANDING OF SPEECH AND LANGUAGE IN THE PASTFOSSIL RECORD

Since language cannot be fossilized and there are no direct traces of it until the emergence of writing, our insight into the early evolutionary past of language (and speech) will be fairly limited. We will use fossil material as one of the best indicators. In the previous chapter we determined some anatomic areas connected to linguistic abilities and speech production, we will move on to try and see, based on available fossil remains, when these elements appeared in human evolution. We will put special emphasis on cranial capacity (i.e. when it increased), the morphological features of Broca's and Wernicke's areas, but also on other anatomical details which can be connected to elements of speech or linguistic abilities.

With different functions of Broca's and Wernicke's areas in mind which developed through specialization, it is not surprising that they were present before the appearance of the tribe hominini. The predecessors of anatomically modern humans and other living primates, had abilities like time and space orientation, good movement control and the ability to interpret sound signals, messages and information they received from members of their species. Evolution made use of these existing anatomical particles and adapted them to language production when it became necessary. The sole existence of these areas or their predecessors in the last common ancestor, however, is not proof of their development and role in communication, or of their evolutionary path. The answers to these questions should be sought in the fossil record of Plio-Pleistocene hominins.

We can learn more about the anatomy and organization of the brain from extremely rare endocasts or artificial casts made based on preserved skulls (see Holloway *et al.* 2004). Back in 1972, Holloway (1972) analyzed a well-preserved endocast of the species *Australopithecus robustus*, searching for anatomical characteristics which could indicate linguistic abilities. His analyses showed that brain reorganization appeared in early hominins, apparent through a bigger and more curved part of Broca's area and through a significant increase in the tem-



kamenih alatki, što zahtjeva koordinaciju oka i ruke. Wilkins (2009) predlaže model prema kojem je motoričko područje rano u ljudskoj povijesti koevoluiralo sa somatosenzornim područjem zahvaljujući selekciji koja je favorizirala mogućnost bolje izrade oruđa te lova na daljinu. Područja koja su se posebno razvila pritom su Brocino i Wernickeovo područje te dijelovi POT-a. Iako se ove anatomske komponente nisu razvile kako bi podržale lingvističke funkcije, njihov je razvoj bio nužan za pojavu jezika i govora (Wilkins 2009). Wilkinsovu teoriju o razvoju motoričkog područja koje je potom poslužilo kao neuralni temelj za jezičnu produkciju podupiru i suvremene spoznaje u rehabilitaciji djece s cerebralnim oštećenjima. Iako se motoričke funkcije na prvi pogled ne čine usko povezane s jezičnom sposobnosti, u mozgu su gusto isprepletene. Vježbe za poticanje koordinacije i razvoj motorike kod djece s oštećenjem mozga tako simultano utječu na razvoj jezične sposobnosti.

Na temelju fosilne građe moguće je zaključiti da su se još značajnije promjene u organizaciji mozga, kao i povećanje kranijalnog kapaciteta javile kod taksona *Homo erectus/ergaster*. Dunbar (1996) smatra da je u to vrijeme vokalizacija preuzela ulogu (Dunbar 1996), iako se suvremena inačica jezika javlja tek mnogo kasnije i prema Dunbaru (1996) vezana je uz anatomske moderne ljude i pojavu simboličke, rituala i religije. Osim povećanja kranijalnog kapaciteta, nalazi pripisani vrsti *H. erectus/ergaster* pružaju dokaze i o prisustvu Brocine i Wernickeove regije (Wynn 1998).

Naglašeno povećanje kranijalnog kapaciteta hominina moguće je pratiti u razdoblju između 2 i 1.5 milijuna godina prije sadašnjosti, nakon čega slijedi razdoblje relativne stagnacije, te ponovo u razdoblju između 600 000 i 250 000 godina prije sadašnjosti, kada je dostignuta današnja vrijednost (Ruff *et al.* 1997). S pojavom vrste *Homo ergaster* tjelesna masa povećala se za gotovo 50-70% u odnosu na ranije hominine, dok se veličina mozga udvostručila (Key & Aiello 1999, vidi tab.2 i sl. 3).

poral lobe in the place where Wernicke's area is in anatomically modern humans.

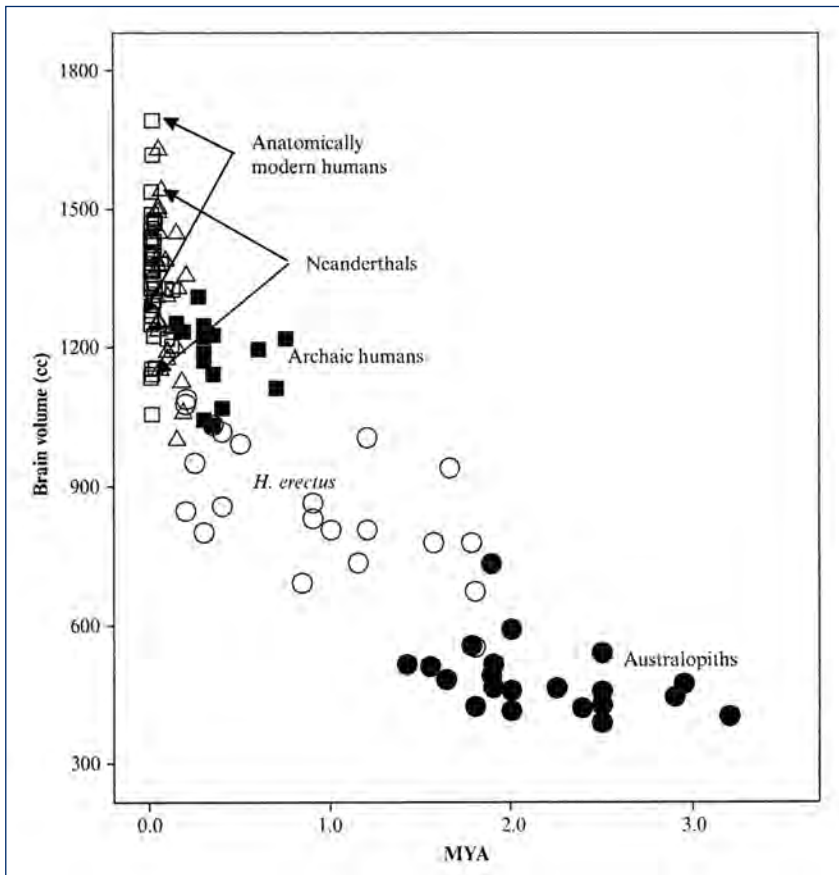
Findings ascribed to *Homo habilis* display brain reorganization in the direction of anatomically modern humans. Cerebral asymmetry is present and, although smaller, areas appear which are similar to Broca's, Wernicke's and PTO areas (Tobias 1998), and the cranial capacity is somewhat larger than in earlier hominins (Deacon 1997), which is connected to the relative size of the neocortex and abilities of complex social interactions and increase in community size (Dunbar 2003; Mithen 1999). Wilkins and Wakefield (1995) widened research on Broca's area by analyzing his non-linguistic functions, especially neural thumb control, connected to using and making stone tools which requires hand to eye coordination. Wilkins (2009) suggested a model which states that motoric areas in early human history coevolved with the somatosensory area thanks to selection which favored the ability to produce better tools and hunting from a distance. Some areas developed precisely due to this, including Broca's, Wernicke's and parts of the PTO areas. Although these anatomical components did not develop in order to support linguistic functions, their development was necessary for the emergence of language and speech (Wilkins 2009). Wilkins's theory on the development of motoric areas which later served as a neural basis for language production were widened by contemporary findings on the rehabilitation of children with cerebral paralysis. Although motoric abilities do not appear to be closely related to linguistic abilities, they are thickly intertwined in the brain. Exercises for increasing coordination and developing motoric abilities in children with brain damage can simultaneously affect linguistic abilities.

Based on fossil material, it is possible to conclude that even more significant changes in brain organization, as well as an increase in cranial capacity, appeared in *Homo erectus/ergaster*. Dunbar (1996)

takson	srednja vrijednost (u ml)	raspon vrijednosti (u ml)
Australopithecus afarensis	445.8	387 - 550
Australopithecus africanus	461.2	400 - 560
Australopithecus aethiopicus	431.7	400 - 490
Australopithecus robustus	493.3	450 - 530
Australopithecus boisei	508.3	475 - 545
Australopithecus garhi	450	-
Homo habilis	610.3	510-687
Homo rudolfensis	788	752-825
Homo ergaster	800	750-848
Homo erectus	951.8	727-1222
Homo heidelbergensis	1262.8	1150-1450
Homo sapiens neanderthalensis	1427.2	1200-1700

Tablica 2: Endokranijalni kapacitet za neke vrste hominina (prema Holloway *et al.* 2004)

Table 2: The endocranial capacity for some species of hominins (according to Holloway *et al.* 2004)



Slika 3: Volumen mozga u cm<sup>3</sup> za neke vrste hominina (prema Dunbar 2009:25) (MYA označava milijune godina prije sadašnjosti).

Figure 3: Brain volume in cm<sup>3</sup> for some species of hominins (according to Dunbar 2009:25) (MYA means millions of years before present).

Povećanje kranijalnog kapaciteta, posebice neurokortexa kao regije u kojoj se spremaju i procesuiraju informacije temelj je razvoja mnogih složenih ponašanja, odnosa, te razvoja složenog jezičnog sustava (Li 2002). Moderna organizacija mozga i razvoj takozvanih jezičnih područja stvorio je dobru podlogu za pojavu i razvoj jezika, no za razvoj govora bile su potrebne i značajne anatomske promjene u govornom aparatu. Jedna od osnovnih promjena bila je bolja kontrola nad interkostalnim mišićima i disanjem (iako su razlozi za ovu anatomsku promjenu vjerojatno bili vezani i uz naglasak na važnost trčanja na duge staze i dr.) (vidi MacLarnon 1993; MacLarnon & Hewitt 1999; 2004).

Anatomska regija koja će nam pružiti uvid u to je vertebralni kanal, odnosno njegove dimenzije (primjerice, suvremene ljudske populacije imaju veće dimenzije vertebralnog kanala od čovjekolikih majmuna). Nažalost, fosilna građa za proučavanje ove anatomske regije (posebice ranih hominina) vrlo je oskudna. Na temelju ograničenih nalaza Mac Larnon i Hewitt (1999; 2004) zaključili su da

states that, at the time, vocalization took over (Dunbar 1996.), although the contemporary version of language appeared later and is, according to Dunbar (1996), connected to anatomically modern humans and the appearance of symbolism, rituals and religion. Apart from an increase in cranial capacity, finds of *H. erectus/ergaster* give evidence for the existence of Broca's and Wernicke's areas (Wynn 1998).

A marked increase in hominin cranial capacity can be followed in the period between 2 and 1.5 million years before present, after which there is a period of relative stagnation, and again in the period between 600 000 and 250 000 years before present, when today's values were reached (Ruff *et al.* 1997). The appearance of *Homo ergaster* meant a 50-70% increase in body mass in relation to earlier

hominins, and the size of the brain doubled (Key & Aiello 1999, see tab. 2 and fig. 3).

The increase in cranial capacity, especially the neocortex as the region where information is stored and processed in the basis for developing many complex behaviors, relations and developing complex language systems (Li 2002). Modern brain organization and the development of the so called linguistic areas created a good foundation for the emergence and development of language. Speech, however, required significant anatomical changes to the speech apparatus, one of the basic changes included a better control of the intercostal muscles and breathing (although the reasons for this change were probably also connected to emphasizing the importance of long-distance running and the like) (see MacLarnon 1993; MacLarnon & Hewitt 1999; 2004).

The anatomical area which can give us insight is the vertebral canal, that is, its dimensions (for example, contemporary human populations have bigger vertebral canals than apes). Unfortunately, fossil material for studying this anatomical region (especially in early hominins) is very sparse. Based on limited finds, Mac Larnon and Hewitt (1999; 2004) concluded that *australopithecines* members had more resemblance to other primates than humans. Based on find KNM-WT 15000 they con-

su australopitecini u tom aspektu sličniji ostalim primatima nego suvremenim ljudima. Na temelju nalaza KNM-WT 15000 zaključili su da je slično i sa taksonom *Homo ergaster* (*Homo erectus*), za razliku od neandertalaca čije vrijednosti se uklapaju pod one kod suvremenih ljudskih populacija. Kasnije analize ukazale su na mnoge patologije nalaza KNM WR 15000 uključujući i one vertebralnog kanala, a analize ranih pripadnika roda *Homo* izvan Afrike (*H ergaster* ili *H. erectus*) s nalazišta Dmanisi u Gruziji (Meyer 2005) kao i preliminarne analize nalaza s lokaliteta Sima de los Huesos u Španjolskoj (*H. heidelbergensis?*, Carretero *et al.* 1999; Gómez-Olivencia *et al.* 2007) pokazuju vrijednosti koje se uklapaju u raspon vrijednosti kod suvremenih ljudskih skupina.

Osim motoričke kontrole disanja, za proizvodnju govora i modernog jezika nužne su promjene u vokalnom traktu, posebice njegovom supralingvalnom dijelu. Budući da se ove promjene nažalost neće očuvati u fosilnoj građi (jedini koštani element je krhka i malena jezična kost, *os hyoideum*), rekonstrukcije vokalnog trakta izumrlih hominina temeljit će se na indirektnim pokazateljima poput procjene omjera ždrijela i usne šupljine i kuta baze kranija. Na tome se temelje i rekonstrukcije Liebermana i McCarthyja (1999) koji zaključuju da je moderni omjer ždrijela i usne šupljine (1:1) prisutan tek kod anatomske modernih ljudi počevši od 40 000 godina prije sadašnjosti, te da niti naši evolucijski najbliži srodnici, neandertalci, nisu govorili poput nas. Neki autori čak predlažu da je evolutivna prednost modernih ljudi nad populacijama neandertalaca dijelom bila u modernom govoru i jeziku te je to dijelom moglo pridonijeti izumiranju neandertalaca (Washburn 1981), iako su mnoga istraživanja pokazala da nema bitnijih razlika u organizaciji mozga između neandertalaca i suvremenog čovjeka (Holloway 1985; Kochetkova 1972; LeMay 1975). Lieberman (2008) smatra kako položaj larinksa niže u grlu i drukčiji omjer okomite i vodoravne šupljine rezultiraju ograničenjem u artikulaciji samoglasnika te nazalnom govoru. Drugim riječima, neandertalcima bi larinks bio smješten duboko u grlu, te ne bi mogli proizvesti samoglasnike [i], [a] te [u] (Lieberman & Crelin 1971; Lieberman i sur 1972; Lieberman 1989; 1992; 1994). Kasnije rekonstrukcije (Falk 1975; LeMay 1975; Aiello 1998; Houghton 1993; 1994) pokazale su da je rekonstrukcija vokalnog trakta koju predlaže Lieberman pogrešna. Nadalje, kada bi ovi autori i bili u pravu i kad bi neandertalci bili ograničeni u mogućnosti produkcije određenih vokala, to ne bi značilo da nisu mogli imati sasvim moderan, iako drugačiji, jezični sustav. Simulacije koje su proveli Boë i suradnici (2002) po-

cluded that the situation was similar with *Homo ergaster* (*Homo erectus*), unlike the Neanderthals whose values fit into those of modern human populations. Later analyses showed many pathologies of KNM WR 15000, including those to the vertebral canal, and the analyses of early *Homo* specimens outside Africa (*H ergaster* or *H. erectus*) from Dmanisi in Georgia (Meyer 2005), as well as preliminary analyses on finds from Sima de los Huesos in Spain (*H. heidelbergensis?*, Carretero *et al.* 1999; Gómez-Olivencia *et al.* 2007) revealed values which fit into the span of values in modern human populations.

Apart from the motoric control of breathing, the production of speech and modern language requires changes in the vocal tract, especially its supralingual part. Since these changes cannot be preserved in the fossil record (the only bone element is small and fragile hyoid bone, *os hyoideum*), the reconstruction of the vocal tract of extinct hominins will be based on indirect indicators like the evaluation of the ration between the pharynx and the oral cavity and the angle of the cranial base. Lieberman and McCarthy based their comparisons on these features (1999) and concluded that the modern ration of pharynx to oral cavity (1:1) is present only in anatomically modern humans, starting from 40 000 years before present, and that not even our closes evolutionary cousins did not speak like we do. Some authors even suggest that the evolutionary advantage of modern humans over Neanderthals was partly in moder speech and language and that this could have been part of the reason why Neanderthals became extinct (Washburn 1981), although many research has shown that there are no significant differences in brain organization of Neanderthals and contemporary humans (Holloway 1985; Kochetkova 1972; LeMay 1975). Lieberman (2008) thinks that the position of the larynx deeper in the throat and a different ratio of the vertical and horizontal cavities results in limiting the articulation of consonants and nasal speech. In other words, the larynx of Neanderthals would be deeper in the throat, so they could not produce the vocals [i], [a] and [u] (Lieberman and Crelin 1971; Lieberman *et al.* 1972; Lieberman 1989; 1992; 1994). Later reconstructions (Falk 1975; LeMay 1975; Aiello 1998; Houghton 1993; 1994) have shown that the reconstruction of the vocal tract suggested by Lieberman was wrong. Furthermore, if these authors were right and if Neanderthals were limited in the production of certain vocals, it would not mean that they could not have had a completely modern, although different, language system. Simulations conducted by Boë *et al.* (2002) show that the length of the pharynx, that is,

kazuju kako dužina farinksa, odnosno niži položaj larinksa, nije nužna predispozicija za produkciju punog raspona glasova. Žene i adolescenti anatomske modernih ljudi, primjerice, imaju kraće ždrijelo u odnosu na odrasle muškarce, no to ne utječe na njihove artikulacijske mogućnosti (de Boër 2009). Istraživanje Boëa i suradnika (2002) pokazalo je kako govornici iste vokale tvore različito te da na tvorbu utječu okreti usnica, jezika i čeljusti. Pritom položaj tijela jezika sudjeluje u tvorbi vokala [a] dok su položaj jezika i otvorenost usnica ključni za artikulaciju vokala [i] te [u] koje Lieberman veže isključivo uz položaj ždrijela. Uzevši sve to u obzir, simulacijom potencijalnog artikulacijskog prostora kod neandertalca Boë i suradnici (2002) pokazali su kako je on identičan onome kod anatomske modernih ljudi.

Otkriće jezične kosti (*os hyoideum*) neandertalca u pećini Kebara u Izraelu (KMH2), datirane na otprilike 60.000 godina prije sadašnjosti (Valladas *et al.* 1987), omogućilo je preciznije rekonstruiranje vokalnog trakta (Arensburg *et al.* 1989; 1990; 1992; Houghton 1993). Pronađena kost svojim morfološkim odlikama ne razlikuje se od jezične kosti u živućih ljudskih populacija (Arensburg *et al.* 1989; 1990; Frayer 1992). Analiza mišićnih hvatišta omogućila je rekonstrukciju položaja jezične kosti u odnosu na donju čeljust, smjestivši je otprilike u razini četvrtog vratnog kralješka, na istoj razini kao i kod suvremenih ljudi.

#### ARHEOLOŠKA GRAĐA *SENSU STRICTO*: MATERIJALNA KULTURA I PONAŠANJE

Prepoznati simboličko ponašanje na temelju ostataka materijalne građe iz prapovijesti vrlo je težak zadatak. No ukoliko određenu sferu simboličkog razmišljanja pretpostavimo na temelju prisustva neutilitarnih predmeta - onih bez funkcije koja je strogo vezana uz preživljavanje, kao i pojavu ukopa, koji većina autora vezuje uz određen stupanj simboličke svijesti (ukoliko nije riječ o praksi iz strogo higijenskih razloga, više o tome vidi u Karavanić 2012 i tamo citiranoj literaturi), naša će razmatranja ipak imati određen temelj (vidi na pr. Ambrose 2001; Klein 2000; McBrearty & Brooks 2000; Mellars 1973, 1998; Davidson & Noble 1989; Noble & Davidson 1991; Mellars 1996; Deacon 1997; Aiello 1998 i tamo citiranu literaturu).

Nadalje, prije same pojave umjetnosti i simboličkog razmišljanja, jezik i govor imao bi važnu ulogu i selektivnu prednost nad neverbalnom komunikacijom već u doba pojave prvih alatki i prenošenja složenih informacija učenjem. Na temelju spoznaja

a lower placement of the larynx is not a necessary precondition for the production of the full span of sounds. Women and adolescents of anatomically modern humans, for example, have a shorter pharynx compared to grown men, but it does not affect their articulatory abilities (de Boër 2009). Research carried out by Boë *et al.* (2002) has shown that speakers create the same vocals in different ways, and that their production is affected by lip, tongue and jaw movement. The body of the tongue participates in the production of the vocal [a], while the position of the tongue and the openness of the nostrils are crucial for the articulation of vocals [i] and [u], which Lieberman linked exclusively to the position of the pharynx. Considering all this, by simulating the potential articulation area in Neandertalsthal, Boë *et al.* (2002) showed that it is identical to that of anatomically modern humans.

The discovery of the hyoid bone (*os hyoideum*) in Neandertals from the Kebara cave in Israel (KMH2), dated to approximately 60.000 years before present (Valladas *et al.* 1987), allowed for more precise reconstructions of the vocal tract (Arensburg *et al.* 1989; 1990; 1992; Houghton 1993). The morphometric features of the found bone do not differ from the hyoid bone in living human populations (Arensburg *et al.* 1989; 1990; Frayer 1992). The analysis of muscular attachments allowed for a reconstruction of the position of the hyoid bone in relation to the lower jaw, placing it at the level of the fourth vertebra, just like in modern humans.

#### ARCHAEOLOGICAL MATERIAL *SENSU STRICTO*: MATERIAL CULTURE AND BEHAVIOR

Recognizing symbolic behavior based on prehistoric material remains is a difficult task. However, if we ascribe symbolic thinking to discovered non-utilitarian objects - those without a function strictly connected to survival, as well as the appearance of burials, linked to a certain degree of symbolic consciousness by most authors (if it is not a strictly hygienic practice, see more in Karavanić 2012 and therein cited bibliography), our considerations will have a more solid basis (e.g. see Ambrose 2001; Klein 2000; McBrearty & Brooks 2000; Mellars 1973, 1998; Davidson & Noble 1989; Noble & Davidson 1991; Mellars 1996; Deacon 1997; Aiello 1998 and therein cited bibliography).

Furthermore, before the appearance of art and symbolic thinking, language and speech would have an important role and selective advantage over nonverbal communication from the time the

suvremene znanosti, prve kamene alatke stare su oko 2.5 milijuna godina (Semaw *et al.* 1997; Semaw 2000). Iako je riječ o oruđima koje je vrlo jednostavno napraviti (sječkači, sjeckala i odbojci tzv. oldovan-ske industrije ili kulture), ti artefakti omogućili su ranim homininima veliku prednost. Eksperimentima je dokazano da za samo nekoliko sati i tim jednostavnim izrađevinama moguće raskomadati i najveće kopnene sisavce, poput slona (Schick & Toth 1994). Prije više od 1,5 milijuna godina (za vrijeme tzv. ašelejske kulture) alatke i proces njihove izradbe postaju sve složeniji, a vidljiv je i pažljiv odabir u materijalu (vrsti kamena) koji je korišten. Budući da je često riječ o materijalu koji je donesen s više kilometara udaljenosti od mjesta njihovog pronalaska, moguće je zaključiti da se paralelno javlja i dugoročno planiranje, što je još više stavilo naglasak na kognitivni razvoj, a najjednostavniji i najsvrsishodniji način prenošenja složenih uputstava i informacija, kao i spoznaja o razlozima zbog kojih je važan odabir određenog kamena i sl., govorni je jezik (Boëda 1991; Karlin & Julien 1994; Pelegrin 1990; Perlès 1992; Schlanger 1994; Wynn 1991). To ne znači da je već u tom razdoblju prisutan suvremen jezik sa svim njegovim današnjim odlikama, nego da bi selekcija djelovala u smjeru njegova razvoja, što će sve većim naglaskom na kulturu i sve složeniji način života i socijalnu strukturu rezultirati ubrzanom razvojem jezičnih i govornih aspekata. Nadalje, u vrijeme pojave prvih pripadnika roda *Homo*, posebice skupina *Homo ergaster/erectus*, ljudi po prvi put napuštaju svoju afričku pradamovinu. To je razdoblje značajnih klimatskih promjena i početka pleistocena u kojem su prisutne oscilacije od oledbi do razdoblja relativno blage klime, što uzrokuju česte promjene u okolišu, kao i biosferi (biljke i životinje). Iako su vidljive mnoge biološke prilagodbe na nove okolnosti i nov okoliš (posebice očite u kosturu tijela koji poprima modernije dimenzije i odnose, no, kao što smo ranije spomenuli i u dimenzijama i organizaciji mozga), osobita promjena uočljiva je i u ponašanju. U razdoblju između 2 milijuna i 500 000 godina prije sadašnjosti čovjek je naselio veći dio Euroazije, ovladao vatrom, počeo graditi nastambe na otvorenom (iako su nalazi takvih struktura relativno rijetki) i počeo organizirano loviti krupni plijen. U svemu tome određene jezične i govorne sposobnosti nesumnjivo bi pružile veliku prednost. Osim povećanja u složenosti kulture koju je moguće iščitati kroz dugi vremenski razvoj starijeg kamenog doba (i u tipološkom i tehnološkom smislu), unutar ovog dugog vremenskog razdoblja javljaju se i drugi elementi putem kojih je možda moguć određen uvid u razvoj govora i jezika. Tu građu običavamo nazivati "neutilitarnim predmetima", budući da

first tools were made and complex information was transferred through learning. Based on findings of contemporary science, the first stone tools are about 2.5 million of years old (Semaw *et al.* 1997; Semaw 2000). Although they are tools which are easy to make (choppers, chopping tools and flakes of the so called Oldowan industry or culture), these artifacts gave early hominins a great advantage. Experiments showed that it takes only a few hours to butcher even the biggest mammals, like elephants, with these tools (Schick & Toth 1994). More than 1.5 million years ago (during the so called Acheulean culture) tools and the way they were made became more complex, and there is a visible careful selection of raw material (type of stone). Since it is often material which was brought from places several kilometers away from where they were found, we it can be concluded that long-term planning also appeared at this point, highlighting cognitive development even more, and the simplest and direct way to transfer complex instructions and information, as well as why a certain type of stone is better than another, is spoken language (Boëda 1991; Karlin & Julien 1994; Pelegrin 1990; Perlès 1992; Schlanger 1994; Wynn 1991). This does not mean that modern language was present in this period with all its present features, but that selection acted towards its development, which would, along with more emphasis on culture and a more complex way of life and social structure result in a faster development of linguistic and speaking aspects. Additionally, when the first *Homo* appeared, especially *Homo ergaster/erectus*, people left their African home for the first time. It was a period of significant climate changes and the beginning of Pleistocene, full of oscillations between glacials and periods of mild climate, which caused frequent changes in the environment and the biosphere (plants and animals). Although many biological adaptations to new circumstances are visible (especially evident in the skeleton which becomes more modern in dimension and relations, but also, as was mentioned, in the dimensions and organization of the brain), a significant change occurred in behavior. In the period between 2 million and 500 000 years before present, man had inhabited most of Eurasia, mastered fire, started building shelters in the open (although finds of such structures are relatively rare) and started to organize hunting for bigger prey. Certain language and speech abilities would surely be a significant advantage in such a situation.

Apart from the increased cultural complexity evident through the long time period of the Old Stone Age (both typologically and technologically), other elements also appeared at this time which could

se ne radi se o oružju i oruđu kojim bi se ispunjavala uloga biološkog preživljavanja. Ova skupina predmeta vrlo je raznolika i uključuje razne modificirane ili bojane predmete iz prirode (primjerice kamenje), ostatke životinja (primjerice modificirane školjke, zube i sl.), kao i nalaze koje s punim pravom nazivamo umjetničkim predmetima (primjerice antropomorfnu i zoomorfnu plastika, gravure, slikarije, glazbene instrumente i sl.). Posebnu kategoriju predstavljaju i spomenuti ukopi pokojnika, bilo da se radi o samim ukopima, ili složenijim simboličkim ili čak religijskim činovima koji se mogu pretpostaviti na temelju grobnih priloga.

Najranije primjere spomenute građe moguće je raspoznati u uporabi boje (pigmenta). Oblutak s tragovima okera koji se možda pomalo maštovito naziva Venerom pronađen je na nalazištu Tan Tan u Maroku (Bernardik 2003.) i datiran u razdoblje između 500 i 300 000 godina prije sadašnjosti. Sličan je slučaj i s kontroverznim nalazom za koji dio znanstvenika smatra da predstavlja ljudski lik pronađenom na nalazištu S nalazišta Berekhat Ram na Golanskoj visoravni (Goren-Inbar 1986.; Goren-Inbar & Peltz 1995.). Ova dva predmeta još su predmet rasprava među znanstvenicima, no ako se pokaže da su uistinu namjerno izrađeni prikazi ljudskog lika, pojavu umjetnosti i simbolike valja pomaknuti mnogo ranije nego se to do sada smatralo. Pojavu simbolike, odnosno prijenosa apstraktnih ideja, većina znanstvenika veže uz govor i vrlo razvijen jezik.

U razdoblju između 200 i 40 000 godina prije sadašnjosti svjedoci smo velikih inovacija u kulturnom izričaju, a istovremeno se javljaju i pokazatelji za koje većina autora smatra da valja tumačiti u sferi simboličkog (poput ukopa i umjetnosti). Neandertalci, koji u to vrijeme obitavaju na tlu Europe i zapadne i središnje Azije, prvi su ljudi za koje imamo nepobitne dokaze o ukapanju mrtvih (vidi raspravu u Garget 1989; Riel-Salvatore & Clark 2001; D'Errico *et al.* 2003; Klein 2000; Harrold 1980; Binford 1968; Toussaint *et al.* 2001; Leroi-Gourhan 1975; Solecki 1963, 1975; Akazawa *et al.* 1995; Ovchinnikov *et al.* 2000; Rak *et al.* 1994; Hovers *et al.* 1995, 2000; Arensburg *et al.* 1985; Hayden 1993; Valladas *et al.* 1987). Ukopi neandertalaca kao što su La Chapelle-aux-Saints, La Ferrassie, Spy, Amud, Kebara, Dederiyeh, Teshik Tash, samo su neki od primjera ovakvog odnosa prema pokojnicima. Ponekad, iako ne toliko često, ukopi sadrže i grobne priloge. Shanidar 4 često se navodi i kao primjer postojanja grobnih ceremonija, budući da visoka koncentracija cvjetnog peluda unutar groba ukazuje na postojanje grobnog priloga u vidu cvijeća, ili pak cvjetnog odra u grobu (Leroi-Gourhan 1975; Solecki 1975; za drugačije objašnjenje vidi Chase i Dibble 1987).

give insight into the development of language and speech. We tend to call this “non-utilitarian objects” since they are not weapons or tools which would serve for biological survival. This group of finds is very diverse and includes different modified or colored objects taken from nature (e.g. rocks), animal remains (e.g. modified shells, teeth and the like), as well as finds which can be rightfully called works of art (e.g. anthropomorphic and zoomorphic figurines, engravings, musical instruments and the like). A special category includes the noted burials, whether in themselves or as more complex symbolic, or even religious acts which can be observed through grave goods.

The earliest examples of this material are seen through the use of color (pigments). A pebble with traces of ochre which is, possibly somewhat fantastically, called a Venus was found at Tan Tan in Morocco (Bernardik 2003) and was dated to between 500 and 300 000 years before present. The situation is similar to the controversial find which some scientists think features a human character, which was found at Berekhat Ram on the Golan Heights (Goren-Inbar 1986; Goren-Inbar & Peltz 1995). These two finds are still a topic of discussion among scientists, and, if it turns out that they were intentionally made to show the human character, the emergence of symbolism and art should be moved to a lot earlier time than we thought so far. The appearance of symbolism, that is, the transfer of abstract ideas, is, by most scientists, linked to speech and very developed language.

Between 200 and 40 000 years before present, we witness great innovations in cultural expression, and, at the same time, indicators appear which most scientists believe should be interpreted as symbolic behavior (like burials and art). Neandertals who, at the time, inhabited Europe and western and central Asia are the first humans who, we can safely say, buried their dead (see discussion in Garget 1989; Riel-Salvatore & Clark 2001; D'Errico *et al.* 2003; Klein 2000; Harrold 1980; Binford 1968; Toussaint *et al.* 2001; Leroi-Gourhan 1975; Solecki 1963, 1975; Akazawa *et al.* 1995; Ovchinnikov *et al.* 2000; Rak *et al.* 1994; Hovers *et al.* 1995; 2000; Arensburg *et al.* 1985; Hayden 1993; Valladas *et al.* 1987). Neandertal burials like those from La Chapelle-aux-Saints, La Ferrassie, Spy, Amud, Kebara, Dederiyeh, Teshik Tash, are only some examples of this relation to the deceased. Sometimes, although not often, the burials contained grave goods. Shanidar 4 is often listed as an example of the existence of burial ceremonies, seeing that the high concentration of flower pollen points to grave goods in the sense of flowers, or a floral catafalque within the grave (Leroi-Gourhan

Brojna nalazišta svjedoče da su neandertalci bili vrlo snalažljivim i inteligentni ljudi koji su se uspješno prilagođavali lokalnim uvjetima života, te brinuli o ozljeđenima i nemoćnim pripadnicima svoje zajednice (Trinkaus 1983; Radovčić *et al.* 1988). Musterijenska kultura ili industrija, koju na tlu Europe vežemo isključivo uz neandertalce sve do pred kraj njihova postojanja, odlikuje se velikim brojem tipova alatki pogodnim za različite radnje (Bordes 1950, 1951, 1961; Mellars 1996). Vrlo složen postupak izrade alatki, obrada drva, ponekad i kosti, pokazuju visoku razinu umješnosti. Nadalje, na gotovo 40 musterijenskih nalazišta u Europi pronađeni su i tragovi pigmenta. U staništima neandertalaca, uz oker i druge crvene i crne pigmente, sakupljani su i različiti fosili školjaka i kamenje neobičnog oblika koje nije imalo praktičnu namjenu (vidi reference u Janković & Karavanić 2009; d'Errico & Soressi 2002; Karavanić 2012). Na lokalitetu Pech-de-l'Aze vidljiva je uporaba pigmenta za koje je mikroskopskom analizom dokazano da su korišteni za crtanje linearnih uzoraka, a dva komada pigmenta na sebi imaju apstraktni uzorak načinjen kamenim alatom (d'Errico *et al.* 2003). Budući da je ovaj lokalitet datiran na 90 000 do 60 000 godina prije sadašnjosti, 20 000 do 50 000 godina prije dolaska anatomski modernih ljudi na ta područja, jasno je da se ovaj aspekt modernog ponašanja razvio neovisno i u Europi. Uporaba pigmenta u razdoblju prije 50 000 godina dokazana je i na lokalitetima Cueva de los Aviones i Cueva Antón u Španjolskoj gdje su pronađene školjke s ostacima crvenog i narančastog pigmenta na vanjskim površinama, kao i veće školjke s ostacima različitih pigmenta za koje se pretpostavlja da su mogle služiti za miješanje i pripremu boja (Zilhão *et al.* 2010). Zbog udaljenosti od mora i nadmorske visine na kojoj se pećine nalaze, školjke se nisu mogle ondje akumulirati prirodnim putem. Istovremeno s biološkim i kulturnim razvojem neandertalaca na tlu Europe i dijela Azije, u Africi se prije između 190 i 160 000 godina pojavljuju prvi nalazi koji svjedoče o, u osnovi, modernoj anatomiji naše vrste (*Homo sapiens sapiens*). Njihovi potomci prije stotinjak tisuća godina počinju širiti i u druge geografske regije (prvo na tlo Zapadne Azije, kasnije dalje na istok, te prije otprilike četrdesetak tisuća godina i na prostor Europe) te svojim kasnijim širenjem u druge geografske prostore zamjenjuju starosjedilačko stanovništvo (vidi McDugall *et al.* 2005; Smith *et al.* 2005; 2012 i rasprave o modelima u Janković 2004. i Janković & Karavanić 2009). Ovaj biološki razvoj prati i promjena u ponašanju. Na nalazištu Twin Rivers u Zambiji i Kapthurin u Keniji (Barham 1998.; 2002) nalazi pigmenta stari su 200 000 godina. U jednom od slojeva na lokalitetu Twin

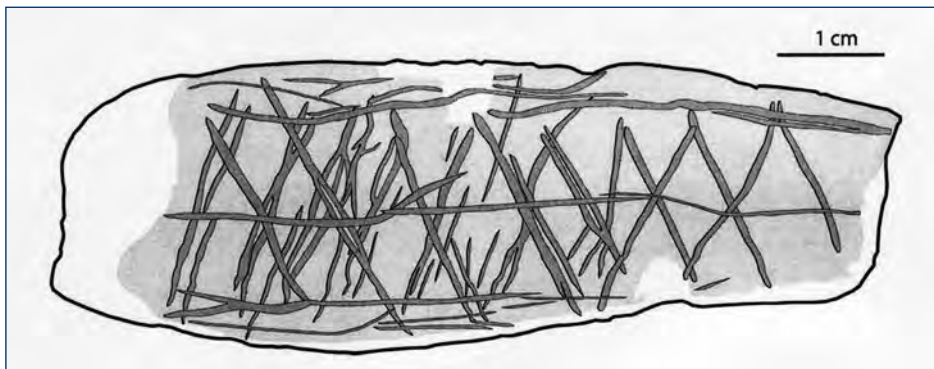
1975; Solecki 1975; for a different explanation see Chase & Dibble 1987).

Numerous sites show that Neandertals were very capable and intelligent people who successfully adapted to local living conditions and took care of the wounded and weak members of their communities (Trinkaus 1983; Radovčić *et al.* 1988). The Mousterian culture or industry, which is, in Europe, ascribed exclusively to the Neandertals until the very end of their existence, is characterized by a large number of tool types suitable for different activities (Bordes 1950, 1951, 1961; Mellars 1996). The procedure of making stone tools is very complex, as is wood, and sometimes bone, working, and they show a high level of skill. Furthermore, traces of pigments were found on almost 40 Mousterian sites in Europe. Along with ochre and other red and black pigments, different shell fossils and unusually shaped rocks were collected in Neandertals habitats which did not have a practical purpose (see references in Janković and Karavanić 2009; d'Errico & Soressi 2002; Karavanić 2012). The site of Pech-de-l'Aze showed the use of a pigment which, as proved by microscopic analysis showed, was used to draw linear patterns, and two pieces of pigment show an abstract pattern made by a stone tool (d'Errico *et al.* 2003). Since this site was dated between 90 000 and 60 000 year before present, meaning 20 000 to 50 000 years before the appearance of anatomically modern humans in this area, it is clear that this aspect of modern behavior developed independently in Europe as well. The use of pigment before 50 000 years ago was proven at Cueva de los Aviones and Cueva Antón in Spain, where shells were found with red and orange pigment remains on the outer surface, along with bigger shells with traces of different pigments which could have been used to mix and prepare colors (Zilhão *et al.* 2010). Due to the distance from the sea and the altitude of these caves, the shells could not have accumulated naturally.

Contemporaneous to the biological and cultural development of Neandertals in Europe and parts of Asia, the first traces of modern anatomy of our species (*Homo sapiens sapiens*) appeared in Africa between 190 and 160 000 years before present. Their descendants, about a hundred thousand years ago, started spreading into other geographical regions (first to western Asia, later further east, and to Europe around forty thousand years ago) replacing the native population (see McDugall *et al.* 2005; Smith *et al.* 2005; 2012 and discussions on models in Janković 2004 and Janković & Karavanić 2009). This biological development was followed by behavioral changes. At Twin Rivers in Zambia and Kapthurin in Kenya (Barham 1998; 2002.) 200 000 year old pig-

Rivers pronađeno je sto osamdeset komada pigmenta, u bojama od jarko crvene (okera) do žutozelene, s vidljivim tragovima trošenja i oblikovanja. Među najstarije nalaze za koje dio autora smatra da predstavljaju simbolički izričaj ubrajamo perlice od ljuštura puževa i komade okera s urezanim motivima iz 70 000 godina starih slojeva špilje Blombos u Južnoafričkoj republici (Henshilwood *et al.* 2002; Henshilwood 2004; Watt 2009: sl. 4).

To su samo neki od primjera mogućeg simboličkog ponašanja u vrijeme srednjeg paleolitika, a kao što vidimo prisutni su i na prostoru gdje borave rani anatomske ljudi, kao i na prostoru gdje su u to doba živjeli neandertalci. Nakon što se prve grupe anatomske modernih ljudi polako sele iz Afrike i dolaze na područje Levanta (u razdoblju između 100 i 50 000 godina prije sadašnjosti), tamo nailaze na neandertalce. Važno je napomenuti da iako mnogi često navode značajne razlike u ponašanju između ove dvije populacije, na temelju arheoloških nalaza to nije očito. I neandertalci i anatomske moderne skupine na području Levanta koriste musterijsku kulturu i obje grupe pokapaju svoje mrtve (vidi Bar-Yosef 1992). Barem u tom razdoblju i tom geografskom prostoru, nije moguće govoriti o značajnoj kognitivnoj prednosti jednih nad drugima. Ako je jezik i moderan govor bio dio „paketa moderniteta“, znanstvenu podlogu za takve tvrdnje nije moguće pronaći na tom mjestu i u tom razdoblju.



Slika 4: Oker s ugraviranim linijama pronađen u pećini Blombos (modificirano prema Henshilwood *et al.* 2009: 35)

Figure 4: Ochre with incised lines found in the Blombos cave (modified from Henshilwood *et al.* 2009: 35)

Temelji modela koji se zalažu za tzv. revoluciju u ponašanju, odnosno naglu promjenu u kulturi i simboličkom izražaju vezanu i uz pojavu modernog jezika postavljeni su (barem u svojim ranijim inačicama) na europskim nalazima i nalazištima. Smatralo se da nakon što anatomske moderne skupine, nosioci „modernijih“ kultura i umjetničkog izričaja dolaze na tlo Europe, u relativno kratkom razdoblju i u potpunosti zamjenjuju neandertalce (nositelje

ments were found. One of the layers at Twin Rivers yielded hundred and eighty (180) pieces of pigment, ranging from bright red (ochre) to yellowish-green, with visible traces of wear and shaping. Beads made of snail shells and pieces of ochre with incised motifs from 70 000 year old layers of Blombos cave in the Republic of South Africa are among the oldest finds testifying to, by some authors, symbolic behavior (Henshilwood *et al.* 2002; Henshilwood 2004; Watt 2009: fig. 4).

These are only some of the examples of possible symbolic behavior in the Middle Paleolithic, and, as we see, they exist in areas occupied by Neandertals as well as those occupied by anatomically modern humans. After the first group of anatomically modern humans slowly moved out of Africa into the Levant (between 100 and 50 000 years before present), they encountered Neandertals. It is important to note that many authors often mention significant differences between these two populations which archaeological finds do not. Both Neandertals and anatomically modern groups on the Levant used Mousterian culture and both buried their dead (see Bar-Yosef 1992). At least in that period and in that region, it is not possible to note a significant cognitive advantage of one group over the other. If language and modern speech were part of the “modern package”, scientific basis for such claims cannot be found here.

The foundations of models supporting the so called behavioral revolution, that is, a sudden change in culture and symbolic expression connected to the emergence of modern language (at least in its early variants) on European finds and sites. It was considered that, after they, the carriers of

“modern” cultures and artistic expression, anatomically modern groups quickly replaced Neandertals (carriers of Middle Paleolithic cultures) (Klein 1989; 2000; Mellars 1996; 1989; Binford 1989). Modern language is considered to be one of the most important advantages of modern immigrants. This model has, over the years, proved insufficient for explaining both the replacement of populations and cultural aspects of different finds and sites. In the 1980s, Neandertals remains were found in association with Chatelperronian, a recognizable Upper Paleolithic industry, at Arcy-sur-Cure and Saint Césaire in France (Léveque & Vandermeersch



kulture srednjeg paleolitika) (Klein 1989; 2000; Mellars 1996; 1989; Binford 1989). Kao jedna od važnijih prednosti modernih pridošlica navodi se moderni jezik. Ovaj model se tijekom godina pokazao nedostatnim objašnjenjem, kako za populacijsku smjenu, tako i za kulturne aspekte raznih nalaza i nalazišta. Osamdesetih godina prošloga stoljeća otkriveni su nalazi neandertalaca u asocijaciji sa šatelperonijemom, prepoznatljivo gornjopaleolitičkom industrijom, na nalazištima Arcy-sur-Cure i Saint Césaire u Francuskoj (Léveque & Vandermeersch 1980; Hedges *et al.* 1994; Hublin *et al.* 1996). Osim kamenih alatki, na tim su lokalitetima pronađeni i ukrasni predmeti poput bušenih zuba, grobnih priloga, namjerno modificiranih kostiju i sl. (Leroi-Gourhan 1958; Hublin *et al.* 1996; Léveque & Vandermeersch 1980; d'Errico *et al.* 1998). Nadalje, brojne analize pokazale su da je kulturna i biološka smjena u vrijeme prijelaza srednjega u gornji paleolitik bila puno složenija nego što se to ranije smaralo te da se u to vrijeme javljaju mnoge kratkotrajne, lokalne kulture i industrije koje u sebi nose elemente starog (musterijen) i novog (gornji paleolitik), (vidi raspravu u Janković *et al.* 2006; 2011 i tamo citiranu literaturu). Ne postoje opravdani razlozi zbog kojih neandertalci ne bi bili sposobni za simboličko mišljenje, umjetnički izričaj, pa i moderan jezik. Mnoge kontroverze podiglo je otkriće tzv. „musterijenske frule“ na nalazištu Divje Babe I u Sloveniji (Turk 1997). Mnogi autori nisu bili skloni u neandertalcima prepoznati glazbenike, te su tumačenja okruglih rupica na spomenutoj kosti pripisivana aktivnosti životinja (d'Errico *et al.* 1998; i vidi raspravu u Chase & Nowell 1998 i Otte 2000.), posebice iz razloga što ostali najraniji glazbeni instrumenti dolaze iz gornjopaleolitičkih slojeva nalazišta poput Vogelherd, Hohle Fels i Geißenklösterle u Njemačkoj (Niven 2006; Conard & Moreau 2004; Conard 2009; Higham *et al.* 2012) i svojim se izgledom i načinom izradbe razlikuju od nalaza iz Divjih Baba. No razlike u materijalu i izradi ne bi smjele biti temelj odbacivanja mogućnosti da je u oba slučaja riječ uistinu o predmetima koji su drevne stanovnike Europe (i neandertalce i anatomske modernije ljude) uveseljavali svojim zvukovima. Eksperimenti na brižno izrađenoj kopiji nalaza iz Divjih Baba rezultirali su velikim rasponom zvukova i u rukama glazbenika proizveli izvedbe mnogih popularnih djela zabavne i klasične glazbe (o čemu svjedoče videosnimke i nosači zvuka) (vidi Turk & Dimkaroski 2011).

Nakon što posljednje skupine neandertalaca nestaju (barem kao anatomske prepoznatljive populacije) i anatomske moderni ljudi (*Homo sapiens sapiens*) postaju globalni fenomen, dolazi do populacijskog porasta. Razlozi za to su brojni i nisu predmet na-

1980; Hedges *et al.* 1994; Hublin *et al.* 1996). Apart from stone tools, these sites yielded decorative objects like perforated teeth, grave goods, intentionally modified bones and the like (Leroi-Gourhan 1958; Hublin *et al.* 1996; Léveque and Vandermeersch 1980; d'Errico *et al.* 1998). Furthermore, analyses showed that the cultural and biological changes at the transition to the Upper Paleolithic was a lot more complex than was thought, and that many short-term, local cultural industries appeared which showed elements of old (Mousterian) and new (Upper Paleolithic) (see discussion in Janković *et al.* 2006; 2011, and therein cited bibliography.). There is no reason why Neandertals could not have been capable of symbolical thinking, artistic expression and even modern language. Many controversies appeared about the so called “Mousterian flute” from Divje Babe I in Slovenia (Turk 1997). Many authors did not see Neandertals as musicians, and round holes on the said bone were interpreted as traces of carnivore activities (d'Errico *et al.* 1998; also see discussion in Chase & Nowell 1998 & Otte 2000), especially because other earliest instruments were found in Upper Paleolithic layers on sites like Vogelherd, Hohle Fels and Geißenklösterle in Germany (Niven 2006; Conard & Moreau 2004; Conard 2009; Higham *et al.* 2012) and differ from the find from Divje Babe in appearance and technique of production. However, these differences should not be the basis for discarding the possibility that in both cases we are dealing with objects which made the ancient Europeans (both Neandertals and modern humans) cheerful. Experiments on a carefully made copy of the find from Divje Babe resulted in a wide range of sounds and reproduced, in the hands of a musician, a lot of popular and classical music (attested by video and audio recordings) (see Turk & Dimkaroski 2011).

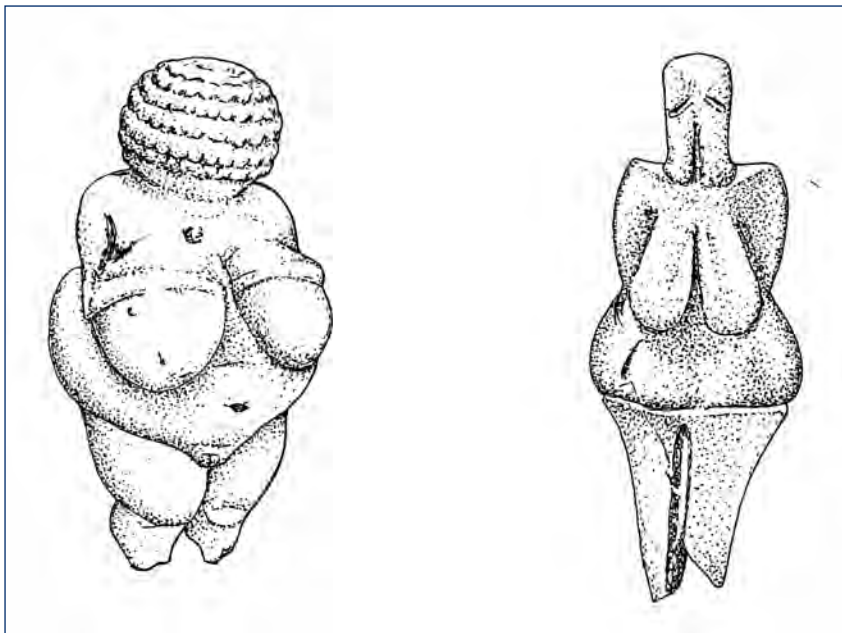
After the last groups of Neandertals disappeared (at least as an anatomically distinct population), and anatomically modern humans (*Homo sapiens sapiens*) became a global phenomenon, there was an increase in population size. The reasons for this are numerous and are not the topic of our discussion, but include new hunting and strategies a different use of space. It is worth noting that it is possible to track the development of a wide communication and exchange network in all of Europe and the larger part of Asia. At this time, artistic expression became wide-spread and appears in different variants, from numerous non-utilitarian objects and tiny statues (different zoomorphic and anthropomorphic figures, and those combining both aspects), musical instruments (flutes), to cave incisions and painting. Furthermore, the contact and exchange

šega rada, no uključuju i drugačije strategije lova i korištenja prostora. Ono što je vrlo značajno jest da je moguće pratiti razvoj raširene mreže kontakata i razmjene na širokom prostoru koji obuhvaća čitavu Europu i veći dio Azije. U tom se razdoblju umjetnički izričaj postaje općeprisutan i javlja se u raznim varijantama, od brojnih neutilitarnih predmeta i sitne plastike (raznih zoomorfnih i antropomorfnih prikaza, te onih koji kombiniraju oba aspekta), glazbenih instrumenata (frulica), pa sve do špiljskih gravura i slikarija. Nadalje, o mreži kontakata i razmjena svjedoče brojni nalazi predmeta koji su izrađeni od materijala koji u pojedinim slučajevima dolazi iz prostora udaljenih više desetaka, ponekad i stotina kilometara (vidi Montet – White & Holden 1991; Knecht *et al.* 1993; Klein 1999; Gamble 1999). Primjerice, na nalazištu Kostenki u Rusiji pronađene su školjke s obala Crnog mora, udaljenog gotovo 500 kilometara (Hahn 1977). Na gravetijenskom nalazištu Sprendlingen u Njemačkoj školjke su donesene s udaljenosti od gotovo 700 kilometara (Bosinski 1979). Školjke gornjopaleolitičkih slojeva poznatog nalazišta Spy u Belgiji najvjerojatnije su donesene iz Engleske (Otte 1977), a mediteranske školjke, najvjerojatnije iz Istre, pronađene su na lokalitetu Pavlov u Češkoj (Otte 1981). Porastom broja nalaza i analiza moguće je ukazati na postojanje određenih puteva kojim su sirovine stizale na svoja udaljena odredišta. Jedna od takvih veza spajala je u kasnom pleistocenu prostore Moravske, Slovačke i južne Poljske. Nalazišta oko rijeke Rajne ukazuju na nešto drugačiji put nabave sirovina, budući da veći dio uvezenog materijala potječe sa sjevera i zapada, dok na većini gornjopaleolitičkih nalazišta francuske školjke dolaze s obala Atlantika, a u manjem broju mediteranske obale (Taborin 1992). Iako nam analize nalaza sirovinskog materijala, školjaka i puževa pružaju sigurnije temelje za rekonstrukciju puteva moguće razmjene ili populacijskih gibanja, pojava određenih neutilitarnih predmeta, poput tzv. paleolitičkih Venera (ženskih figurica naglašenih spolnih atributa koje su vrlo česte u vrijeme gravetijenske industrije, sl. 5) navele su dio znanstvenika na razmišljanje o postojanju razmjena ideja. Spomenute figurice česte su i rasprostranjene na velikom geografskom prostoru Europe (za opširan pregled nalaza i nalazišta vidi pr. Knecht *et al.* 1992; Gamble 1986; 1999; Klein 1999; Janković & Karavanić 2009; Karavanić 2012 i tamo citiranu literaturu). Izrađene su od najrazličitijeg materijala (bjelokosti, kosti, kamena, pečene gline i dr.) i odlikuju se stilskim razlikama u izvedbi, no zajednička tematika pogoduje interpretacijama o jedinstvu svjetonazora i postojanju određenih raširenih i zajedničkih simboličnih predodžbi. Nema sumnje da je za ovakav kompleksan sociokulturni sustav bio nužan moderni jezik.

networks are attested to by numerous finds made from materials which, in certain cases, came from tens, even hundreds of kilometers away (see Montet – White & Holden 1991; Knecht *et al.* 1993; Klein 1999; Gamble 1999). For example, shells from the Black Sea were found at Kostenki in Russia which came from almost 500 kilometers away (Hahn 1977.). The Gravettien site of Sprendlingen in Germany yielded shells which originated almost 700 kilometers away (Bosinski 1979). The shells from the Upper Paleolithic layers of Spy in Belgium most probably originated from England (Otte 1977), and Mediterranean shells, probably from Istria, were found at Pavlov in the Czech Republic (Otte 1981). The increase of finds and analyses point to the existence of certain paths used for transporting raw materials to their distant destinations. One of these paths from the late Pleistocene connected Moravia, Slovakia and southern Poland. Sites around the Rhine point to a somewhat different path of raw material acquisition, since most of the imported material originate in the north and west, while, on most Upper Paleolithic sites in France, shells originated from the Atlantic, and less frequently from the Mediterranean (Taborin 1992). Although analyses of raw materials, shells and snails provide firmer basis for reconstructing the possible paths of exchange or population shifts, the appearance of certain non-utilitarian objects like the so called Paleolithic Venuses (female figurines with accentuated attributes which are common in the Gravettien industry, fig. 5) led some scientists to think about the exchange of ideas. The mentioned figurines are common and spread over a large geographical area of Europe (for a detailed list of finds and sites see Knecht *et al.* 1992; Gamble 1986; 1999; Klein 1999; Janković & Karavanić 2009; Karavanić 2012, and therein cited bibliography). They were made out of different materials (ivory, bone, stone, baked clay and other) and are characterized by stylistic differences in form, but the common theme is susceptible to interpretations on a unified worldview and the existence of widespread common symbolical concepts. Without a doubt, this complex socio-cultural system required the use of modern language.

#### GENETIC RESEARCH

Numerous breakthroughs were achieved in the study of language through genetics in the last ten years. In 2001, Lai *et al.* (2001) published a paper in which they successfully identified the FOXP2 gene which is important for developing the predisposition for talking and linguistic abilities in general, which was in popular literature somewhat clumsily,



Slika 5: Gornjopaleolitičke „Venere“ s lokaliteta Willendorfu Njemačkoj (lijevo) i Dolni Věstonice u Moravskoj (desno). Prema Janković & Karavanić (2009:229, crtež M. Galić).

Figure 5: Upper Paleolithic “Venuses” from Willendorf in Germany (left) and Dolni Věstonice in Moravia (right); according to Janković & Karavanić (2009:229, drawn by M. Galić).

#### GENETIČKA ISTRAŽIVANJA

Posljednjih desetak godina veliki pomaci u proučavanju jezika napravljeni su na polju genetike. Godine 2001 Lai i suradnici (2001) objavili su rad u kojem su uspješno identificirali gen FOXP2 za koji se pokazalo da ima važnu ulogu u razvoju predispozicije za govor i jezične sposobnosti uopće, te je u popularnoj literaturi ubrzo, pomalo nespretno nazvan „gen za jezik“. No, iako nam funkcija ovog gena nije u potpunosti poznata (između ostalog, ovaj gen ima regulacijsku ulogu u aktivaciji drugih gena i uključen je u razne razvojne i druge procese, vidi npr. Shu *et al.* 2001; Lieberman & McCarthy 2007; Marcus & Fisher 2003), a razvoj govora i jezičnih sposobnosti puno je složeniji proces i nije reguliran samo jednim genom, istraživanja su pokazala vrlo zanimljive rezultate. Možda je najbolje poznata studija obitelji koja je u literaturi radi zaštite privatnosti nazvana KE, koja u tri generacije ima 15 pripadnika oboljelih od teških poteškoća vezanih uz govor i jezične sposobnosti (problemi s artikulacijom govora, gramatičkim pravilima i sl.). Pokazalo se da svi oboljeli imaju oštećenje upravo FOXP2 gena (Lai *et al.* 2000; 2001; Fisher *et al.* 1998; MacDermot *et al.* 2005). Zanimljiva je činjenica da je ovaj gen doživio vrlo malo promjena u dugom evolucijskom razvoju. Primjerice, iako kodira 715 aminokiselina, ljudska inačica gena se od one kod miša razlikuje samo u

called “the language gene”. However, although we do not fully understand the function of this gene (among other things, this gene plays a regulatory role in the activation of other genes and is involved in different developmental and other processes, e.g. see Shu *et al.* 2001; Lieberman & McCarthy 2007; Marcus & Fisher 2003), and the development of speech and linguistic abilities is a much more complex process which is not regulated by a single gene, their research yielded interesting results. Possibly the most famous study was carried out on a family which was, for privacy reasons, called KE, and which has 15 members suffering

from speech and language ability problems in the last three generations (problems with speech articulation, grammar rules, etc.). All members with problems had damage precisely on the FOXP2 gene (Lai *et al.* 2000; 2001; Fisher *et al.* 1998; MacDermot *et al.* 2005). It is interesting to note that this gene went through very little change in its long evolutionary development. For example, although it codes 715 amino acids, the human variant differs from that of a mouse only in the coding of three amino acids (Enard *et al.* 2002). It is even more interesting that this gene in chimpanzees, our closest living relative, differs from ours in coding only two amino acids (Enard *et al.* 2002; Zhang *et al.* 2002). In other words, if we suppose this gene and its human variant take part in the development of speech and modern language, the same should be looked for in the period after the genetic lines of humans diverged from that of chimpanzees (between 6 and 5 million years before present), that is, within the tribe hominini.

The successful isolation of ancient DNA from Neandertal bones found on the Spanish site of El Sidrón (Krause *et al.* 2007) showed that this prehistoric population had the same variant of the FOXP2 gene as modern human populations and that the “modern” forms of this gene appeared already in the common ancestor of Neandertal and anatomically modern humans (before more than 300-400 000 years ago), and not like it was thought, within the last 200 000 years (Enard *et al.* 2002; Zhang *et al.* 2002).

kodiranju tri aminokiseline (Enard *et al.* 2002). Još je zanimljivije da se ovaj gen kod čimpanze, našeg najbližeg živućeg srodnika, od našeg gena razlikuje u kodiranju dvije aminokiseline (Enard *et al.* 2002; Zhang *et al.* 2002). Drugim riječima, i ako pretpostavimo da ovaj gen i njegova ljudska inačica imaju ulogu u razvoju govora i modernog jezika, istu valja tražiti u razdoblju nakon što su se odvojile evolucijske linije čovjeka i čimpanze (između 6 i 5 milijuna godina prije sadašnjosti), dakle unutar plemena hominini.

Uspješna izolacija drevne DNA (*ancient DNA*) iz neandertalskih kostiju sa španjolskog nalazišta El Sidrón (Krause *et al.* 2007) pokazala je da ova prapovijesna populacija ima istu inačicu FOXP2 gena kao i suvremene ljudske populacije, te da se „moderan“ oblik ovog gena pojavio već u zadnjeg zajedničkog pretka neandertalaca i anatomske modernih ljudi (prije više od 300-400 000 godina), a ne, kao što se to do sada pretpostavljalo, unutar posljednjih 200 000 godina (Enard *et al.* 2002; Zhang *et al.* 2002).

## ZAKLJUČNA RAZMATRANJA

Na temelju različite građe i analiza koje su prikazane u tekstu smatramo da je moguće odbaciti početnu hipotezu da je suvremeni jezik (i govorne sposobnosti) nastao saltacijski te da je tu evolucijsku novinu moguće vezati isključivo uz suvremene ljudske populacije gornjega paleolitika i tzv. „kognitivnu revoluciju“. Smatramo da je pojava govora i jezika rezultat dugog evolucijskog razvoja iz nekog od ranijih (gesturalnih?) načina komunikacije miocenskih primata u vokalnu komunikaciju. Evolucijsku prednost vokalne komunikacije moguće je promatrati unutar nekih od predloženih modela (vidi npr. Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005 i tamo citiranu literaturu). Nakon što je naglasak prešao na vokalnu komunikaciju, selekcija će favorizirati složeniji sustav komunikacije vezan uz različite čimbenike, uključujući povećanje zajednice, širenje u nove ekološke zone, naglasak na sve složeniju kulturu, pojavu umjetnosti, ukopa, simboličkog ponašanja, kao i stvaranja geografski rasprostranjene mreže kontakata u vrijeme kasnijeg gornjeg paleolitika. Naše je mišljenje da su određeni preduvjeti za razvoj kasnijih jezičnih sposobnosti (na temelju komparativnih istraživanja komunikacije neljudskih primata) prisutni već prije odvajanja plemena hominini od ostalih hominida. Rani hominini (rod *Australopithecus*) posjeduju određene neuralne strukture (povećanje u dijelovima Brocina i Wernickeova područja, iako ne u mjeri i morfološki identično kao kod kasnijih hominina i anatomske modernih ljudi) koje ukazuju na selekcijski naglasak

## CONCLUDING REMARKS

Based on different materials and analyses presented in this paper, we feel that it is viable to discard the opening hypothesis that contemporary language (and speaking abilities) were created through saltation and that this evolutionary novelty should be connected exclusively to modern human populations from the Upper Paleolithic and the so called “cognitive revolution”. We feel that the emergence of speech and language is a result of a long evolutionary development from some of the earlier (gestural?) modes of communication of Miocene primates into vocalized communication. The evolutionary advantages of verbal communication are discussed through some of the above suggested models (e.g. see Tomasello 2008; Riede *et al.* 2005; Zuberbühler 2005, and therein cited bibliography). After the transition to verbal communication, selection favored more complex system of communication connected to different factors, including population increase, spreading into new ecological zones, more complex cultural systems, emergence of art, burials, symbolic behavior, as well as developing a geographically wide network of communication in the Later Upper Paleolithic. We feel that certain preconditions for the development of later language abilities (based on comparative studies in non-human primate communication) were present already before the divergence of the hominins from other hominids. Early hominins (*Australopithecus*) had certain neural structures (increase in Broca’s and Wernicke’s areas, although not as much and morphologically identical to those of later hominins and anatomically modern humans) which point to selective emphasis and importance of these structures (although the direct role of these in the emergence of speech and language remains unclear), despite the fact that they did not differ from their predecessors or living apes in brain size and anatomy of the vertebral canal. When the *Homo* (*Homo ergaster/erectus*) genus appeared, a change was noted in almost all structures which we link to speaking and language abilities in modern humans (although we should stress that the analyzed fossil material is very sparse) and, additionally, there was an increasingly complex culture and requirements pertaining to spreading into new geographical regions and ecological zones. The Neandertal anatomy related to speech and language does not differ from those of modern human groups (including the morphology of the hyoid bone), and their culture and behavior (including symbolism and burials) testifies to the adaptability of these people and their complex social structure, while the structure of the FOXP2 gene displays a variant identical

i važnost tih struktura (premda je direktna uloga istih u pojavi govora i jezika još nejasna), usprkos tome što se veličinom mozga, kao i anatomijom vertebralnog kanala, ne razlikuju od svojih prethodnika, kao ni od živućih čovjekolikih majmuna. Pojavom roda *Homo* (*Homo ergaster/erectus*) vidljiva je promjena u gotovo svim strukturama koje kod suvremenih ljudskih populacija vežemo uz govorne i jezične sposobnosti (iako valja naglasiti da je fosilna građa na kojoj su provedene analize vrlo oskudna), čemu možemo dodati i sve složeniju kulturu te zahtjeve vezane uz širenje u nove geografske regije i ekološke zone. Anatomija neandertalaca u aspektima vezanim uz govor i jezik ne razlikuje se od one kod suvremenih ljudskih skupina (uključujući i morfologiju jezične kosti), njihova kultura i ponašanje (uključujući i pojavu simbolike i ukopa) odražava vrlo prilagodljive ljude i složenu socijalnu strukturu, dok struktura FOXP2 gena pokazuje identičan oblik kao i u suvremenih ljudi. U razdoblju tzv. srednjeg paleolitika Europe i dijela Azije, odnosno srednjeg kamenog doba Afrike određeni oblici simboličkog ponašanja i umjetničkog izričaja javljaju se i na prostorima gdje obitavaju neandertalci (Euroazija) i rani anatomske moderni ljudi (Afrika). Nije moguće braniti tezu o „kognitivnoj revoluciji“ i saltacijskoj pojavi „evolucijskog paketa modernog ponašanja“. Promjene u ponašanju rezultat su dugog razvojnog procesa, kako u Africi (McBrearty & Brooks 2000), tako i na ostalim geografskim prostorima. Razloge zašto u određenom razdoblju gornjeg paleolitika (a pogotovo na tlu Europe) nalazi koj svjedoče o umjetničkom izričaju i simbolici postaju pravilo a ne iznimka, valja tražiti u drugim aspektima čovjekova života, kulture, odnosa u zajednici i sl. Nesumljivo je da je za ovakvo složeno ponašanje i prijenos ideja bilo nužno korištenje modernog jezika, no smatramo da je na temelju svega iznesenog u radu priča o razvoju govora i različitih aspekata jezika rezultat dugog razvojnog puta, a ne nagle i relativno nedavne (u evolucijskom kontekstu) pojave.

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to those of contemporary people. In the so called Middle Paleolithic of Europe and parts of Asia, that is, in the Middle Stone Age of Africa, certain forms of symbolic behavior and artistic expression appear on areas where both Neandertals (Eurasia) and early anatomically modern humans (Africa) people lived. It is not possible to justify the “cognitive revolution” hypothesis and the saltational appearance of the “evolutionary package of modern behavior” hypothesis. Behavioral changes are a result of a long developmental process, both in Africa (McBrearty & Brooks 2000) and other geographic regions. Reasons why certain periods of the Upper Paleolithic (especially in Europe) yielded finds attesting to artistic expression and symbolism become a rule and not an exception, should be sought for in other aspects of human life, culture, relations within the community and the like. Undoubtedly, this kind of complex behavior and transfer of ideas required the use of modern language, but we feel that, based on everything stated above, the story about the development of speech and different aspects of language, is a result of a long evolutionary path, and not of a sudden and relatively recent (in the evolutionary context) emergence.

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