# DİL VE BEYİN
# ARAŞTIRMALARI HABERLERİ

**Derleyen**
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# Önsöz

Dil Bilimi – Linguistics Facebook Grubumuzda DİL ve BEYİN ile ilgili paylaştığımız haberleri, Türkçe ve İngilizce kitap ve dergileri, dikkat uyandıran alıntıları okurların faydasına sunmak üzere bir araya getirdik. Grup üyelerimizden Özgür Aydın Hocamızın ile Pınar Yeşil Yıldırım Hanımefendinin de iki haber paylaşımını metne ekledik.

Kafatasımızın içinde taşıdığımız bu esnek organı yeni tarama teknikleriyle şimdi keşfediyoruz. Türk okurunun bu keşiflerin gerisinde kalmaması, Türkiye'nin geleceği için önemlidir diye düşünüyoruz. Bu alanda Sabancı Üniversitesi'nin Avrupa Birliği kapsamında oluşturulan İnsan Beyni Projesi'ne (Human Brain Project) katılımcı olması gelecek adına bizleri umutlandırıyor. ABD'de de benzer bir projenin başlatıldığını söyleyelim.

Önümüzdeki 10 yıl içinde hem insan beyni hem de onun bilgisayar modellemesi üzerine çığır açacak gelişmeleri bekleyebiliriz. Bu çalışmalar psikolojik hastalıkların biyolojik kökenlerine inmemizi, yeni tedavi yöntemleri geliştirmemizi sağlayacaktır. Beynin bilgisayar modellemesi ile de insan gibi düşünen robotların üretilmesi mümkün olabilir. Belki yeni bir dili öğrenmek daha da kolaylaşır. Beyne takılacak bir çip yardımıyla İnternet ağından istediğimiz bilgiyi indirebiliriz. Beynimiz ve onun harici deposu İnternet bütünleşik bir yapıya dönüşebilir. Human 2.0 dedikleri yeni bir çağın ilk adımları bu yolla gerçekleşebilir.

Bu bize karanlık bir gelecek mi vaat ediyor? Tesla'nın kurucusu Elon Musk bugünden uyarıyor: Yapay zekâ denetim altına alınmazsa felâketimiz olur.

İyi ve güzel şeyler düşünelim istiyorum. Kötü niyetliler hep olacak ama bu iyi niyetli çabalarla geliştirilen ürünlerin toplumdan uzak tutulması anlamını taşımamalı. Engelliler, felçliler, bakıma muhtaç yaşlılar için gelecek bugünden daha iyi bir yaşam kalitesi demek olabilir.

selam, sevgi ve saygılarımla.[1]

**Mustafa Altun**
**21 Ağustos 2017**
**Hendek Sakarya**

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[1] **Kapak fotoğrafı :** https://www.flickr.com/photos/flamephoenix1991/8376271918

# Kitap Alıntıları

Duyularımız aracılığıyla dış dünyaya doğrudan erişimimiz olduğunu hissedersiniz. Elinizi uzatır ve fiziksel dünyaya ait bir nesneye dokunabilirsiniz, bu kitap ya da oturmakta olduğunuz koltuk gibi. Bu dokunuşu parmaklarınızda hissetseniz de, aslında her şey beynin görev kontrol merkezinde gerçekleşmektedir. Aynı şey, bütün duyusal deneyimleriniz için de geçerlidir. Görme, gözlerinizde, işitme, kulaklarınızda, koklama burnunuzda yürütülen bir eylem değildir. Bütün duyusal deneyimleriniz, beyninizdeki bilgisayımsal malzeme içindeki etkinlik fırtınalarıyla gerçekleşir.

İşin özü şurada yatar: Beyninizin dışıradaki dünyaya herhangi bir erişimi yoktur. Kafatasınızın içindeki karanlık, sessiz odasına hapsedilmiş olan bu organ dış dünyayı hiçbir zaman doğrudan deneyimlememiştir ve deneyimleyemecektir de.

Dışarıdaki bilginin beyne girişi için tek yol vardır: Duyu organlarınız, yani gözleriniz, kulaklarınız, burnunuz, diliniz ve deriniz birer çevirmen olarak işlev görür ve birbirinden çok farklı bilgi kaynaklarından (fotonlar, hava basınç dalgaları, molekül derişimleri, basınç, doku, sıcaklık gibi) algıladıkları bilgileri beyinde kullanılan ortak birime, elektrokimyasal sinyallere dönüştürürler.

Bu elektrokimsayal sinyaller, yoğun nöron ağı içinde fişek gibi ilerler. Sinyal üretici temel hücreler, nöronlardır. Beyin içinde bulunan yaklaşık yüz milyar nörondan her biri, yaşamınız boyunca her saniye onlarca ya da yüzlerce elektrik atımını binlerce başka nörona göndermektedir.

Deneyimlediğiniz her şey, algıladığınız her bir görüntü, ses ya da koku, dolaysız bir deneyim olmaktan çok, karanlık bir tiyatroda oynanan elektrokimsayal bir yorumdur.

Öyleyse beyin, bu muazzam elektrokimyasal örüntüleri, dünyayla ilgili işe yarar bir kavrayışa nasıl dönüştürür? Bunu yapmak için kullandığı yol, farklı duyusal girdilerden aldığı sinyalleri karşılaştırmak ve 'dışarıda olup bitenler' hakkında en iyi tahmini yürütmek için de var olan örüntüleri saptamaktır. Bu işleyiş öylesine güçlüdür ki, yapılan işin hiç çaba gerektirmediği izlenimi verir. Ama biraz daha yakından bakalım duruma.

En baskın duyumuzla, görmeyle işe başlayalım. Görme eylemi bizim için öylesine doğaldır ki bunu gerçekleştiren harikulade mekanizmayı takdir etmek zordur. İnsan beyninin yaklaşık üçte bir igörme işlevine, ham haldeki ışık fotonlarını annemizin yüzüne, sevgi dolu hayvan dostumuza ya da üzerinde uyumak üzere olduğumuz kanepeye dönüştürmeye adanmıştır."

**David Eagleman (2016), Beyin-Senin Hikâyen, Domingo Yayınları, s.47-48.**

"Lisanı (konuşma yetisini değil !) ve soyut düşünceyi insana kazandıran şey "oldukça gelişmiş beyni" değildi. Aksine, soyut düşünme kabiliyetini ve gelişmiş beyni bize lisan kazandırmıştı. "Öz-bilinç, soyutlama becerisi vesaire gibi belirli güçlerin insana özgü olduğu iddia edilecekse, bu yetilerin, başka gelişmiş düşünsel melekelerden kazara doğmuş yetiler olması, söz konusu melekelerin de son derece gelişmiş bir lisanın mütemadiyen kullanımından doğmuş olması gayet muhtemeldir." (s.9)

"Lisan ardında fosil bırakmaz. Bu konuda deney yapamazsınız (en azından etik kurallarına uygun deneyler yapamazsınız) . Lisan, tek bireyden oluşan bir popülasyondur, tamamıyla emsalsiz bir vasıftır.
Tüm bilim adamlarının ürktüğü bir durumdur bu, çünkü karşılaştırmalı yöntemlerin kullanılamayacağı anlamına gelir; oysa benzeşen fakat hafif farklılık gösteren olguları kıyaslamak, bilimdeki en verimli yöntemlerden birini teşkil eder." (s.10)

"Dolayısıyla, beyinlerimiz daha büyük ve daha iyi hale geldiği için lisana kavuşmadık; önce lisan gelişti, bu da bize büyük ve üstün beyinlerimizi kazandırdı." (s.40)

"Biyolog gibi düşünmeye çalışırken oldu bu . Başka alanlardan gelen insanlar için hiç de kolay iş değildir hani. Disiplinler arası çalışmaları bu kadar zor kılan unsur, tüm akademik disiplinlerin at gözlüğü gibi olması, sizi ancak belirli istikametlere bakmaya zorlaması ve öteki bakış açılarına set çekmesidir. Bu gidişatın üstesinden gelmek için, yoğun bilinçli çaba sarf etmek gerekir, ayrıca başka insanların yazdıklanna da gömülmek lazım." (s.41)

"Beş ila yedi milyon yıl önce, primat soy çizgisi bir kez daha bölündü (geçmişte zaten iki kez dallanıp önce orangutanları sonra gorilleri meydana getirmişti) . Dallardan biri bonobolara ve şempanzelere hayat verdi; ötekisi atalarımızın dalıydı. Küresel çoraklık yüzünden ormandan çıkıp çayırda yaşamak zorunda kalan atalarımız, beslenmelerinde ete ağırlık vermeye mecburdu. Et bakımından zengin beslenme sayesinde beyinleri büyüdü , dolayısıyla zekaları arttı. Bonobolarla ve şempanzelerle ortak bir etken olan toplumsal rekabet de zekalarını artırmıştı. Kuyruksuz maymunlar daima karşılarındakini zekalarıyla alt etmeye, grup içinde itibar kazanmaya, çiftleşmek için tercih edilen birey olmaya, yakalanan avı ilk yeme hakkını elde etmeye çalışır. Etin tedarik ettiği zeka, bu etken sayesinde seçilimde öne çıktı ve faydalı bir sarmal meydana gelmiş oldu. Kuyruksuz maymunların bu sarmala giren eski HİS'i gelişti ve çeşitlilik kazandı. Bizim açımızdan belirlemenin belki de imkansız olduğu bir noktada HİS pürüzsüz bir şekilde lisanla kaynaştı . Lisan hayatı daha girift hale getirdi ve bu zorluklarla başa çıkmak için daha da giriftleşti ta ki bizler mevcut durumumuza ulaşana dek." (s.63)

"Beynin esnekliği kısıtlıdır. Esaslı mimari değişiklikler gerçekleştiremez, fakat pek çok odasını yeniden düzenleyebilir, bu esnada ev idaresinde hiçbir aksaklık meydana gelmez." (s.89)

"Şimdi Chomsky'nin modeline dönelim; en önemli aşamalarının hiçbir saiki bulunmaz. Bunların itici gücü yoktur. İnsana özgü kavramlar hiç yoktan fışkırıverir. Ortada fol yok yumurta yokken beyin devreleri yeniden düzenlenir. İnsanlar durup dururken konuşmaya başlar, yine ortada fol yok yumurta yoktur (sırf "yarar sağlayacak, " diye! ) ; ayrıca, konuşmaya nasıl başladıklarıyla, kafalarında dolanan onca kavram varken bunları isimlendirme konusunda nasıl fikir birliğine vardıklarıyla ilgili sıradan ayrıntılar hasır altı edilmiştir.

Chomsky'nin evrim modeli, dünyanın gerçekleriyle ya da evrimin gerçekleriyle hiçbir şekilde kesişmez; o fanusta bir evrimdir, tamamen soyut, kendini dış dünyadan yalıtmış bir süreçtir. Ancak, Amerikan bilim dergilerinin amiral gemisinde yayımlanmış, iki biyoloğun birlikte kaleme aldığı bir makalede örtük şekilde bize sunulur. Varın siz anlayın.

Burada, lisanın evrimleşmesinden daha fazlası olduğuna dikkatinizi çekerim. Lisan ile düşünce arasındaki ilişkinin bütünü söz konusudur. Eğer bu kitabın altbaşlığının son kısmına (İnsan mı Lisandan) değineceksem, bu meseleyle boğuşmam gerekir. Bu konuda da Chomsky ve ben, birbirimizi tamamen zıt konumlarda buluyoruz:

Chomsky, insanlarda önce düşünme yetilerinin doğduğuna bu yetilerin sonra lisanı mümkün kıldığına inanır.

Ben ise, önce lisanın doğduğuna ve düşünme yetilerini mümkün kıldığına inanıyorum." (s.202)

"Beyin, yapmak zorunda olmadığı işi (normalde) yapmaz, çünkü enerji bakımından maliyetlidir. Beynimiz, enerjimizin yüzde yirmisini kullanıyor, gerçi bazı insanlara bakınca öyle olmadığını düşünebilirsiniz.

Özleştirmecilik (pürizm) yanlıları , beyni bilgisayarlara benzetmeye çalışanların cesaretini kırar. Biraz da dudak bükerek, her kültür beyni kendi en ileri teknolojisine benzetmiştir, derler; Yunanlılar su değirmenine, Viktorya dönemi insanları telefon sohbetlerine benzetmiş; dolayısıyla, bu sadece geçici bir hevesmiş. Fakat, aslında beynin amacı, özel bir bilgisayar türünün, teknelerde, arabalarda, uçaklarda ya da uzay istasyonlarında gördüğümüz, panolara yerleşik bilgisayarların amacıyla tamamen aynı.

Yerleşik bilgisayarın amacı, artık her neye yerleşik ise, o yapının iç dengesini muhafaz etmektir. Hem iç hem de dış şartları izleyerek bu işi yapar; iç sıcaklığı dar bir aralıkta tutan cihazlardan, bir cisme çarpmak üzere olduğunuzu belirten uyarılan veren cihazlara kadar hepsinin görevi budur. Fakat yerleşik bilgisayarın davranış yelpazesi içinde, size, kendi başına oluşturduğu ve kendi işine yarayacak mesaj lar göndermek yoktur. Onun, kendi amaçları yoktur. Ne için programlanmışsa ancak o görevi vardır.

Mühendisler, yerleşik bilgisayarları programlamaktadır, fakat beyni evrim programlamıştır. Beyni, iç dengeyi korusun ve organizmanın mesken tuttuğu iç ve dış koşulların, mümkün mertebe organizmanın esenliğini kollayacak şekilde kalmasını sağlasın diye programlamıştır." (s.204-205)

**Derek Bickerton (2012) Âdemin Dili-İnsan Lisanı Nasıl Yarattı-Lisan İnsanı Nasıl Yarattı, Boğaziçi Üniversitesi Yayınları.**

**Türkçe Çeviri**

Yirmi birinci yüzyıl dil biliminde gerekli olan şey, Descartes değil, Darwin'den esinlenen dilin anlaşılmasıdır.

1. Descartes'tan esinlenen bir dil bilimi, güzel ama durağandır.

Darwin'den esinlenen bir dil bilimi dağınık ve devingendir.

2. Descartes'tan esinlenen bir dil bilimi, iletişimin nasıl gerçekleştiğini açıklamaya çalışır.

Darwin'den esinlenen bir dil bilimini harekete geçiren, niçindir: Niçin iletişim oluşur, belirli bir grup niçin dile sahip olur, hangi niyetle bir kişi birşeyi söyler ya da söylemez?

3. Descartes'tan esinlenen bir dil bilimi, zaman ve mekândan uzak dil evrensellerini soyutlar ve onlar genomun gizemleri arasında gözden kaybolur.

Darwin'den esinlenen bir dil bilimi, ayaklarının yere oturduğu tüm vücutlara yönelir ve ASPM (hücre bölünmesini sağlayan bir protenin oluşması için emirler veren gen) ve Mikrosefalin (cenin beyninin gelişimin açığa çıkaran bir gen) gibi beyin gelişim genleri arasındaki olası ilişkiyi ve bir ton dili Çince ya da İngilizce gibi. tonal olmayan bir dil öğrenmede zorluk derecesini anlamaya çalışır.

4. Descartes'tan esinlenen bir dil bilimi, doğa ve beslenme terimlerinin bilinen karşıtlığında işlev gören bir çerçevede çalışır.

Hem evrimsel zamanın hem de bir bireyin ömrünün açıklayıcı boyutlarına yönelik soruşturmayı önler ve insan genomundaki zorluklarla mikro değişkenler barındırır.

Darwin'den esinlenen bir dil bilimi, karşıtlığın doğasını / yetiştirilmesini kavramsal olarak karmaşasını ortadan kaldırır ve evrimsel istikrarlı bir gelişimsel sistem çerçevesinde açıklamalar tekrarlar.

Son elli yılda Amerika Birleşik Devletleri'nde ve dünyanın herhangi bir yerindeki bilişsel bilim dalları ile birlikte dil bilimi kuram ve uygulamalarının büyük bölümünün Noam Chomsky'nin desteklediği Kartezyen (Descartesçi) temelli dil biliminden etkilendiğini söylemek doğru olur.

Ayrıştırılmış cümleleri çözümleme yöntemi, bir bireyin dil bilgisinin altında yattığı söylenen soyut, evrensel ilkelerin keşfedilmesi bağlamından bağımsız olarak aynı amaçla tamamlanmaktadır. Bu bilgi ya da yeterlilik, sonsuz sayıda yeni cümleler üretme ve anlama becerisini güvence altına alan doğuştan gelen karmaşık bir bilişsel sistem olarak kuramsallaştırılır. Bu bilgi doğuştan geldiğinde, nispeten kısa süre önce ele alınan bir evrimsel sorundur. Bu bilginin nasıl geliştiğine hiç değinilmemiştir, çünkü evrensel, doğuştan gelen yetenek bireysel gelişime açık değildir.

**Özgün Metin:**

What is needed for a twenty-first-century linguistics is an understanding of language that is inspired not by Descartes but by Darwin. A linguistics inspired by Descartes is beautiful but static. A linguistics inspired by Darwin is messy and dynamic. A linguistics inspired by Descartes assumes that communication occurs and proceeds to explain how it occurs. A linguistics inspired by Darwin is motivated by the whys: why communication occurs, why a group has the particular language it has, why on any given occasion an individual says this or that or nothing at all. A linguistics inspired by Descartes abstracts linguistic universals away from time and space and lets them disappear into the mysteries of the genome. A linguistics inspired by Darwin tethers itself to whole bodies whose feet are on the ground and seeks to understand the possible relationship between brain development genes such as ASPM and Microcephalin and the degree of difficulty in learning a tonal language like Chinese or a non-tonal language like English. A linguistics inspired by Descartes operates in a framework where the terms nature and nurture function in familiar opposition, precludes investigation into the explanatory dimensions of both evolutionary time and an individual's lifetime, and accommodates with difficulty micro-variables in the human genome. A linguistics inspired by Darwin dispels the conceptual chaos of the nature/nurture opposition and recasts explanations within the framework of a developmental system that has evolutionary stability.

For the past fifty years, it is fair to say that large parts of linguistic theory and practice in the United States and elsewhere in the world, along with certain branches of the cognitive sciences, have been influenced by the Cartesianinspired linguistics promoted by Noam Chomsky. Its methodology of analyzing sentences in isolation is complemented by the equally context-independent goal of discovering the abstract, universal principles that are said to underlie an individual's knowledge of language. This knowledge or competence is theorized to be an inborn complex cognitive system that secures the ability to understand and produce an infinite number of novel sentences. How this knowledge comes to be inborn is an evolutionary question that has been only relatively recently addressed. How this knowledge develops is not addressed at all, because a universal, inborn ability is not open to individual development.

**Julie Tetel Andresen (2009), Lingustics and Evolution, Cambridge Press, s. 1-2.**

**Okuma Bize Ne Kaybettiriyor?**

"Okuryazarlığın ana etkisinin olumlu olduğuna şüphe yoktur: okumayı öğrenmek, muazzam bilişsel kazanımları da beraberinde getirmektedir. Ancak eğer nöron geri dönüşümü hipotezi doğruysa beyin okuryazarlık için bir bedel ödemektedir. OKUMA, BAŞKA KULLANIM ALANLARI İÇİN ORTAYA ÇIKMIŞ NÖRON DEVRELERİNİ İŞGAL ETMEKTE ve muhtemelen de bize EVRİM tarafından verilmiş olan bazı bilişsel YETİLERİN KAYBINA sebep olmaktadır."

s.276.

"Konu okuma olunca harfleri tanımak için harcanan saatler muhtemelen görsel duyarlılığımızı artırmaktadır. Doğrusu okuryazar olanlar olmayanlara kıyasla daha iyi bir geometrik şekil algısına sahiptir."

s.278.

**Stanislas Dehaene (2011), Beyin Nasıl Okur-Okumanın Bilimi ve Evrimi, Alfa Yayınları.**

**Dil ile ilgili bölümü özetleyerek maddeler halinde sıralamaya çalıştım.**

1. Homo Sapiens'in yeni diller kullanabilmesi nasıl olduğunu bilmediğimiz bir mutasyon sonucu gerçekleşmiştir. Neden Neandertal'da değil de Homo Sapiens'in DNA'sında bu mutasyon gerçekleşmiştir, bunu bilmiyoruz. Önemli olan bunun sonuçlarını anlamaktır.

2. Diğer hayvanların da dilleri var ancak Sapiens sadece 'Dikkat et! Aslan!' gibi uyarıların ötesine geçer, aslanın yerini onun takip ettiği bir bizon sürüsünü tarif edebilir, aslanı kaçırarak bizonları yakalayabilir.

3. Kuramlardan biri de dedikodu kuramıdır. Birkaç düzinelik bir grupta kimin kimle ne yaptığın öğrenebilmek için dedikoduya ihtiyaçları vardır. Dedikodu kalabalık gruplar halinde yaşamanın temelini oluşturur.

4. Dilin bir başka özelliği de var olmayan şeyler hakkında bilgi paylaşımına olanak sağlamasıdır. Efsaneler, mitler, tanrılar ve dinlek ilk kez Bilişsel Devrim sayesinde ortaya çıkmıştır. Bu mitler birbirini tanımayan Sapiens'lerin birlikte çalışabilmesini sağlamıştır. Ancak diğer hayvanlar sadece tanıdıkları yakın akrabalarıyla iletişime geçer ve onlarla işbirliği yapabilirler.

5. Dedikodunun da sınırı vardır. Yapılan araştırmalar dedikodu sayesinde bir arada durabilen 'doğal' bir grubun sınırının 150 olduğunu göstermiştir. Daha fazla sayıda Sapiens'i bir arada tutan ise ortak mitlerdir.

6. Kelimelerden hayali gerçekler yaratabilme becerisi, çok sayıda yabancının etkili bir işbirliği yapabilmesini sağlarken bunun ötesine de geçti. 1789'da Fransız nüfusu, neredeyse bir gecede kralların tanrısal gücü mitine inanmayı bırakıp halkın egemenliği mitine inanmaya başladı.

7. Sapiens'in icat ettiği hayali gerçekliklerin muazzam çeşitliliği ve bunun sonucu olarak gelişen davranış örüntülerinin çokluu, 'kültür' dediğimiz şeyin başlıca bileşenleridir. Kültürler ortaya çıktığından beri değişim ve gelişimleri hiç durmamıştır ve 'tarih' dediğimiz de bu durdurulamayan değişimlerdir. Buna bağlı olarak Bilişsel Devrim tarihin biyolojiden bağımsızlığını ilan ettiği andır.

**Yuval Noah Harari (2016), "Bilgi Ağacı', Hayvanlardan Tanrılara Sapiens, Kollektif Yayınları, 31-51.**

**Özet Türkçe Çeviri:**

İnsan evrimi, beyin ve dil süreçlerinin incelenmesindeki gelişmeler bizim büyük resmi tamamlamamıza yardımcı olacak ancak buna ne kadar yakınız? Maymun beyinlerinden göreceli boyutta ayrıldığımızı biliyoruz. Çocukların dil edinimi ile vahşi doğadaki hayvanların dil becerileri üzerine çalışmalar yapıyoruz. İnsan beyni üzerine araştırmalarımız da ilerledi ancak hâlâ bütün ayrıntıları bir araya getiren genel bir anlayışa sahip değiliz. Atalarımızın beyinlerinin boyut ve şekilleri üzerine bilgimiz var ancak bu beyinlerin mikro-mimarisi hakkında bir fikrimiz yok. İlk beyinlerin bir dil yeteneğine sahip olup olmadığını da asla öğrenemeyeceğiz. Ancak ikinci derecede bir bilgi edinebileceğiz.

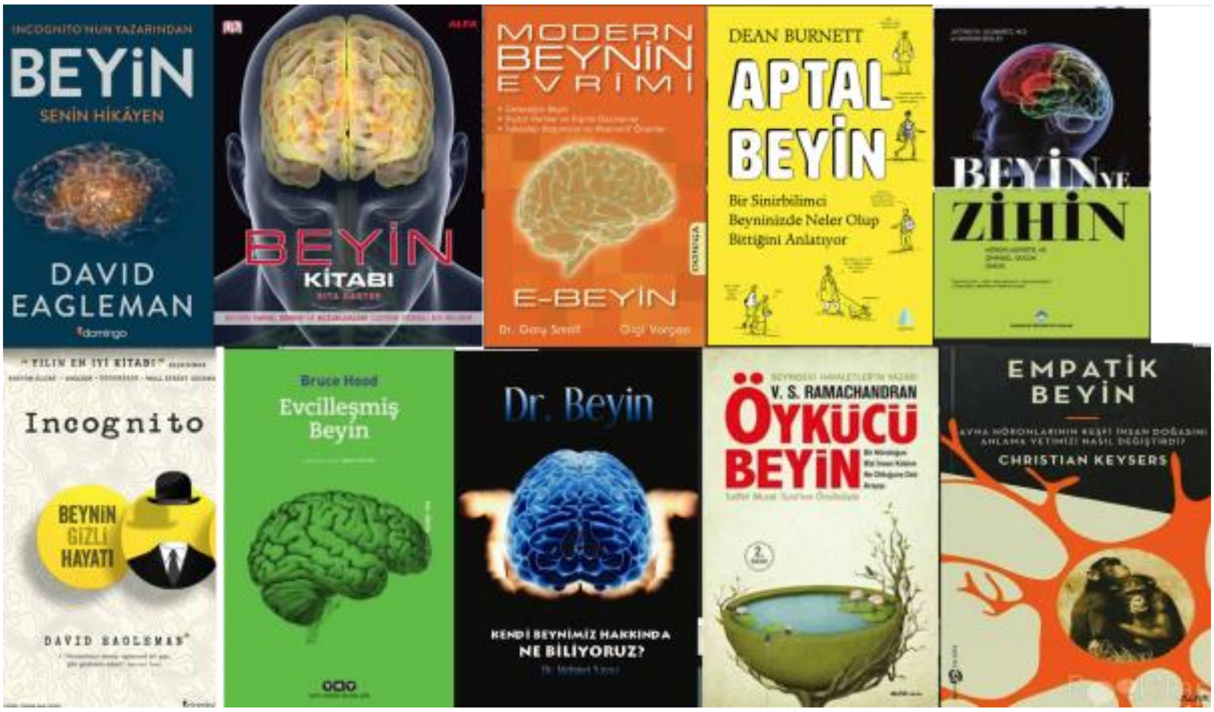
**Özgün Metin:**

"Advances in the study of human evolution, the brain, and language processes have led many scientists confidently to claim to be closing in on the final clues to this mystery. How close are we? Many lines of evidence seem to be converging on an answer. With respect to our ancestry, the remaining gaps in the fossil evidence of Our prehistory are being rapidly filled in. Within the last few decades a remarkably rich picture of the sizes and shapes of fossil hominid bodies and brains has emerged. It is probably fair to say that at least with respect to the critical changes that distinguish us in this way from other apes, there are few missing links yet to be found, just particulars to be filled in. That crucial phase in hominid evolution when our ancestors' brains began to diverge in relative size from other apes' brains is well bracketed by fossils that span the range. As for the inside story, the neurosciences are providing powerful new tools with which it has become possible to obtain detailed images from working human brains performing language tasks, or to investigate the processes that build our brains during development and distinguish the brains of different species, or even to model neural processes outside of brains. Finally, linguists' analyses of the lOgical structure of languages, their diversity and recent ancestry, and the patterns that characterize their development in children have provided a wealth of information about just what needs to be explained, and comparative studies of animals' communications in the wild and their language like capacities in the laboratory have helped to frame these questions with explicit examples.

Despite all these advances, some critical pieces of the puzzle still elude us. Even though neural science has pried ever deeper into the mysteries of brain function, we still lack a theory of global brain functions. We understand many of the cellular and molecular details, we have mapped a number of cognitive tasks to associated brain regions, and we even have constructed computer simulations of networks that operate in ways that are vaguely like parts of brains; but we still lack insight into the general logic that ties such details together. On the whole, most neuroscientists take the prudent perspective that only by continuing to unmask the details of simple neural processes in simple brains, and slowly, incrementally, putting these pieces together, will we ever be able to address such global theoretical questions as the neural basis for language. We must add to this many new problems arising out of the comparisons of animal communication to language. If anything, these problems have become more complex and more confusing the more we have learned about the sophistication of other species' abilities and the paradoxes implicit in our own abilities. But the most critical missing piece of the puzzle is access to the brains in question: ancestral hominid brains. Though we have considerable information about brain sizes in fossil species, and a little information about brain shapes, the relevant anatomical information, the internal microarchitecture of these brains, has left no fossil trail. With respect to fossil brains, we will never find the "smoking gun"-the first brain capable of language. We will only have access to circumstantial information."

**Terrence W. Deacon (1997), The Symbolic Species-The Co-evolution of Language and Brain, Norton Company, s. 23-24.**

# Türkçe Kitaplar





STEVEN PINKER
ZİHİN NASIL ÇALIŞIR
YUVAL NOAH HARARI
HAYVANLARDAN TANRILARA
SAPIENS
insan türünün kısa bir tarihi
YUVAL NOAH HARARI
HOMO DEUS
yarının kısa bir tarihi
ZİHNİN GELECEĞİ
MICHIO KAKU
İnsan İletişiminin Kökenleri
metis bilim
STEVEN PINKER
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21. Yüzyılda Beyin
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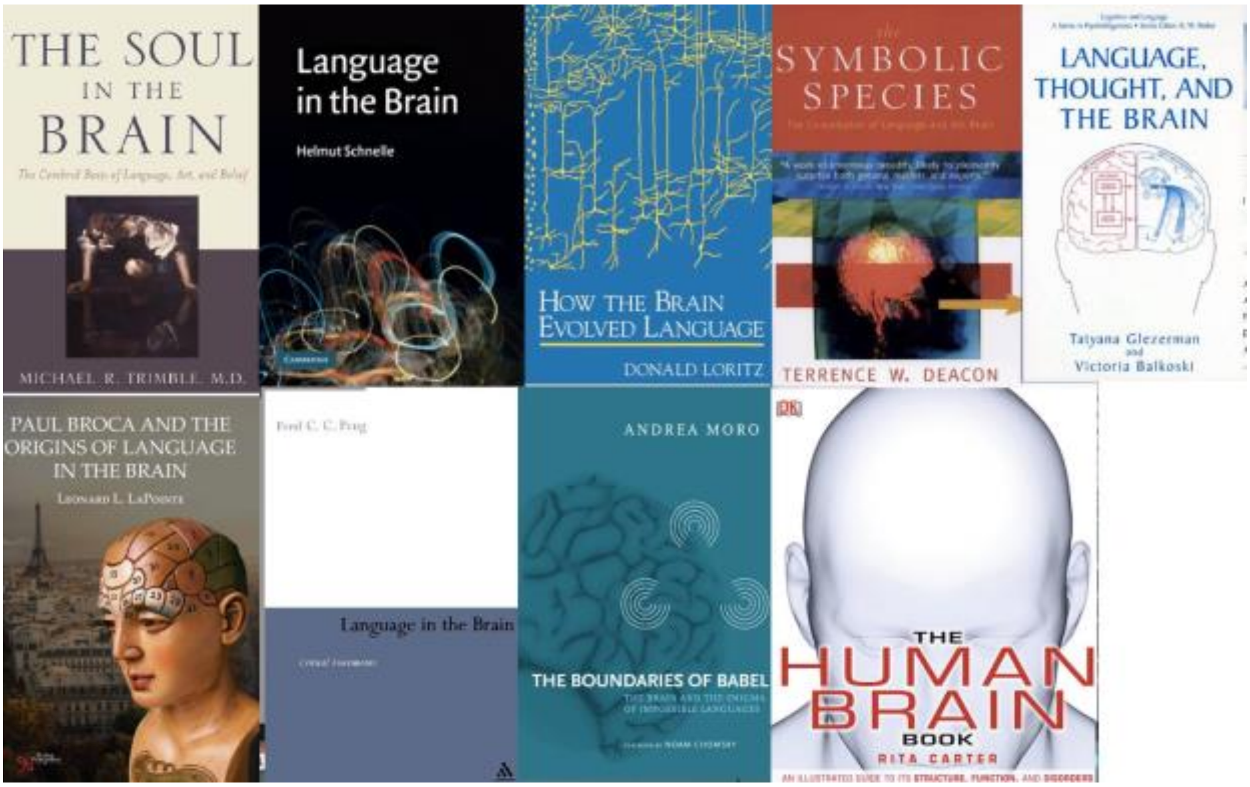
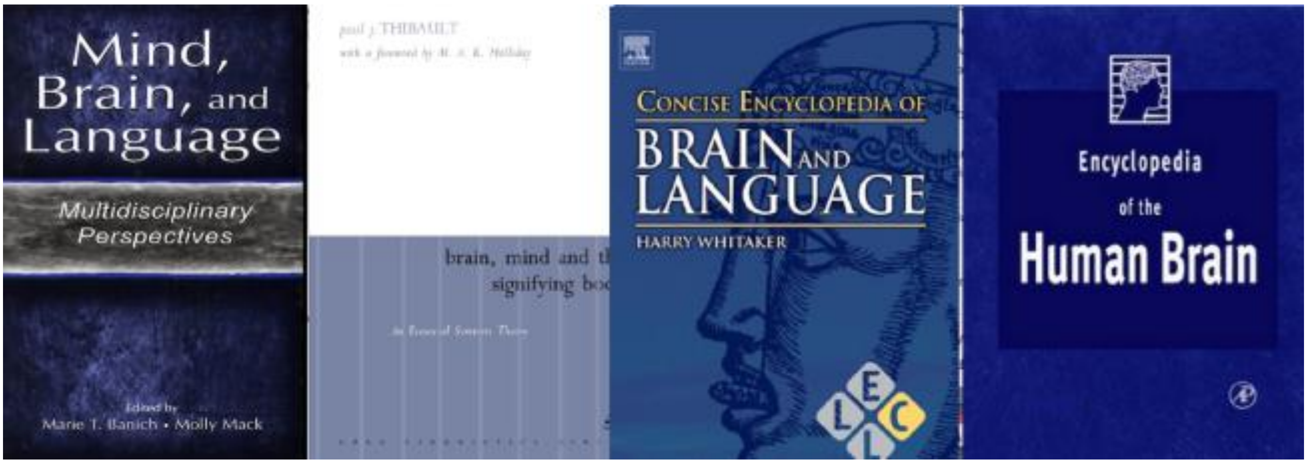
Âdem'in Dili
İnsan Lisanı Nasıl Yarattı
Lisan İnsanı Nasıl Yarattı
PROUST VE MÜREKKEP BALIĞI
MARYANNE WOLF
Stanislas Dehaene
beyin nasıl okur?

# İngilizce Kitaplar



# Süreli Yayın

## Brain and Language

Bağlantı Adresi: http://www.sciencedirect.com/science/journal/0093934X?sdc=1

**Editor-in-Chief:**
Steven L. Small

**Description**

An interdisciplinary journal, *Brain and Language* focuses on the **neurobiological mechanisms** underlying **human language**. The journal covers the large variety of modern techniques in **cognitive neuroscience**, including lesion-based approaches as well as functional and structural brain imaging, electrophysiology, cellular and molecular neurobiology, genetics, and computational modeling. All articles must relate to human language and be relevant to an elaboration of its neurobiological basis. Along with an emphasis on neurobiology, journal articles are expected to take into account relevant data and theoretical perspectives from **psychology** and **linguistics**.

Brain and Language is published 12 times yearly.

https://www.sott.net/article/317498-Neuroscientists-create-atlas-showing-how-our-vocabulary-is-mapped-in-the-brain haberi:

'Zihinsel sözlük' tartışmasına bir başka katkı..

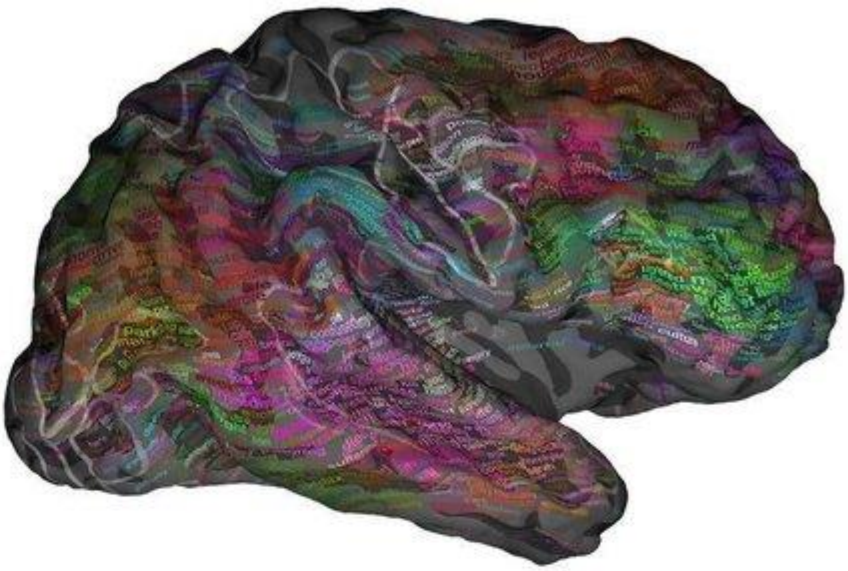
"Neuroscientists create 'atlas' showing how our vocabulary is mapped in the brain"

## Sinirbilimciler beynimizde sözcükleri nasıl haritalandırdığımıza dair bir atlas oluşturdular.

Paylaşım için Özgür Aydın Hocamıza teşekkürlerimizle...

## Neuroscientists create 'atlas' showing how our vocabulary is mapped in the brain

Ian Sample
The Guardian
Wed, 27 Apr 2016 20:34 UTC



© Alexander Huth / The Regents of the University of California
One person's right cerebral hemisphere. The overlaid words, when heard in context, are predicted to evoke strong responses near the corresponding location. Green words are mostly visual and tactile, red words are mostly social.

*Using brain imaging, scientists have built a map displaying how words and their meanings are represented across different regions of the brain*

Scientists have created an "atlas of the brain" that reveals how the meanings of words are arranged across different regions of the organ.Like a colourful quilt laid over the cortex, the atlas displays in rainbow hues how individual words and the concepts they convey can be grouped together in clumps of white matter.

"Our goal was to build a giant atlas that shows how one specific aspect of language is represented in the brain, in this case semantics, or the meanings of words," said Jack Gallant, a neuroscientist at the University of California, Berkeley.

No single brain region holds one word or concept. A single brain spot is associated with a number of related words. And each single word lights up many different brain spots. Together they make up networks that represent the meanings of each word we use: life and love; death and taxes; clouds, Florida and bra. All light up their own networks.

Scientists have created an interactive map showing which brain areas respond to hearing different words.

Described as a "tour de force" by one researcher who was not involved in the study, the atlas demonstrates how modern imaging can transform our knowledge of how the brain performs some of its most important tasks. With further advances, the technology could have a profound impact on medicine and other fields.

"It is possible that this approach could be used to decode information about what words a person is hearing, reading, or possibly even thinking," said Alexander Huth, the first author on the study. One potential use would be a language decoder that could allow people silenced by motor neurone disease or locked-in syndrome to speak through a computer.

To create the atlas, the scientists recorded people's brain activity while they listened to stories read out on *The Moth Radio Hour*, a US radio show. They then matched the transcripts of the stories with the brain activity data to show how groups of related words triggered neural responses in 50,000 to 80,000 pea-sized spots all over the cerebral cortex.

Huth used stories from *The Moth Radio Hour* because they are short and compelling. The more enthralling the stories, the more confident the scientists could be that the people being scanned were focusing on the words and not drifting off. Seven people listened to two hours of stories each. Per person, that amounted to hearing roughly 25,000 words- and more than 3,000 different words - as they lay in the scanner.

The atlas shows how words and related terms exercise the same regions of the brain. For example, on the left-hand side of the brain, above the ear, is one of the tiny regions that represents the word "victim". The same region responds to "killed", "convicted", "murdered" and "confessed". On the brain's right-hand side, near the top of the head, is one of the brain spots activated by family terms: "wife", "husband", "children", "parents".

Each word is represented by more than one spot because words tend to have several meanings. One part of the brain, for example, reliably responds to the word "top", along with other words that describe clothing. But the word "top" activates many other regions. One of them responds to numbers and measurements, another to buildings and places. The scientists have created an interactive website where the public can explore the brain atlas.

Strikingly, the brain atlases were similar for all the participants, suggesting that their brains organised the meanings of words in the same way. The scientists only scanned five men and two women, however. All are native English speakers, and two are authors of the study published in *Nature*. It is highly possible that people from different backgrounds and cultures will have different semantic brain atlases.

Armed with the atlas, researchers can now piece together the brain networks that represent wildly different concepts, from numbers to murder and religion. "The idea of murder is represented a lot in the brain," Gallant said.

Using the same haul of data, the group has begun work on new atlases that show how the brain holds information on other aspects of language, from phonemes to syntax. A brain atlas for narrative structure has so far proved elusive, however. "Every time we come up with a set of narrative features, we get told they aren't the right set of narrative features," said Gallant.

Uri Hasson, a neuroscientist at Princeton University, praised the work. Unlike many studies that looked at brain activity when an isolated word or sentence was spoken, Gallant's team had shed light on how the brain worked in a real-world scenario, he said. The next step, he said, was to create a more comprehensive and precise semantic brain atlas. Ultimately, Hasson believes it will be possible to reconstruct the words a person is thinking from their brain activity. One more benign use would see brain activity used to assess whether political messages have been effectively communicated to the public. "There are so many implications, and we are barely touching the surface," he said.

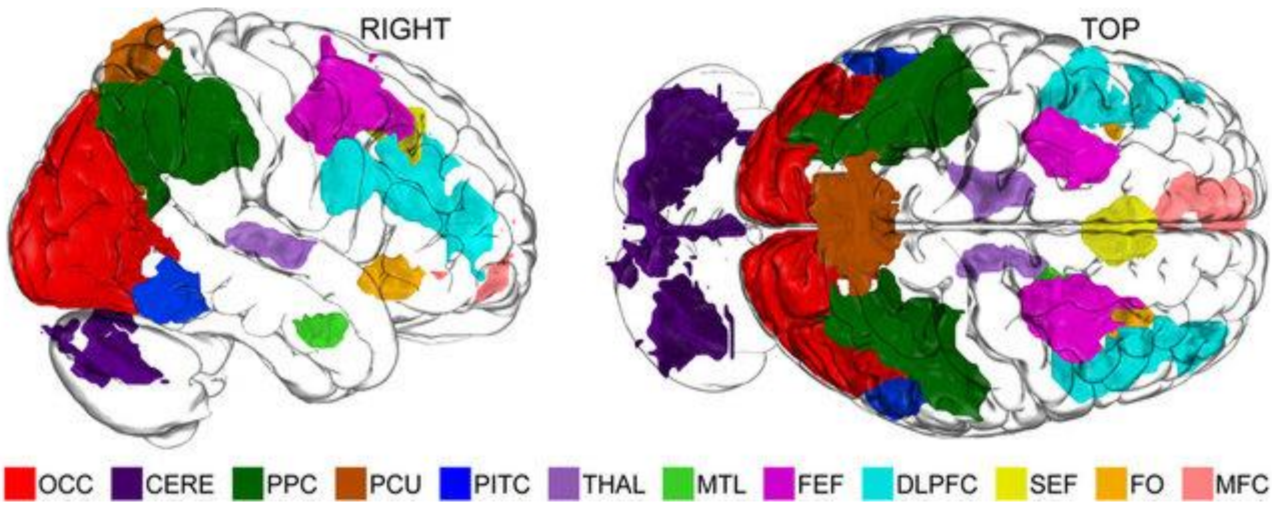
Lorraine Tyler, a cognitive neuroscientist and head of the Centre for Speech, Language and the Brain at Cambridge University said the research was a "tour de force in its scope and methods". But the brain atlas in its current form does not capture fine differences in word meanings. Take the word "table". It can be a member of many different groups, says Tyler. "It can be something to eat off, things made of wood, things that are heavy, things having four legs, non-animate objects, and so on. This kind of detailed semantic information that enables words to be used flexibly is lost in the analysis," she said. "While this research is path-breaking in its scope, there is still a lot to learn about how semantics is represented in the brain."

**https://www.livescience.com/39671-roots-of-creativity-found-in-brain.html?fref=gc haberi:**

## Beyinde yaratıcılın kökleri bulundu.

# The Roots of Creativity Found in the Brain

By Tanya Lewis, Staff Writer | September 16, 2013 03:00pm ET




Eleven areas of the brain are showing differential activity levels in a Dartmouth study using functional MRI to measure how humans manipulate mental imagery.
*Credit: Alex Schlegel*

The ability of humans to create art, think rationally or invent new tools has long interested scientists, and a new study reveals how the brain achieves these imaginative feats.

Human imagination stems from a widespread network of brain areas that collectively manipulate ideas, images and symbols, the study finds.

Creativity in art, science, music and other fields requires the ability to combine different mental representations to form new ones. [Creative Genius: The World's Greatest Minds]

For example, if a person is asked to imagine a banana spinning around quickly and getting bigger or smaller, he can do so effortlessly, said study researcher Alex Schlegel, a cognitive neuroscientist at Dartmouth College in Hanover, N.H.

"When you start to look at more complex cognitive process like imagination or creative thinking, it's not just isolated [brain] areas that are responsible, but communication of the entire brain that's required," Schlegel told LiveScience.

In the study, the researchers focused on visual forms of imagination.

Schlegel and his colleagues asked participants to imagine certain shapes, and sometimes manipulate them by either combining them with other shapes or mentally breaking the shapes apart. They put people in a magnetic resonance imaging (MRI) scanner to measure their brain activity during the task.

The scans showed that a broad network of brain areas were involved in the imagination task, and they appeared to be working in concert. In particular, manipulating the images involved a network of four core brain areas — the occipital cortex, the posterior parietal cortex (PPC), the posterior precuneus and the dorsolateral prefrontal cortex (DLPFC) — which are involved in visual processing, attention and executive functions.

In addition, several other brain regions were active during the task, suggesting the brain's mental workspace involves a more extended network.

Previous studies suggested the brain's visual processing areas are also involved in creating imagery. But the new study looked at not only how the brain forms images, but also how it modifies them.

The imagination experiment was somewhat unrealistic compared with creative tasks in everyday life. "It would be great if we could stick someone in an MRI machine and say 'create some art,'" Schlegel said. But for a scientific study, the task must be more uniform, he said.

Understanding imagination reveals what makes humans unique among animals, Schlegel said.

The findings could ultimately help improve artificial intelligence. Computers are good at a lot of things, but are less adept at seeing patterns or thinking creatively. "The more we understand how the human brain does this, the better we can design machines," Schlegel said.

The study was detailed this week in the journal Proceedings of the National Academy of Sciences.

*Follow Tanya Lewis on Twitter and Google+. Follow us @livescience, Facebook & Google+. Original article on LiveScience.*

http://www.sciencedaily.com/releases/2016/02/160202185457.htm haberi:

## Bir insanın yazım yanlışlarını niçin yaptığına dair bir çalışma...

Felçli hastaların yazım yanlışlarından yola çıkılarak beynin hangi bölgelerinin bu yazım yanlışlarıyla ilişkili olduğu ortaya çıkarılmış.

## What goes wrong in the brain when someone can't spell

Date: February 2, 2016
Source: Johns Hopkins University
Summary: By studying stroke victims who have lost the ability to spell, researchers have pinpointed the parts of the brain that control how we write words.

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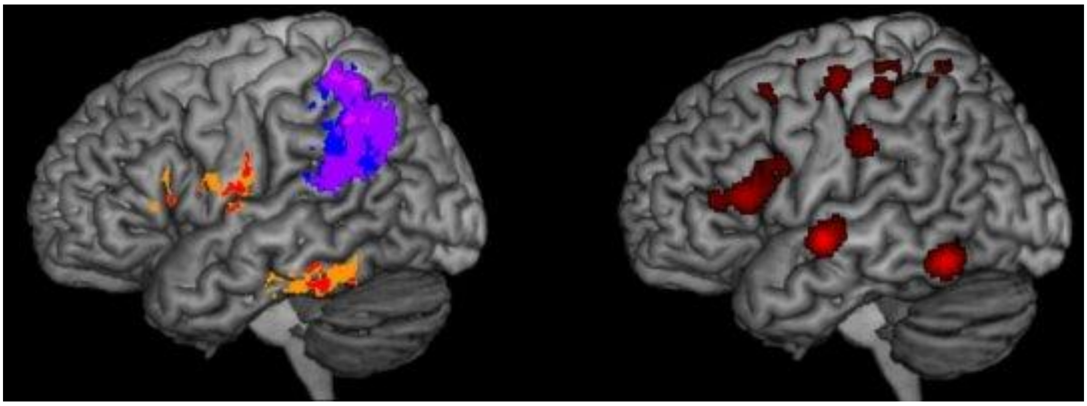

Left: A composite image showing the brain lesions of people with spelling difficulty after strokes. Right: An image of a healthy brain depicting the regions typically active during spelling.
*Credit: Johns Hopkins University*

By studying stroke victims who have lost the ability to spell, researchers have pinpointed the parts of the brain that control how we write words.

In the latest issue of the journal *Brain*, Johns Hopkins University neuroscientists link basic spelling difficulties for the first time with damage to seemingly unrelated regions of the brain, shedding new light on the mechanics of language and memory.

"When something goes wrong with spelling, it's not one thing that always happens -- different things can happen and they come from different breakdowns in the brain's machinery," said lead author Brenda Rapp, a professor in the Department of Cognitive Sciences. "Depending on what part breaks, you'll have different symptoms."

Rapp's team studied 15 years' worth of cases in which 33 people were left with spelling impairments after suffering strokes. Some of the people had long-term memory difficulties, others working-memory issues.

With long-term memory difficulties, people can't remember how to spell words they once knew and tend to make educated guesses. They could probably correctly guess a predictably spelled word like "camp," but with a more unpredictable spelling like "sauce," they might try "soss." In severe cases, people trying to spell "lion" might offer things like "lonp," "lint" and even "tiger." With working memory issues, people know how to spell words but they have trouble choosing the correct letters or assembling the letters in the correct order -- "lion" might be "liot," "lin," "lino," or "liont."

The team used computer mapping to chart the brain lesions of each individual and found that in the long-term memory cases, damage appeared on two areas of the left hemisphere, one towards the front of the brain and the other at the lower part of the brain towards the back. In working memory cases, the lesions were primarily also in the left hemisphere but in a very different area in the upper part of the brain towards the back.

"I was surprised to see how distant and distinct the brain regions are that support these two subcomponents of the writing process, especially two subcomponents that are so closely inter-related during spelling that some have argued that they shouldn't be thought of as separate functions," Rapp said. "You might have thought that they would be closer together and harder to tease apart."

Though science knows quite a bit about how the brain handles reading, these findings offer some of the first clear evidence of how it spells, an understanding that could lead to improved behavioral treatments after brain damage and more effective ways to teach spelling.

Rapp's co-authors are Johns Hopkins postdoctoral fellow Jeremy Purcell; School of Medicine professor Argye E. Hillis; Rita Capasso of S.C.A. Associates in Rome, Italy; and Gabriele Miceli, a professor at University of Trento, Italy.

This work was supported by National Institutes of Health grants DC012283 and DC05375.

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**Story Source:**

Materials provided by **Johns Hopkins University**. *Note: Content may be edited for style and length.*

https://www.sciencedaily.com/releases/2013/08/130827122713.htm haberi:

## Washington Üniversitesi'ndeki araştırmacılar beyinden beyine iletişimi sağlayan bir düzenek kurdular. Buna göre bir insan diğer bir insanın hareketlerini kontrol edebiliyor.

Haberde dikkati çeken bir alıntı:

"İnsanlar aynı dili konuşmasalar bile bir insandan diğerine beyin sinyalleri çalışabilir."

"The brain signals from one person to another would work even if they didn't speak the same language."

Araştırmayı Amerikan Ulusal Bilim Vakfı, Amerikan Ordusu Araştırma Ofisi ve Ulusal Sağlık Enstitüsü de destekliyor.

## Researcher controls colleague's motions in first human brain-to-brain interface

Date: August 27, 2013
Source: University of Washington
Summary: Researchers have performed what they believe is the first noninvasive human-to-human brain interface, with one researcher able to send a brain signal via the Internet to control the hand motions of a fellow researcher.

University of Washington University of Washington researcher Rajesh Rao, left, plays a computer game with his mind. Across campus, researcher Andrea Stocco, right, wears a magnetic stimulation coil over the left motor cortex region of his brain. Stocco's right index finger moved involuntarily to hit the "fire" button as part of the first human brain-to-brain interface demonstration.
*Credit: Image courtesy of University of Washington*

University of Washington researchers have performed what they believe is the first noninvasive human-to-human brain interface, with one researcher able to send a brain signal via the Internet to control the hand motions of a fellow researcher.

Using electrical brain recordings and a form of magnetic stimulation, Rajesh Rao sent a brain signal to Andrea Stocco on the other side of the UW campus, causing Stocco's finger to move on a keyboard.

While researchers at Duke University have demonstrated brain-to-brain communication between two rats, and Harvard researchers have demonstrated it between a human and a rat, Rao and Stocco believe this is the first demonstration of human-to-human brain interfacing.

"The Internet was a way to connect computers, and now it can be a way to connect brains," Stocco said. "We want to take the knowledge of a brain and transmit it directly from brain to brain."

The researchers captured the full demonstration on video recorded in both labs. The version available at the end of this story has been edited for length.

Rao, a UW professor of computer science and engineering, has been working on brain-computer interfacing (BCI) in his lab for more than 10 years and just published a textbook on the subject. In 2011, spurred by the rapid advances in BCI technology, he believed he could demonstrate the concept of human brain-to-brain interfacing. So he partnered with Stocco, a UW research assistant professor in psychology at the UW's Institute for Learning & Brain Sciences.

On Aug. 12, Rao sat in his lab wearing a cap with electrodes hooked up to an electroencephalography machine, which reads electrical activity in the brain. Stocco was in his lab across campus wearing a purple swim cap marked with the stimulation site for the transcranial magnetic stimulation coil that was placed directly over his left motor cortex, which controls hand movement.

The team had a Skype connection set up so the two labs could coordinate, though neither Rao nor Stocco could see the Skype screens.

Rao looked at a computer screen and played a simple video game with his mind. When he was supposed to fire a cannon at a target, he imagined moving his right hand (being careful not to actually move his hand), causing a cursor to hit the "fire" button. Almost instantaneously, Stocco, who wore noise-canceling earbuds and wasn't looking at a computer screen, involuntarily moved his right index finger to push the space bar on the keyboard in front of him, as if firing the cannon. Stocco compared the feeling of his hand moving involuntarily to that of a nervous tic.

"It was both exciting and eerie to watch an imagined action from my brain get translated into actual action by another brain," Rao said. "This was basically a one-way flow of information from my brain to his. The next step is having a more equitable two-way conversation directly between the two brains."

The technologies used by the researchers for recording and stimulating the brain are both well-known. Electroencephalography, or EEG, is routinely used by clinicians and researchers to record brain activity noninvasively from the scalp. Transcranial magnetic stimulation, or TMS, is a noninvasive way of delivering stimulation to the brain to elicit a response. Its effect depends on where the coil is placed; in this case, it was placed directly over the brain region that controls a person's right hand. By activating these neurons, the stimulation convinced the brain that it needed to move the right hand.

Computer science and engineering undergraduates Matthew Bryan, Bryan Djunaedi, Joseph Wu and Alex Dadgar, along with bioengineering graduate student Dev Sarma, wrote the computer code for the project, translating Rao's brain signals into a command for Stocco's brain.

"Brain-computer interface is something people have been talking about for a long, long time," said Chantel Prat, assistant professor in psychology at the UW's Institute for Learning & Brain Sciences, and Stocco's wife and research partner who helped conduct the experiment. "We plugged a brain into the most complex computer anyone has ever studied, and that is another brain."

At first blush, this breakthrough brings to mind all kinds of science fiction scenarios. Stocco jokingly referred to it as a "Vulcan mind meld." But Rao cautioned this technology only reads certain kinds of simple brain signals, not a person's thoughts. And it doesn't give anyone the ability to control your actions against your will.

Both researchers were in the lab wearing highly specialized equipment and under ideal conditions. They also had to obtain and follow a stringent set of international human-subject testing rules to conduct the demonstration.

"I think some people will be unnerved by this because they will overestimate the technology," Prat said. "There's no possible way the technology that we have could be used on a person unknowingly or without their willing participation."

Stocco said years from now the technology could be used, for example, by someone on the ground to help a flight attendant or passenger land an airplane if the pilot becomes incapacitated. Or a person with disabilities could communicate his or her wish, say, for food or water. The brain signals from one person to another would work even if they didn't speak the same language.

Rao and Stocco next plan to conduct an experiment that would transmit more complex information from one brain to the other. If that works, they then will conduct the experiment on a larger pool of subjects.

Their research was funded in part by the National Science Foundation's Engineering Research Center for Sensorimotor Neural Engineering at the UW, the U.S. Army Research Office and the National Institutes of Health.

http://www.youtube.com/watch?v=rNRDc714W5I

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**Story Source:**

Materials provided by **University of Washington**. Original written by Doree Armstrong and Michelle Ma. *Note: Content may be edited for style and length.*

https://blogs.scientificamerican.com/guest-blog/a-brief-guide-to-embodied-cognition-why-you-are-not-your-brain/

## Scientific American Blogundan, Samuel MacNerney'in yazısı: 'Bedenleşmiş Biliş'in Kısa Bir Kılavuzu: Niçin Siz Beyniniz Değilsiniz? Yazıda George Lakoff'un Kavramsal Metaforları'na göndermeler yapılmış.

## A Brief Guide to Embodied Cognition: Why You Are Not Your Brain

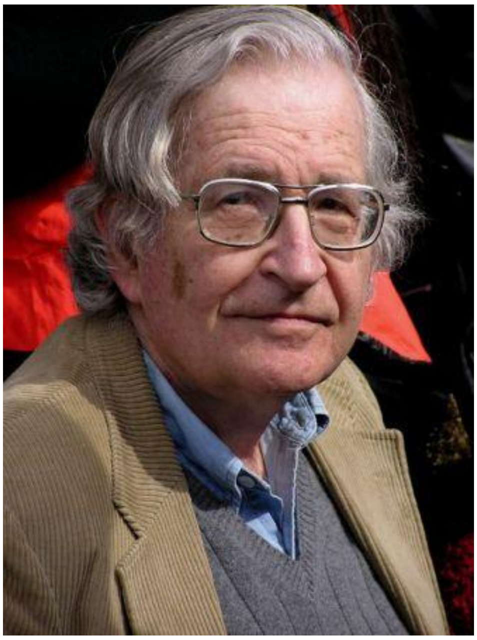
- By Samuel McNerney on November 4, 2011

Embodied cognition, the idea that the mind is not only connected to the body but that the body influences the mind, is one of the more counter-intuitive ideas in cognitive science. In sharp contrast is dualism, a theory of mind famously put forth by Rene Descartes in the 17th century when he claimed that "there is a great difference between mind and body, inasmuch as body is by nature always divisible, and the mind is entirely indivisible... the mind or soul of man is entirely different from the body." In the proceeding centuries, the notion of the disembodied mind flourished. From it, western thought developed two basic ideas: reason is disembodied because the mind is disembodied and reason is transcendent and universal. However, as George Lakoff and Rafeal Núñez explain:

Cognitive science calls this entire philosophical worldview into serious question on empirical grounds... [the mind] arises from the nature of our brains, bodies, and bodily experiences. This is not just the innocuous and obvious claim that we need a body to reason; rather, it is the striking claim that the very structure of reason itself comes from the details of our embodiment... Thus, to understand reason we must understand the details of our visual system, our motor system, and the general mechanism of neural binding.

What exactly does this mean? It means that our cognition isn't confined to our cortices. That is, our cognition is influenced, perhaps determined by, our experiences in the physical world. This is why we say that something is "over our heads" to express the idea that we do not understand; we are drawing upon the physical inability to not see something over our heads and the mental feeling of uncertainty. Or why we understand warmth with affection; as infants and children the subjective judgment of affection almost always corresponded with the sensation of warmth, thus giving way to metaphors such as "I'm warming up to her."

Embodied cognition has a relatively short history. Its intellectual roots date back to early 20th century philosophers Martin Heidegger, Maurice Merleau-Ponty and John Dewey and it has only been studied empirically in the last few decades. One of the key figures to empirically study embodiment is University of California at Berkeley professor George Lakoff.



Noam Chomsky (Wikimedia Commons)

Lakoff was kind enough to field some questions over a recent phone conversation, where I learned about his interesting history first hand. After taking linguistic courses in the 1960s under Chomsky at MIT, where he eventually majored in English and Mathematics, he studied linguistics in grad school at Indiana University. It was a different world back then, he explained, "it was the beginning of computer science and A.I and the idea that thought could be described with formal logic dominated much of philosophical thinking. Turing machines were popular discussion topics, and the brain was widely understood as a digital computational device." Essentially, the mind was thought of as a computer program separate from the body with the brain as general-purpose hardware.

Chomsky's theory of language as a series of meaningless symbols fit this paradigm. It was a view of language in which grammar was independent of meaning or communication. In contrast, Lakoff found examples showing that grammar was *depended* of meaning in 1963. From this observation he constructed a theory called Generative Semantics, which was also disembodied, where logical structures were built into grammar itself.

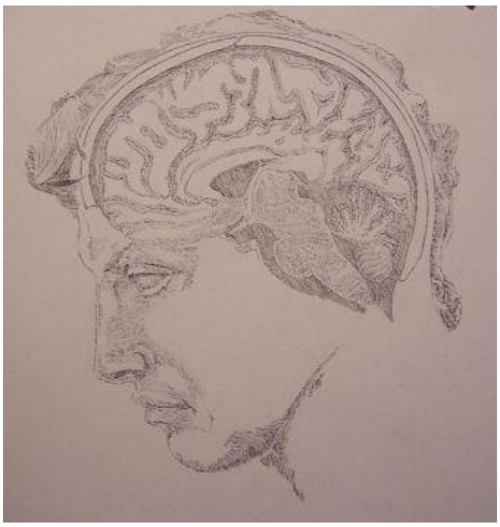
To be sure, cognitive scientists weren't dualists like Descartes – they didn't actually believe that the mind was physically separate from the body – but they didn't think that the body influenced cognition. And it was during this time - throughout the 60s and 70s -Lakoff realized the flaws of thinking about the mind as a computer and began studying embodiment.

The tipping point came after attending four talks that hinted at embodied language at Berkeley in the summer of 1975. In his words, they forced him to "give up and rethink linguistics and the brain." This prompted him and a group of colleagues to start cognitive linguistics, which contrary to Chomskyan theory and the entire mind as a computer paradigm, held that "semantics arose from the nature of the body." Then, in 1978, he "discovered that we think metaphorically," and spent the next year gathering as many metaphors as he could find.

Many cognitive scientists accepted his work on metaphors though it opposed much of mainstream thought in philosophy and linguistics. He caught a break on January 2nd 1979, when he got a call from Mark Johnson, who informed him that he was coming to Berkeley to replace someone in the philosophy department for six months. Johnson had just gotten his PhD from Chicago where he studied continental philosophy and called Lakoff to see if he was interested in studying metaphors. What came next was one of the more groundbreaking books in cognitive science. After co-writing a paper for the journal of philosophy in the spring of 1979, Lakoff and Johnson began working on *Metaphors We Live By,* and managed to finish it three months later.

Their book extensively examined how, when and why we use metaphors. Here are a few examples. We understand control as being UP and being subject to control as being DOWN: We say, “I have control *over* him,” “I am *on top of* the situation,” “He’s at the *height* of his power,” and, “He ranks *above* me in strength,” “He is *under* my control,” and “His power is on the *decline.*” Similarly, we describe love as being a physical force: “I could feel the *electricity* between us,” “There were *sparks*,” and “They *gravitated* to each other immediately.” Some of their examples reflected embodied experience. For example, Happy is Up and Sad is Down, as in “I’m feeling up today,” and “I’m feel down in the dumps.” These metaphors are based on the physiology of emotions, which researchers such as Paul Eckman have discovered. It’s no surprise, then, that around the world, people who are happy tend to smile and perk up while people who are sad tend to droop.

*Metaphors We Live By* was a game changer. Not only did it illustrate how prevalent metaphors are in everyday language, it also suggested that a lot of the major tenets of western thought, including the idea that reason is conscious and passionless and that language is separate from the body aside from the organs of speech and hearing, were incorrect. In brief, it demonstrated that “our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature.”



David - brain (Wikimedia Commons)

After *Metaphors We Live By* was published, embodiment slowly gained momentum in academia. In the 1990s dissertations by Christopher Johnson, Joseph Grady and Srini Narayanan led to a neural theory of primary metaphors. They argued that much of our language comes from physical interactions during the first several years of life, as the

Affection is Warmth metaphor illustrated. There are many other examples; we equate up with control and down with being controlled because stronger people and objects tend to control us, and we understand anger metaphorically in terms of heat pressure and loss of physical control because when we are angry our physiology changes e.g., skin temperature increases, heart beat rises and physical control becomes more difficult.

This and other work prompted Lakoff and Johnson to publish *Philosophy in the Flesh*, a six hundred-page giant that challenges the foundations of western philosophy by discussing whole systems of embodied metaphors in great detail and furthermore arguing that philosophical theories themselves are constructed metaphorically. Specifically, they argued that the mind is inherently embodied, thought is mostly unconscious and abstract concepts are largely metaphorical. What's left is the idea that reason is not based on abstract laws because cognition is grounded in bodily experience (A few years later Lakoff teamed with Rafael Núñez to publish *Where Mathematics Comes From* to argue at great length that higher mathematics is also grounded in the body and embodied metaphorical thought).

As Lakoff points out, metaphors are more than mere language and literary devices, they are conceptual in nature and represented physically in the brain. As a result, such metaphorical brain circuitry can affect behavior. For example, in a study done by Yale psychologist John Bargh, participants holding warm as opposed to cold cups of coffee were more likely to judge a confederate as trustworthy after only a brief interaction. Similarly, at the University of Toronto, "subjects were asked to remember a time when they were either socially accepted or socially snubbed. Those with warm memories of acceptance judged the room to be 5 degrees warmer on the average than those who remembered being coldly snubbed. Another effect of Affection Is Warmth." This means that we both physically and literary "warm up" to people.

The last few years have seen many complementary studies, all of which are grounded in primary experiences:

• Thinking about the future caused participants to lean slightly forward while thinking about the past caused participants to lean slightly backwards. *Future is Ahead*

• Squeezing a soft ball influenced subjects to perceive gender neutral faces as female while squeezing a hard ball influenced subjects to perceive gender neutral faces as male. *Female is Soft*

• Those who held heavier clipboards judged currencies to be more valuable and their opinions and leaders to be more important. *Important is Heavy*.

• Subjects asked to think about a moral transgression like adultery or cheating on a test were more likely to request an antiseptic cloth after the experiment than those who had thought about good deeds. *Morality is Purity*

Studies like these confirm Lakoff's initial hunch - that our rationality is greatly influenced by our bodies in large part via an extensive system of metaphorical thought. How will the observation that ideas are shaped by the body help us to better understand the brain in the future?

I also spoke with Term Assistant Professor of Psychology Joshua Davis, who teaches at Barnard College and focuses on embodiment. I asked Davis what the future of embodiment studies looks like (he is relatively new to the game, having received his PhD in 2008). He explained to me that although "a lot of the ideas of embodiment have been around for a few decades, they've hit a critical mass… whereas sensory inputs and motor outputs were secondary, we now see them as integral to cognitive processes." This is not to deny computational theories, or even behaviorism, as Davis said, "behaviorism and computational theories will still be valuable," but, "I see embodiment as a new paradigm that we are shifting towards."

What exactly will this paradigm look like? It's unclear. But I was excited to hear from Lakoff that he is trying to "bring together neuroscience with the neural theory of language and thought," through a new brain language and thought center at Berkeley. Hopefully his work there, along with the work of young professors like Davis, will allow us to understand the brain as part of a much greater dynamic system that isn't confined to our cortices.

*The author would like to personally thank Professors Lakoff and Davis for their time, thoughts, and insights. It was a real pleasure.*



## ABOUT THE AUTHOR(S)

Samuel McNerney

Sam McNerney graduated from the greatest school on Earth, Hamilton College, where he earned a bachelors in Philosophy. After reading too much Descartes and Nietzsche, he realized that his true passion is reading and writing about cognitive science. Now, he is working as a science journalist writing about philosophy, psychology, and neuroscience. He has a column at CreativityPost.com and a blog at BigThink.com called "Moments of Genius". He spends his free time listening to Lady Gaga, dreaming about writing bestsellers, and tweeting @SamMcNerney.

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http://www.nytimes.com/2014/02/25/science/the-brains-inner-language.html?_r=0 haberi:

# Beynin iç dili...

Nöronlar arasında iletişim nasıl gerçekleşiyor? Beyin bir hareketin gerçekleşmesine yönelik kararı nasıl alıyor? Bu ve benzeri sorulara cevaplar aranıyor. Haberde fare beyni üzerine yapılan çalışmaların sonuçları da öne çıkıyor....

## The Brain's Inner Language

By JAMES GORMAN FEB. 24, 2014

Clay Reid and colleagues are going deep into the mouse brain to decipher the conversations and decisions of neurons.

By Zach Wise on Publish Date February 24, 2014. .

SEATTLE — When Clay Reid decided to leave his job as a professor at Harvard Medical School to become a senior investigator at the Allen Institute for Brain Science in Seattle in 2012, some of his colleagues congratulated him warmly and understood right away why he was making the move.

Others shook their heads. He was, after all, leaving one of the world's great universities to go to the academic equivalent of an Internet start-up, albeit an extremely well- financed, very ambitious one, created in 2003 by Paul Allen, a founder of Microsoft.

Still, "it wasn't a remotely hard decision," Dr. Reid said. He wanted to mount an all-out investigation of a part of the mouse brain. And although he was happy at Harvard, the Allen Institute offered not only great colleagues and deep pockets, but also an approach to science different from the classic university environment. The institute was already mapping the mouse brain in fantastic detail, and specialized in the large-scale accumulation of information in atlases and databases available to all of science.

Now, it was expanding, and trying to merge its semi-industrial approach to data gathering with more traditional science driven by individual investigators, by hiring scientists like Christof Koch from the California Institute of Technology as chief scientific officer in 2011 and Dr. Reid. As a senior investigator, he would lead a group of about 100, and work with scientists, engineers and technicians in other groups.

Without the need to apply regularly for federal grants, Dr. Reid could concentrate on one piece of the puzzle of how the brain works. He would try to decode the workings of one part of the mouse brain, the million neurons in the visual cortex, from, as he puts it, "molecules to behavior."

There are many ways to map the brain and many kinds of brains to map. Although the ultimate goal of most neuroscience is understanding how human brains work, many kinds of research can't be done on human beings, and the brains of mice and even flies share common processes with human brains.

The work of Dr. Reid, and scientists at Allen and elsewhere who share his approach, is part of a surge of activity in brain research as scientists try to build the tools and knowledge to explain — as well as can ever be explained — how brains and minds work. Besides the Obama administration's $100 million Brain Initiative and the European Union's $1 billion, decade-long Human Brain Project, there are numerous private and public research efforts in the United States and abroad, some focusing on the human brain, others like Dr. Reid's focusing on nonhumans.

While the Human Connectome Project, which is spread among several institutions, aims for an overall picture of the associations among parts of the human brain, other scientific teams have set their sights on drilling to deeper levels. For instance, the Connectome Project at Harvard is pursuing a structural map of the mouse brain at a level of magnification that shows packets of neurochemicals at the tips of brain cells.

Photo

When neurons in the brain of a live mouse, top, are active, they flash brightly. Dr. Clay Reid, above left, and colleagues at the Allen Institute for Brain Science are working with mice to better understand the human mind. Above center, areas of the mouse cortex related to vision, and connected to other parts involving visual perception. Credit Zach Wise for The New York Times

At Janelia Farm, the Virginia research campus of the Howard Hughes Medical Institute, researchers are aiming for an understanding of the complete fly brain — a map of sorts, if a map can be taken to its imaginable limits, including structure, chemistry, genetics and activity.

"I personally am inspired by what they're doing at Janelia," Dr. Reid said.

All these efforts start with maps and enrich them. If Dr. Reid is successful, he and his colleagues will add what you might call the code of a brain process, the language the neurons use to store, transmit and process information for this function.

Not that this would be any kind of final answer. In neuroscience, perhaps more than in most other disciplines, every discovery leads to new questions.

“With the brain,” Dr. Reid said, “you can always go deeper.”

**‘Psychoanalyst’s Kid Probes Brain!’**

Dr. Reid, 53, grew up in Boston, in a family with deep roots in medicine. His grandfather taught physiology at Harvard Medical School. “My parents were both psychoanalysts,” he said during an interview last fall, smiling as he imagined a headline for this article, “Psychoanalyst’s Kid Probes Brain!”

“I pretty much always knew that I wanted to be a scientist,” he said.

As an undergraduate at Yale, he majored in physics and philosophy and in mathematics, but in the end decided he didn’t want to be a physicist. Biology was attractive, but he was worried enough about his mathematical bent to talk to one of his philosophy professors about concerns that biology would too fuzzy for him.

The professor had some advice. “You really should read Hubel and Wiesel,” he said, referring to David Hubel and Torsten Wiesel, who had just won the Nobel Prize in 1981 for their work showing how binocular vision develops in the brain.

He read their work, and when he graduated in 1982, he was convinced that the study of the brain was both hard science and a wide-open field. He went on to an M.D.-Ph.D. program at Cornell Medical College and Rockefeller University, where Dr. Wiesel had his lab (he would go on to be president of Rockefeller).

As his studies progressed, Dr. Reid began to have second thoughts about pursuing medicine rather than research. Just a week before he was to commit to a neurology residency, he said, “I ran into a friend from the Wiesel lab and said, ‘Save me.’ ”

Photo

A diamond-tipped slicer is used to prepare a piece of a mouse's brain for examination with a modified electron microscope at the Allen Institute. Credit Zach Wise for The New York Times

That plea led to postdoctoral research in the Rockefeller lab. He stayed as a faculty member until moving to Harvard in 1996.

Mathematics and physics were becoming increasingly important in neurobiology, a trend that has continued, but there was still a certain tension between different mind-sets, he recalled. He found that there were intangible skills involved in biological research. "Good biological intuition was equally important to chops in math and physics," he said.

"Torsten once said to me, 'You know, Clay, science is not an intelligence test.' "

Though he didn't recall that specific comment, Dr. Wiesel said recently that it sounded like something he would have said. "I think there are a lot of smart people who never make it in science. Why is it? What is it that is required in addition?"

Intuition is important, he said, "knowing what kind of questions to ask." And, he said, "the other thing is a passion for getting to the core of the problem."

Dr. Reid, he said, was not only smart and full of energy, but also "interested in asking questions that I think can get to the core of a problem."

At Harvard, Dr. Reid worked on the Connectome Project to map the connections between neurons in the mouse brain. The Connectome Project aims at a detailed map, a wiring diagram at a level fantastically more detailed than the work being done to map the human brain with M.R.I. machines. But electron microscopes produce a static picture from tiny slices of preserved brain.



Dr. Reid began working on tying function to mapping. He and one of his graduate students, Davi Bock, now at Janelia Farm, linked studies of active mouse brains to the detailed structural images produced by electron microscopes.

Dr. Bock said he recalled Dr. Reid as having developed exactly the kind of intuition and "good lab hands" that Dr. Wiesel seemed to be encouraging. He and another graduate student were stumped by a technical problem involving a new technique for studying living brains, and Dr. Reid came by.

"Clay got on this bench piled up with components," Dr. Bock said. "He started plugging and unplugging different power cables. We just stood there watching him, and I was sure he was going to scramble everything." But he didn't. Whatever he did worked.

That was part of the fun of working in the lab, Dr. Bock said, “not that he got it right every time.” But his appreciation for Dr. Reid as a leader and mentor went beyond admiration for his “mad scientist lab hands.”

“He has a deep gut level enthusiasm for what’s beautiful and what’s profound in neuroscience, and he’s kind of relentless,” Dr. Bock said.

**Showing a Mouse a Picture**

That instinct, enthusiasm and relentlessness will be necessary for his current pursuit. To crack the code of the brain, Dr. Reid said, two fundamental problems must be solved.

The first is: “How does the machine work, starting with its building blocks, cell types, going through their physiology and anatomy,” he said. That means knowing all the different types of neurons in the mouse visual cortex and their function — information that science doesn’t have yet.

It also means knowing what code is used to pass on information. When a mouse sees a picture, how is that picture encoded and passed from neuron to neuron? That is called neural computation.

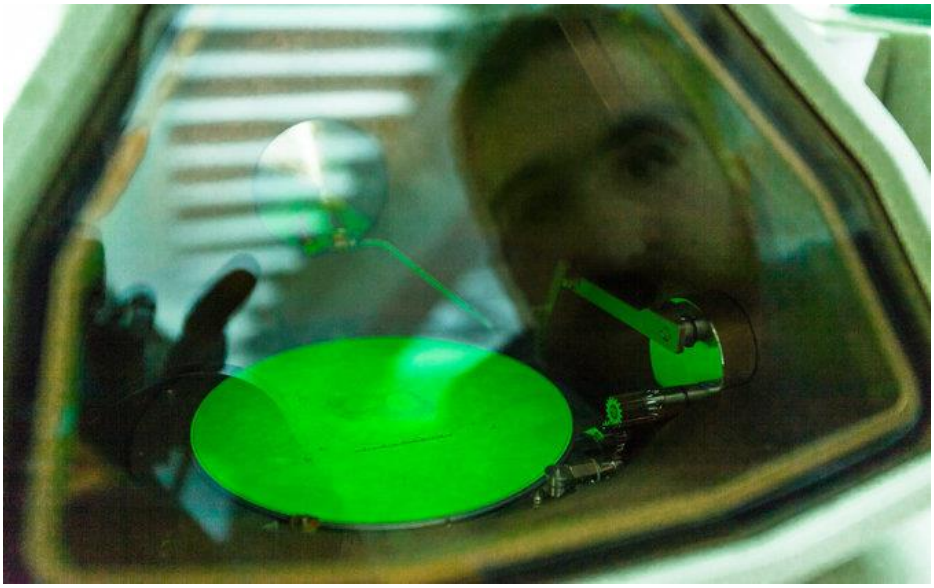
“The other highly related problem is: How does that neural computation create behavior?” he said. How does the mouse brain decide on action based on that input?

He imagined the kind of experiment that would get at these deep questions. A mouse might be trained to participate in an experiment now done with primates in which an animal looks at an image. Later, seeing several different images in sequence, the animal presses a lever when the original one appears. Seeing the image, remembering it, recognizing it and pressing the lever might take as long as two seconds and involve activity in several parts of the brain.

Understanding those two seconds, Dr. Reid said, would mean knowing “literally what photons hit the retina, what information does the retina send to the thalamus and the cortex, what computations do the neurons in the cortex do and how do they do it, how does that level of processing get sent up to a memory center and hold the trace of that picture over one or two seconds.”

Then, when the same picture is seen a second time, “the hard part happens,” he said. “How does the decision get made to say, ‘That’s the one’?”

Photo


Nuno da Costa of the Allen Institute prepared a slice of mouse brain for the modified electron microscope at Dr. Reid's lab in Seattle. "With the brain, you can always go deeper," Dr. Reid said. Credit Zach Wise for The New York Times

In pursuit of this level of understanding, Dr. Reid and others are gathering chemical, electrical, genetic and other information about what the structure of that part of the mouse brain is and what activity is going on.

They will develop electron micrographs that show every neuron and every connection in that part of a mouse brain. That is done on dead tissue. Then they will use several techniques to see what goes on in that part of the brain when a living animal reacts to different situations. "We can record the activity of every single cell in a volume of cortex, and capture the connections," he said.

With chemicals added to the brain, the most advanced light microscopes can capture movies of neurons firing. Electrodes can record the electrical impulses. And mathematical analysis of all that may decipher the code in which information is moved around that part of the brain.

Dr. Reid says solving the first part of the problem — receiving and analyzing sensory information — might be done in 10 years. An engineer's precise understanding of everything from photons to action could be more on the order of 20 to 30 years away, and not reachable through the work of the Allen Institute alone. But, he wrote in an email, "the large-scale, coordinated efforts at the institute will get us there faster." He is studying only one part of one animal's brain, but, he said, the cortex — the part of the mammalian brain where all this calculation goes on — is something of a general purpose computer. So the rules for one process could explain other processes, like hearing. And the rules for decision-making could apply to many more complicated situations in more complicated brains. Perhaps the mouse visual cortex can be a kind of Rosetta stone for the brain's code.

All research is a gamble, of course, and the Allen Institute's collaborative approach, while gaining popularity in neuroscience, is not universally popular. Dr. Wiesel said it was "an important approach" that would "provide a lot of useful information." But, he added, "it won't necessarily create breakthroughs in our understanding of how the brain works."

“I think the main advances are going to be made by individual scientists working in small groups,” he said.

Of course, in courting and absorbing researchers like Dr. Reid, the Allen Institute has been moving away from its broad data-gathering approach toward more focused work by individual investigators.

Dr. Bock, his former student, said his experience suggested that Dr. Reid had not only a passion and intensity for research, but a good eye for where science is headed as well.

“That’s what Clay does,” he said. “He is really good in that Wayne Gretzky way of skating to where the puck will be.”

The Map Makers: Second in a series of articles about scientists behind the new efforts to explore the brain.

A version of this article appears in print on February 25, 2014, on Page D1 of the New York edition with the headline: The Brain’s Inner Language. 

https://www.sciencedaily.com/releases/2013/01/130103192348.htm haberi:

**Haberi göre bilişsel bilim araştırmacılara Susam Sokağı adlı programı izleyen hem çocuklar hem de yetişkinler üzerine deneysel bir çalışma gerçekleştirmiş.**

Araştırmada okuma ve matematik gibi entelektüel becerilerin çocukların beyninde nasıl gerçekleştiği üzerinde durulmuş. Beyin tarama sonuçlarına göre Susam Sokağı gibi videoların derslerde kullanılmasının çocukların entelektüel gelişimine yardımcı olabileceği vurgulanmış, ancak sonuçlara bakarak televizyon izlemenin faydalı olacağı gibi bir yargıya da varılmaması özellikle belirtilmiş.

# Your brain on Big Bird: Sesame Street helps to reveal patterns of neural development

Date: January 3, 2013
Source: University of Rochester
Summary: Using brain scans of children and adults watching Sesame Street, cognitive scientists are learning how children's brains change as they develop intellectual abilities like reading and math. The novel use of brain imaging during everyday activities like watching TV, say the scientists, opens the door to studying other thought processes in naturalistic settings and may one day help to diagnose and treat learning disabilities.

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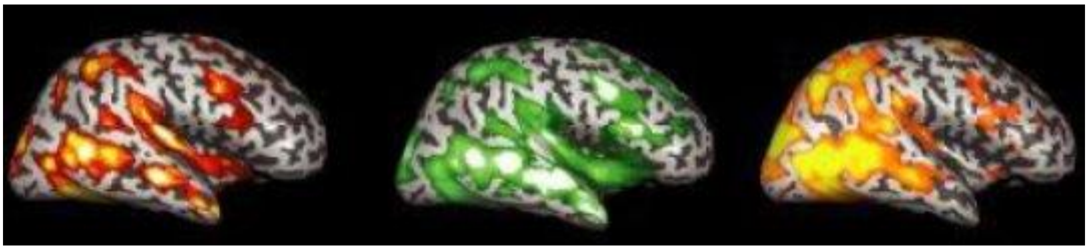

The fMRI scan on the left represents correlations in neural activity between children and adults, in the middle between children and other children, and on the right between adults and other adults. Such neural maps, says University of Rochester cognitive scientist Jessica Cantlon, reveal how the brain's neural structure develops along predictable pathways as we mature.
*Credit: Jessica Cantlon, University of Rochester*

Using brain scans of children and adults watching Sesame Street, cognitive scientists are learning how children's brains change as they develop intellectual abilities like reading and math.

The novel use of brain imaging during everyday activities like watching TV, say the scientists, opens the door to studying other thought processes in naturalistic settings and may one day help to diagnose and treat learning disabilities.

Scientists are just beginning to use brain imaging to understand how humans process thought during real-life experiences. For example, researchers have compared scans of adults watching an entertaining movie to see if neural responses are similar across different individuals. "But this is the first study to use the method as a tool for understanding development," says lead author Jessica Cantlon, an assistant professor in brain and cognitive sciences at the University of Rochester.

Eventually, that understanding may help pinpoint the cause when a child experiences difficulties mastering school work. "Psychologists have behavioral tests for trying to get the bottom of learning impairments, but these new imaging studies provide a totally independent source of information about children's learning based on what's happening in the brain," says Cantlon.

The neuroimaging findings are detailed in a new study published Jan. 3 by the Public Library of Science's open-access journal *PLoS Biology*, by Cantlon and her former research assistant Rosa Li, now a graduate student at Duke University.

For the investigation, 27 children between the ages of 4 and 11, and 20 adults watched the same 20-minute Sesame Street video. Like the regular program, the recording featured a variety of short clips focused on numbers, words, shapes, and other subjects. The children then took standardized IQ tests for math and verbal ability.

To capture the neural response to the show, the researchers turned to functional magnetic resonance imaging (fMRI) scans. Unlike X-rays, CAT scans, and other types of brain imaging, fMRI involves no risks, injections, surgery, or exposure to radiation. Using magnetic fields, the scans virtually segment the brain into a three-dimensional grid of about 40,000 pixels, known as voxels, and measure the neural signal intensity in each of those tiny sectors. The study produced 609 scans of each participant, one every two seconds, as they watched Big Bird, the Count, Elmo and other stars of the educational series. Using statistical algorithms, the researchers then created "neural maps" of the thought processes for the children and the adults and compared the groups.

The result? Children whose neural maps more closely resembled the neural maps of adults scored higher on standardized math and verbal tests. In other words, the brain's neural structure, like other parts of the body, develops along predictable pathways as we mature.

The study also confirmed where in the brain these developing abilities are located. For verbal tasks, adult-like neural patterns in the Broca area, which is involved in speech and language, predicted higher verbal test scores in children. For math, better scores were linked to more mature patterns in the intraparietal sulcus (IPS), a region of the brain known to be involved in the processing of numbers.

Using normal activities, like TV watching, may provide a more accurate indicator of children's learning and brain development in the real world than the short and simple tasks typical of fMRI studies, the authors argue. Like the Sesame Street video, learning environments in schools are rich in complexity along with the academic lessons, write the authors.

To test that assumption, Cantlon and Li had the children perform traditional fMRI tasks by matching simple pictures of faces, numbers, words, or shapes. During these more limited activities with simple images, the neural responses of the children did not predict their test scores, unlike the more naturalistic task of watching Sesame Street.

Although the study does not advocate TV watching, it does show that "neural patterns during an everyday activity like watching television are related to a person's intellectual maturity," says Cantlon. "It's not the case that if you put a child in front of an educational TV program that nothing is happening-that the brain just sort of zones out. Instead, what we see is that the patterns of neural activity that children are showing are meaningful and related to their intellectual abilities."

Conducted at the Rochester Center for Brain Imaging, the study was supported by a National Institutes of Health grant (R01 HD064636) and by a James S. McDonnell Foundation grant to Cantlon.

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**Story Source:**

Materials provided by **University of Rochester**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Cantlon JF, Li R. **Neural Activity during Natural Viewing of Sesame Street Statistically Predicts Test Scores in Early Childhood**. *PLoS Biol*, 2013; 11(1): e1001462 DOI: 10.1371/journal.pbio.1001462

http://www.bbc.com/news/health-27634990 haberi:

## İkinci dil öğrenmek beynin yaşlanmasını yavaşlatıyor...

## Learning second language 'slows brain ageing'

- 2 June 2014


Image copyright Thinkstock Image caption

Learning a second language could improve reading and intelligence skills

Learning a second language can have a positive effect on the brain, even if it is taken up in adulthood, a University of Edinburgh study suggests.

Researchers found that reading, verbal fluency and intelligence were improved in a study of 262 people tested either aged 11 or in their seventies.

A previous study suggested that being bilingual could delay the onset of dementia by several years.

The study is published in Annals of Neurology.

The big question in this study was whether learning a new language improved cognitive functions or whether individuals with better cognitive abilities were more likely to become bilingual.

Dr Thomas Bak, from the Centre for Cognitive Ageing and Cognitive Epidemiology at the University of Edinburgh, said he believed he had found the answer.

Millions of people around the world acquire their second language later in life. Our study shows that bilingualism, even when acquired in adulthood, may benefit the ageing brainDr Thomas Bak, University of Edinburgh

Using data from intelligence tests on 262 Edinburgh-born individuals at the age of 11, the study looked at how their cognitive abilities had changed when they were tested again in their seventies.

The research was conducted between 2008 and 2010.

All participants said they were able to communicate in at least one language other than English.

Of that group, 195 learned the second language before the age of 18, and 65 learned it after that time.

## Strong effects

The findings indicate that those who spoke two or more languages had significantly better cognitive abilities compared to what would have been expected from their baseline test.

The strongest effects were seen in general intelligence and reading.

The effects were present in those who learned their second language early, as well as later in life.

Dr Bak said the pattern they found was "meaningful" and the improvements in attention, focus and fluency could not be explained by original intelligence.

"These findings are of considerable practical relevance. Millions of people around the world acquire their second language later in life. Our study shows that bilingualism, even when acquired in adulthood, may benefit the aging brain."

But he admitted that the study also raised many questions, such as whether learning more than one language could also have the same positive effect on cognitive ageing and whether actively speaking a second language is better than just knowing how to speak it.

Dr. Alvaro Pascual-Leone, professor of medicine at Harvard Medical School in Boston, US, said: "The epidemiological study provides an important first step in understanding the impact of learning a second language and the ageing brain.

"This research paves the way for future causal studies of bilingualism and cognitive decline prevention."

https://www.sciencedaily.com/releases/2014/07/140714152311.htm? Haberi

## Washington Üniversitesi'ndeki araştırmaya göre bebekler ilk kelimeyi telaffuz edene kadar beyinleri kelimeleri telaffuz etmek için hazırlık yapıyor.

# Months before their first words, babies' brains rehearse speech mechanics

Date: July 14, 2014
Source: University of Washington
Summary: New research in 7- and 11-month-old infants shows that speech sounds stimulate areas of the brain that coordinate and plan motor movements for speech. The study suggests that baby brains start laying down the groundwork of how to form words long before they actually begin to speak.

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A year-old baby sits in a brain scanner, called magnetoencephalography -- a noninvasive approach to measuring brain activity. The baby listens to speech sounds like "da" and "ta" played over headphones while researchers record her brain responses.
*Credit: Institute for Learning & Brain Sciences at the University of Washington*

Infants can tell the difference between sounds of all languages until about 8 months of age when their brains start to focus only on the sounds they hear around them. It's been unclear how this transition occurs, but social interactions and caregivers' use of exaggerated "parentese" style of speech seem to help.

University of Washington research in 7- and 11-month-old infants shows that speech sounds stimulate areas of the brain that coordinate and plan motor movements for speech.

The study, published July 14 in the Proceedings of the National Academy of Sciences, suggests that baby brains start laying down the groundwork of how to form words long before they actually begin to speak, and this may affect the developmental transition.

"Most babies babble by 7 months, but don't utter their first words until after their first birthdays," said lead author Patricia Kuhl, who is the co-director of the UW's Institute for Learning and Brain Sciences. "Finding activation in motor areas of the brain when infants are simply listening is significant, because it means the baby brain is engaged in trying to talk back right from the start and suggests that 7-month-olds' brains are already trying to figure out how to make the right movements that will produce words."

Kuhl and her research team believe this practice at motor planning contributes to the transition when infants become more sensitive to their native language.

The results emphasize the importance of talking to kids during social interactions even if they aren't talking back yet.

"Hearing us talk exercises the action areas of infants' brains, going beyond what we thought happens when we talk to them," Kuhl said. "Infants' brains are preparing them to act on the world by practicing how to speak before they actually say a word."

In the experiment, infants sat in a brain scanner that measures brain activation through a noninvasive technique called magnetoencephalography. Nicknamed MEG, the brain scanner resembles an egg-shaped vintage hair dryer and is completely safe for infants. The Institute for Learning and Brain Sciences was the first in the world to use such a tool to study babies while they engaged in a task.

The babies, 57 7- and 11- or 12-month-olds, each listened to a series of native and foreign language syllables such as "da" and "ta" as researchers recorded brain responses. They listened to sounds in English and in Spanish.

The researchers observed brain activity in an auditory area of the brain called the superior temporal gyrus, as well as in Broca's area and the cerebellum, cortical regions responsible for planning the motor movements required for producing speech.

This pattern of brain activation occurred for sounds in the 7-month-olds' native language (English) as well as in a non-native language (Spanish), showing that at this early age infants are responding to all speech sounds, whether or not they have heard the sounds before.

In the older infants, brain activation was different. By 11-12 months, infants' brains increase motor activation to the non-native speech sounds relative to native speech, which the researchers interpret as showing that it takes more effort for the baby brain to predict which movements create non-native speech. This reflects an effect of experience between 7 and 11 months, and suggests that activation in motor brain areas is contributing to the transition in early speech perception.

The study has social implications, suggesting that the slow and exaggerated parentese speech -- "Hiiiii! How are youuuuu?" -- may actually prompt infants to try to synthesize utterances themselves and imitate what they heard, uttering something like "Ahhh bah bah baaah."

"Parentese is very exaggerated, and when infants hear it, their brains may find it easier to model the motor movements necessary to speak," Kuhl said.

Co-authors Rey Ramirez, Alexis Bosseler, Jo-Fu Lotus Lin and Toshiaki Imada are all with UW's Institute for Learning & Brain Sciences.

The National Science Foundation Science of Learning Program grant to the UW's LIFE Center funded the study.

Here's a video of one the babies in the experiment: http://youtu.be/aFJNTaPvXpk

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**Story Source:**

Materials provided by **University of Washington**. Original written by Molly McElroy. *Note: Content may be edited for style and length.*

https://www.theguardian.com/education/2014/sep/04/what-happens-to-the-brain-language-learning?platform=hootsuite haberi:

## Siz dil öğrenirken beyninizde neler oluyor ?

## What happens in the brain when you learn a language?

Kara Morgan-Short using electrophysiology to examine the inner workings of the brain during language learning. Photograph: Yara Mekawi/University of Illinois

Alison Mackey

Thursday 4 September 2014 14.35 BST Last modified on Thursday 1 June 2017 20.53 BST

Learning a foreign language can increase the size of your brain. This is what Swedish scientists discovered when they used brain scans to monitor what happens when someone learns a second language. The study is part of a growing body of research using brain imaging technologies to better understand the cognitive benefits of language learning. Tools like magnetic resonance imaging (MRI) and electrophysiology, among others, can now tell us not only whether we need knee surgery or have irregularities with our heartbeat, but reveal what is happening in our brains when we hear, understand and produce second languages.

The Swedish MRI study showed that learning a foreign language has a visible effect on the brain. Young adult military recruits with a flair for languages learned Arabic, Russian or Dari intensively, while a control group of medical and cognitive science students also studied hard, but not at languages. MRI scans showed specific parts of the brains of the language students developed in size whereas the brain structures of the control group remained unchanged. Equally interesting was that learners whose brains grew in the hippocampus and areas of the cerebral cortex related to language learning had better language skills than other learners for whom the motor region of the cerebral cortex developed more.

In other words, the areas of the brain that grew were linked to how easy the learners found languages, and brain development varied according to performance. As the researchers noted, while it is not completely clear what changes after three months of intensive language study mean for the long term, brain growth sounds promising.

Looking at functional MRI brain scans can also tell us what parts of the brain are active during a specific learning task. For example, we can see why adult native speakers of a language like Japanese cannot easily hear the difference between the English “r” and “l” sounds (making it difficult for them to distinguish “river” and “liver” for example). Unlike English, Japanese does not distinguish between “r” and “l” as distinct sounds. Instead, a single sound unit (known as a phoneme) represents both sounds.

When presented with English words containing either of these sounds, brain imaging studies show that only a single region of a Japanese speaker’s brain is activated, whereas in English speakers, two different areas of activation show up, one for each unique sound.

For Japanese speakers, learning to hear and produce the differences between the two phonemes in English requires a rewiring of certain elements of the brain’s circuitry. What can be done? How can we learn these distinctions?

Early language studies based on brain research have shown that Japanese speakers can learn to hear and produce the difference in “r” and “l” by using a software program that greatly exaggerates the aspects of each sound that make it different from the other. When the sounds were modified and extended by the software, participants were more easily able to hear the difference between the sounds. In one study, after only three 20-minute sessions (just a single hour’s worth), the volunteers learned to successfully distinguish the sounds, even when the sounds were presented as part of normal speech.

This sort of research might eventually lead to advances in the use of technology for second-language learning. For example, using ultrasound machines like the ones used to show expectant parents the features and movements of their babies in the womb, researchers in articulatory phonetics have been able to explain to language learners how to make sounds by showing them visual images of how their tongue, lips, and jaw should move with their airstream mechanisms and the rise and fall of the soft palate to make these sounds.

Ian Wilson, a researcher working in Japan, has produced some early reports of studies of these technologies that are encouraging. Of course, researchers aren’t suggesting that ultrasound equipment be included as part of regular language learning classrooms, but savvy software engineers are beginning to come up with ways to capitalise on this new knowledge by incorporating imaging into cutting edge language learning apps.

Kara Morgan-Short, a professor at the University of Illinois at Chicago, uses electrophysiology to examine the inner workings of the brain. She and her colleagues taught second-language learners to speak an artificial language – a miniature language constructed by linguists to test claims about language learnability in a controlled way.

In their experiment, one group of volunteers learned through explanations of the rules of the language, while a second group learned by being immersed in the language, similar to how we all learn our native languages. While all of their participants learned, it was the immersed learners whose brain processes were most like those of native speakers. Interestingly, up to six months later, when they could not have received any more exposure to the language at home because the language was artificial, these learners still performed well on tests, and their brain processes had become even more native-like.

In a follow-up study, Morgan-Short and her colleagues showed that the learners who demonstrated particular talents at picking up sequences and patterns learned grammar particularly well through immersion. Morgan-Short said: “This brain-based research tells us not only that some adults can learn through immersion, like children, but might enable us to match individual adult learners with the optimal learning contexts for them.”

Brain imaging research may eventually help us tailor language learning methods to our cognitive abilities, telling us whether we learn best from formal instruction that highlights rules, immersing ourselves in the sounds of a language, or perhaps one followed by the other.

However we learn, this recent brain-based research provides good news. We know that people who speak more than one language fluently have better memories and are more cognitively creative and mentally flexible than monolinguals. Canadian studies suggest that Alzheimer’s disease and the onset of dementia are diagnosed later for bilinguals than for monolinguals, meaning that knowing a second language can help us to stay cognitively healthy well into our later years.

Even more encouraging is that bilingual benefits still hold for those of us who do not learn our second languages as children. Edinburgh University researchers point out that “millions of people across the world acquire their second language later in life: in school, university, or work, or through migration or marriage.” Their results, with 853 participants, clearly show that knowing another language is advantageous, regardless of when you learn it.

*Alison Mackey is professor of linguistics at Georgetown University and Lancaster University*.

https://www.sciencedaily.com/releases/2014/11/141112120208.htm

# Dil öğrenmenin beyne olumlu etkisi olduğuna dair uygulamalı bir araştırma sonucu

# Learning languages is a workout for brains, both young, old

Date: November 12, 2014
Source: Penn State
Summary: Learning a new language changes your brain network both structurally and functionally, according to researchers. "Like physical exercise, the more you use specific areas of your brain, the more it grows and gets stronger," said the lead investigator.
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FULL STORY

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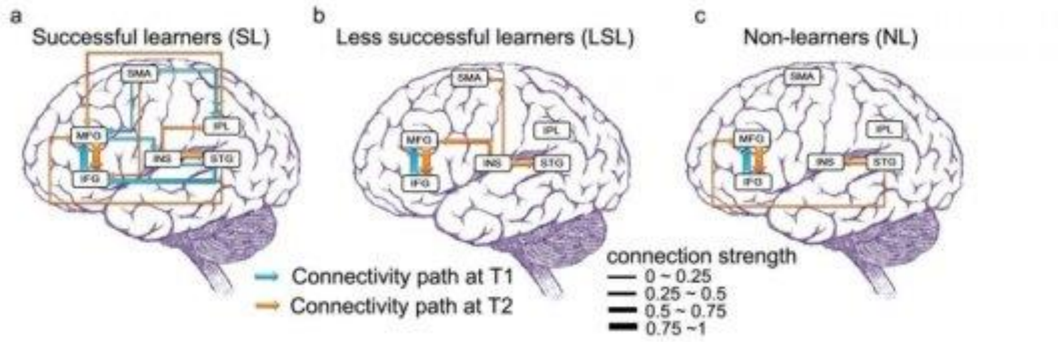


These are schematics of connectivity in the brain showing connectivity at two different times with strength indicated by line thickness. a) Is the connectivity of a successful learner, b) connectivity of less successful learner and c) is connectivity of non-learners.
*Credit: Li Lab, Penn State*

Learning a new language changes your brain network both structurally and functionally, according to Penn State researchers. "Learning and practicing something, for instance a second language, strengthens the brain," said Ping Li, professor of psychology, linguistics and information sciences and technology. "Like physical exercise, the more you use specific areas of your brain, the more it grows and gets stronger."

Li and colleagues studied 39 native English speakers' brains over a six-week period as half of the participants learned Chinese vocabulary. Of the subjects learning the new vocabulary, those who were more successful in attaining the information showed a more connected brain network than both the less successful participants and those who did not learn the new vocabulary.

The researchers also found that the participants who were successful learners had a more connected network than the other participants even before learning took place. A better-integrated brain network is more flexible and efficient, making the task of learning a new language easier. Li and colleagues report their results in a recent article published in the *Journal of Neurolinguistics*.

The efficiency of brain networks was defined by the researchers in terms of the strength and direction of connections, or edges, between brain regions of interest, or nodes. The stronger the edges going from one node to the next, the faster the nodes can work together, and the more efficient the network.

Participants each underwent two fMRI scans -- one before the experiment began and one after -- in order for the researchers to track neural changes. At the end of the study period, the researchers found that the brains of the successful learners had undergone functional changes -- the brain network was better integrated.

Such changes, Li and colleagues suggested while reviewing a number of related studies, are consistent with anatomical changes that can occur in the brain as a result of learning a second language, no matter the age of the learner, as they reported in a recent issue of *Cortex*.

"A very interesting finding is that, contrary to previous studies, the brain is much more plastic than we thought," said Li, also co-chair of the interdisciplinary graduate degree program in neuroscience. "We can still see anatomical changes in the brain [in the elderly], which is very encouraging news for aging. And learning a new language can help lead to more graceful aging."

Meanwhile, Li and colleagues have begun working on interactive ways to teach language using virtual 3-D-like environments with situation-based learning to help the brain make some of those new connections more effectively. Such studies hold the promise that the process of learning a second language as an adult can in fact lead to both behavioral and physical changes that may approximate the patterns of learning a language as a child.

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**Story Source:**

Materials provided by **Penn State**. Original written by Victoria M. Infivero. *Note: Content may be edited for style and length.*

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**Journal References**:


1. Jing Yang, Kathleen Marie Gates, Peter Molenaar, Ping Li. **Neural changes underlying successful second language word learning: An fMRI study**. *Journal of Neurolinguistics*, 2014; DOI: 10.1016/j.jneuroling.2014.09.004
2. Ping Li, Jennifer Legault, Kaitlyn A. Litcofsky. **Neuroplasticity as a function of second language learning: Anatomical changes in the human brain**. *Cortex*, 2014; 58: 301 DOI: 10.1016/j.cortex.2014.05.001

https://www.sciencedaily.com/releases/2017/01/170103162356.htm haberi:

## Araştırmacılar kekemeliğin beynin dil ile ilişkili bölümündeki kan akışının azalmasıyla gerçekleştiği iddiasındalar.

## Stuttering linked to reduced blood flow in area of brain associated with language

Date: January 3, 2017
Source: Children's Hospital Los Angeles
Summary: A new study demonstrates that regional cerebral blood flow is reduced in the Broca's area -- the region in the frontal lobe of the brain linked to speech production -- in persons who stutter. More severe stuttering is associated with even greater reductions in blood flow to this region.
Share:
FULL STORY

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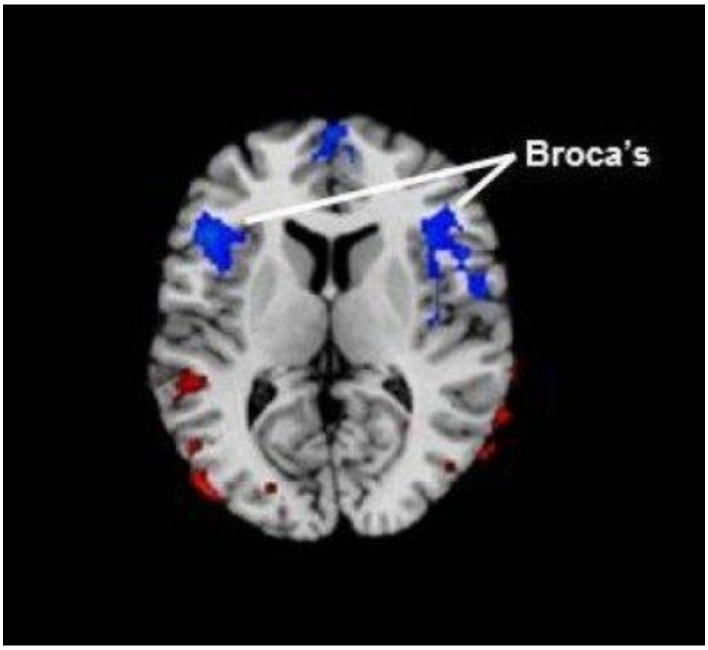

Broca's area, located in the frontal lobe of brain, plays a key role in expressive speech. Blue regions represent areas of decreased blood flow in children and adults with stuttering when compared to fluent healthy participants. The red areas represent relatively higher blood flow.
*Credit: Children's Hospital Los Angeles*

A study led by researchers at Children's Hospital Los Angeles demonstrates what lead investigator Bradley Peterson, MD, calls "a critical mass of evidence" of a common underlying lifelong vulnerability in both children and adults who stutter. They discovered that regional cerebral blood flow is reduced in the Broca's area -- the region in the frontal lobe of the brain linked to speech production -- in persons who stutter. More severe stuttering is associated with even greater reductions in blood flow to this region.

In addition, a greater abnormality of cerebral blood flow in the posterior language loop, associated with processing words that we hear, correlates with more severe stuttering. This finding suggests that a common pathophysiology throughout the neural "language" loop that connects the frontal and posterior temporal lobe likely contributes to stuttering severity.

Peterson, who is director of the Institute for the Developing Mind at CHLA and a professor of the Keck School of Medicine at the University of Southern California, says that such a study of resting blood flow, or perfusion, has never before been conducted in persons who stutter. His team also recently published a study using proton magnetic resonance spectroscopy to look at brain regions in both adults and children who stutter. Those findings demonstrated links between stuttering and changes in the brain circuits that control speech production, as well as those supporting attention and emotion. The present blood flow study adds significantly to the findings from that prior study and furthermore suggests that disturbances in the speech processing areas of the brain are likely of central importance as a cause of stuttering.

According to Peterson, the new study -- published on December 30 in the journal *Human Brain Mapping* -- provides scientists with a completely different window into the brain. The researchers were able to zero in on the Broca's area as well as related brain circuitry specifically linked to speech, using regional cerebral blood flow as a measure of brain activity, since blood flow is typically coupled with neural activity.

"When other portions of the brain circuit related to speech were also affected according to our blood flow measurements, we saw more severe stuttering in both children and adults," said first author Jay Desai, MD, a clinical neurologist at CHLA. "Blood flow was inversely correlated to the degree of stuttering -- the more severe the stuttering, the less blood flow to this part of the brain," said Desai, adding that the study results were "quite striking."

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**Story Source:**

Materials provided by **Children's Hospital Los Angeles**. *Note: Content may be edited for style and length.*

http://www.theglobeandmail.com/news/national/new-brain-map-reveals-a-world-of-meaning/article29769370/ haberi :

## Yeni beyin haritası anlam dünyasını ortaya çıkarıyor.

## New brain map reveals a world of meaning

Digital visualization by Alexander Huth on the way the meaning of language is organized across the entire brain.

Ivan Semeniuk
SCIENCE REPORTER
March 24, 2017 April 27, 2016

Everyone likes a good story. Now, scientists can finally see why.

By monitoring the neural activity of human subjects while listening to hour after hour of stories, researchers have captured – in vivid detail and in real time – the way the meaning of language is organized across the entire brain.

The result could prove useful for understanding how people can bounce back from strokes or other brain-related injuries that can affect language. But more broadly, it shows just how thoroughly our capacity to understand speech engages our mental processes in virtually every region of the brain.

"Nobody has actually done this before," said Alex Huth, a postdoctoral researcher at the University of California, Berkeley, and lead author of what he and his colleagues describe as a "semantic map" of the human cerebral cortex. "We're showing where all these different concepts are represented."

The effort, published Wednesday in the journal Nature, might be compared to getting a first look at Earth from space. While it's not a surprise to see continents and oceans, the richness and variety of the vistas are unexpectedly mesmerizing.

Previous studies have already shown that certain brain areas light up in response to particular words or ideas. The new map goes much further by showing the fine-grained mosaic of activity within these regions and also by showing that many words are associated with multiple regions.

To create the map, the researchers used reams of data drawn from seven individuals who each spent about six hours listening to real-life stories from *The Moth Radio Hour*, a public radio program. Their brain responses to the stories were monitored using functional magnetic resonance imaging (fMRI), a technique that subdivides the brain into many thousands of tiny compartments, or "voxels," and records blood oxygen levels in each one. The levels can be used as a proxy for how hard the brain cells located within each voxel are working.

Dr. Huth noted that the stories were essential for the semantic mapping experiment because simply testing subjects with lists of individual words or phrases would not elicit nearly the same level of brain activity.

"If you want to get strong responses to language, you need to have language that says something the person cares about hearing," he said.

All told, the experiment involved the subjects listening to more than 10,000 individual words that researchers classified under 12 broad categories such as "social," "locational," "professional" and "violent."

Using the categories, they were then able to identify at least 100 separate brain regions where activity related to those categories appeared to cluster. These regions were remarkably consistent between individuals, though the researchers caution that individuals living in very different cultures and settings may well show a different semantic organization.

The pattern is in keeping with an emerging paradigm in cognitive research that no longer sees the brain as being built out of discrete modules, but more as a vast interconnected network where each area plays multiple roles. "It's the constellation of activity across really large swaths of brain that's interesting," said Marc Joanisse, a professor with the University of Western Ontario's Brain and Mind Institute who specializes in the neuroscience of language and was not involved in the study.

The history of language and brain research dates back to the 19th century, when European physicians Pierre Paul Broca and Carl Wernicke separately noticed that patients with damage to certain parts of the brain had difficulty comprehending or producing speech. But while these areas are now regarded as important to the mechanics of language, the Berkeley map shows that the way language connects to cognition is far more distributed around the entire cerebral cortex.

Dr. Huth and his colleagues stress that they were not setting out to test a particular hypothesis, but rather were simply aiming to create the most comprehensive view of brain activity in response to human speech to date.

The Berkeley team also took into account the fact that some brain regions can be triggered by an emotional response that is more generic than a response linked to a specific set of words, and found little change in their result.

"We don't think that emotions alone are a big driver of what's happening here," Dr. Huth said.

He added that he and his colleagues are in the midst of comparing their semantic map generated by stories with an earlier map the team produced by scanning the brains of subjects while they were exposed to different kinds of images. Another study with bilingual speakers is also under way to look at how the brain preserves meaning and context across languages.

http://mosaicscience.com/bilingual-brains haberi:

## İkidillilik beynimizin sağlıklı kalmasına niçin yardımcı oluyor sorusuna cevap arayan bir yazı.

## Why being bilingual helps keep your brain fit

Most people in the world speak more than one language, suggesting the human brain evolved to work in multiple tongues. If so, asks Gaia Vince, are those who speak only one language missing out?

07 August 2016

In a café in south London, two construction workers are engaged in cheerful banter, tossing words back and forth. Their cutlery dances during more emphatic gesticulations and they occasionally break off into loud guffaws. They are discussing a woman, that much is clear, but the details are lost on me. It's a shame, because their conversation looks fun and interesting, especially to a nosy person like me. But I don't speak their language.

Out of curiosity, I interrupt them to ask what they are speaking. With friendly smiles, they both switch easily to English, explaining that they are South Africans and had been speaking Xhosa. In Johannesburg, where they are from, most people speak at least five languages, says one of them, Theo Morris. For example, Theo's mother's language is Sotho, his father's is Zulu, he learned Xhosa and Ndebele from his friends and neighbours, and English and Afrikaans at school. "I went to Germany before I came here, so I also speak German," he adds.

Was it easy to learn so many languages?

"Yes, it's normal," he laughs.

He's right. Around the world, more than half of people – estimates vary from 60 to 75 per cent – speak at least two languages. Many countries have more than one official national language – South Africa has 11. People are increasingly expected to speak, read and write at least one of a handful of "super" languages, such as English, Chinese, Hindi, Spanish or Arabic, as well. So to be monolingual, as many native English speakers are, is to be in the minority, and perhaps to be missing out.

Multilingualism has been shown to have many social, psychological and lifestyle advantages. Moreover, researchers are finding a swathe of health benefits from speaking more than one language, including faster stroke recovery and delayed onset of dementia.

Could it be that the human brain evolved to be multilingual – that those who speak only one language are not exploiting their full potential? And in a world that is losing languages faster than ever – at the current rate of one a fortnight, half our languages will be extinct by the end of the century – what will happen if the current rich diversity of languages disappears and most of us end up speaking only one?

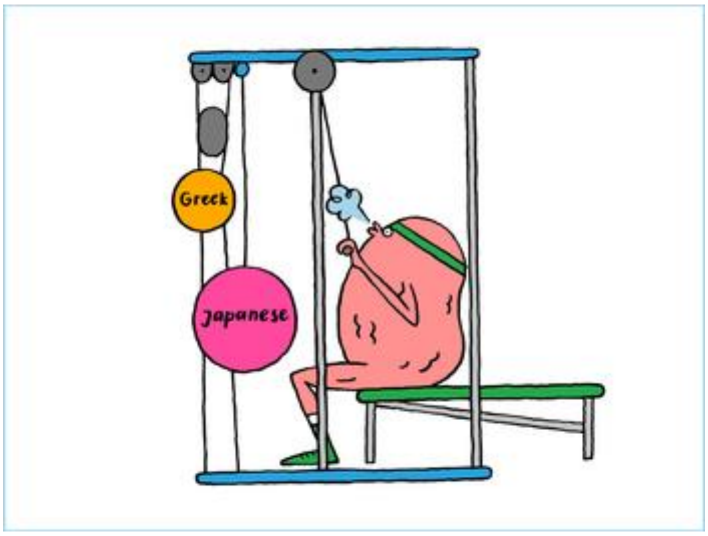
Bilinguals perform these tasks much better than monolinguals – they are faster and more accurate.

I am sitting in a laboratory, headphones on, looking at pictures of snowflakes on a computer. As each pair of snowflakes appears, I hear a description of one of them through the headphones. All I have to do is decide which snowflake is being described. The only catch is that the descriptions are in a completely invented language called Syntaflake.

It's part of an experiment by Panos Athanasopoulos, an ebullient Greek with a passion for languages. Professor of psycholinguistics and bilingual cognition at Lancaster University, he's at the forefront of a new wave of research into the bilingual mind. As you might expect, his lab is a Babel of different nationalities and languages – but no one here grew up speaking Syntaflake.

The task is profoundly strange and incredibly difficult. Usually, when interacting in a foreign language, there are clues to help you decipher the meaning. The speaker might point to the snowflake as they speak, use their hands to demonstrate shapes or their fingers to count out numbers, for example. Here I have no such clues and, it being a made-up language, I can't even rely on picking up similarities to languages I already know.

After a time, though, I begin to feel a pattern might be emerging with the syntax and sounds. I decide to be mathematical about it and get out pen and paper to plot any rules that emerge, determined not to "fail" the test.

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The experience reminds me of a time I arrived in a rural town a few hours outside Beijing and was forced to make myself understood in a language I could neither speak nor read, among people for whom English was similarly alien. But even then, there had been clues… Now, without any accompanying human interaction, the rules governing the sounds I'm hearing remain elusive, and at the end of the session I have to admit defeat.

I join Athanasopoulos for a chat while my performance is being analysed by his team.

Glumly, I recount my difficulties at learning the language, despite my best efforts. But it appears that was where I went wrong: “The people who perform best on this task are the ones who don’t care at all about the task and just want to get it over as soon as possible. Students and teaching staff who try to work it out and find a pattern always do worst,” he says.

“It’s impossible in the time given to decipher the rules of the language and make sense of what’s being said to you. But your brain is primed to work it out subconsciously. That’s why, if you *don’t* think about it, you’ll do okay in the test – children do the best.”

Being so bound up with identity, language is also deeply political.

The first words ever uttered may have been as far back as 250,000 years ago, once our ancestors stood up on two legs and freed the ribcage from weight-bearing tasks, allowing fine nerve control of breathing and pitch to develop. And when humans had got one language, it wouldn’t have been long before we had many.

Language evolution can be compared to biological evolution, but whereas genetic change is driven by environmental pressures, languages change and develop through social pressures. Over time, different groups of early humans would have found themselves speaking different languages. Then, in order to communicate with other groups – for trade, travel and so on – it would have been necessary for some members of a family or band to speak other tongues.

We can get some sense of how prevalent multilingualism may have been from the few hunter-gatherer peoples who survive today. “If you look at modern hunter-gatherers, they are almost all multilingual,” says Thomas Bak, a cognitive neurologist who studies the science of languages at the University of Edinburgh. “The rule is that one mustn’t marry anyone in the same tribe or clan to have a child – it’s taboo. So every single child’s mum and dad speak a different language.”

In Aboriginal Australia, where more than 130 indigenous languages are still spoken, multilingualism is part of the landscape. “You will be walking and talking with someone, and then you might cross a small river and suddenly your companion will switch to another language,” says Bak. “People speak the language of the earth.” This is true elsewhere, too. “Consider in Belgium: you take a train in Liège, the announcements are in French first. Then, pass through Loewen, where the announcements will be in Dutch first, and then in Brussels it reverts back to French first.”

Gaia Vince celebrates the newcomers in our evolving linguistic landscape.

Being so bound up with identity, language is also deeply political. The emergence of European nation states and the growth of imperialism during the 19th century meant it was regarded as disloyal to speak anything other than the one national language. This perhaps contributed to the widely held opinion – particularly in Britain and the US – that bringing up children to be bilingual was harmful to their health and to society more generally.

There were warnings that bilingual children would be confused by two languages, have lower intelligence, low self-esteem, behave in deviant ways, develop a split personality and even become schizophrenic. It is a view that persisted until very recently, discouraging many immigrant parents from using their own mother tongue to speak to their children, for instance.

This is in spite of a a 1962 experiment, ignored for decades, which showed that bilingual children did better than monolinguals in both verbal and non-verbal intelligence tests.

However, research in the last decade by neurologists, psychologists and linguists, using the latest brain-imaging tools, is revealing a swathe of cognitive benefits for bilinguals. It's all to do with how our ever-flexible minds learn to multitask.

Many bilinguals say they feel like a different person when they speak their other language.

Ask me in English what my favourite food is, and I will picture myself in London choosing from the options I enjoy there. But ask me in French, and I transport myself to Paris, where the options I'll choose from are different. So the same deeply personal question gets a different answer depending on the language in which you're asking me. This idea that you gain a new personality with every language you speak, that you act differently when speaking different languages, is a profound one.

Athanasopoulos and his colleagues have been studying the capacity for language to change people's perspectives. In one experiment, English and German speakers were shown videos of people moving, such as a woman walking towards her car or a man cycling to the supermarket. English speakers focus on the action and typically describe the scene as "a woman is walking" or "a man is cycling". German speakers, on the other hand, have a more holistic worldview and will include the goal of the action: they might say (in German) "a woman walks towards her car" or "a man cycles towards the supermarket".

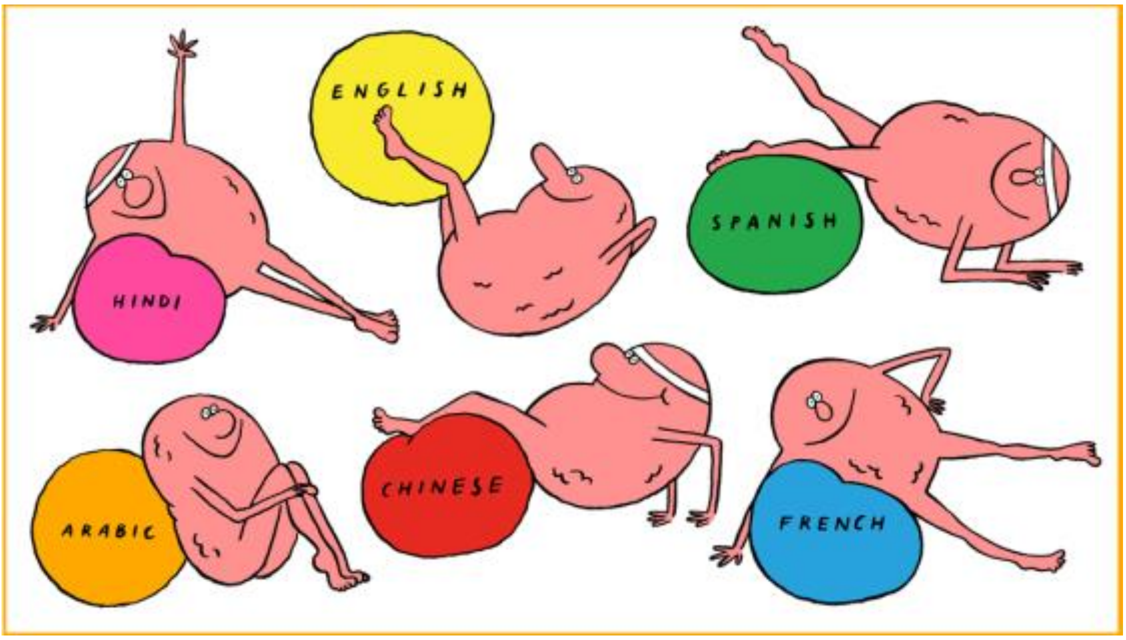
Part of this is due to the grammatical toolkit available, Athanasopoulos explains. Unlike German, English has the -ing ending to describe actions that are ongoing. This makes English speakers much less likely than German speakers to assign a goal to an action when describing an ambiguous scene. When he tested English–German bilinguals, however, whether they were action- or goal-focused depended on which country they were tested in. If the bilinguals were tested in Germany, they were goal-focused; in England, they were action-focused, no matter which language was used, showing how intertwined culture and language can be in determining a person's worldview.

In the 1960s, one of the pioneers of psycholinguistics, Susan Ervin-Tripp, tested Japanese–English bilingual women, asking them to finish sentences in each language. She found that the women ended the sentences very differently depending on which language was used. For example, "When my wishes conflict with my family…" was completed in Japanese as "it is a time of great unhappiness"; in English, as "I do what I want". Another example was "Real friends should…", which was completed as "help each other" in Japanese and "be frank" in English.

From this, Ervin-Tripp concluded that human thought takes place within language mindsets, and that bilinguals have different mindsets for each language – an extraordinary idea but one that has been borne out in subsequent studies, and many bilinguals say they feel like a different person when they speak their other language.

These different mindsets are continually in conflict, however, as bilingual brains sort out which language to use.

In a revealing experiment with his English–German bilingual group, Athanasopoulos got them to recite strings of numbers out loud in either German or English. This effectively "blocked" the other language altogether, and when they were shown the videos of movement, the bilinguals' descriptions were more action- or goal-focused depending on which language had been blocked. So, if they recited numbers in German, their responses to the videos were more typically German and goal-focused. When the number recitation was switched to the other language midway, their video responses also switched.

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So what's going on? Are there really two separate minds in a bilingual brain? That's what the snowflake experiment was designed to find out. I'm a little nervous of what my fumbling performance will reveal about me, but Athanasopoulos assures me I'm similar to others who have been tested – and so far, we seem to be validating his theory.

In order to assess the effect that trying to understand the Syntaflake language had on my brain, I took another test before and after the snowflake task. In these so-called flanker tasks, patterns of arrows appeared on the screen and I had to press the left or right button according to the direction of the arrow in the centre. Sometimes the surrounding pattern of arrows was confusing, so by the end of the first session my shoulders had been hunched somewhere near my ears and I was exhausted from concentrating. It's not a task in which practice improves performance (most people actually do worse second time round), but when I did the same test again after completing the snowflake task, I was significantly better at it, just as Athanasopoulos has predicted.

"Learning the new language improved your performance second time around," he explains. Relieved as I am to fit into the normal range, it's a curious result. How can that be?

The flanker tasks were exercises in cognitive conflict resolution – if most of the arrows were pointing to the left, my immediate impulse was to push the left button, but this wasn't the correct response if the central arrow was pointing right. I had to block out my impulse and heed the rule instead. Another example of cognitive conflict is a test in which the names of colours are written in different colours ("blue" written in red, for example). The aim is to say which colour each word is written in, but this is tricky, because we read the word much quicker than we process the colour of the letters. It requires considerable mental effort to ignore the impulse just to say the word we can't help but read.

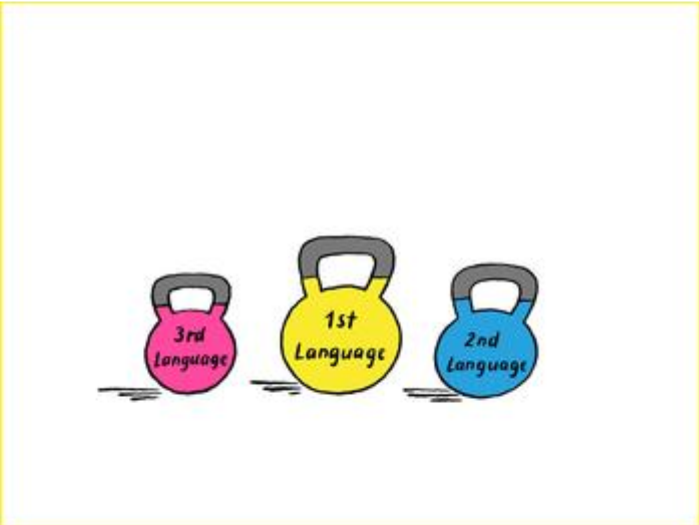
Extra

Where is language in the brain?

Language is all around us but where does it sit inside us?

The snowflake test prepared my ACC for the second flanker task, just as speaking more than one language seems to train the executive system more generally. A steady stream of studies over the past decade has shown that bilinguals outperform monolinguals in a range of cognitive and social tasks from verbal and nonverbal tests to how well they can read other people. Greater empathy is thought to be because bilinguals are better at blocking out their own feelings and beliefs in order to concentrate on the other person's.

"Bilinguals perform these tasks much better than monolinguals – they are faster and more accurate," says Athanasopoulos. And that suggests their executive systems are different from monolinguals'.

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In fact, says cognitive neuropsychologist Jubin Abutalebi, at the University of San Raffaele in Milan, it is possible to distinguish bilingual people from monolinguals simply by looking at scans of their brains. "Bilingual people have significantly more grey matter than monolinguals in their anterior cingulate cortex, and that is because they are using it so much more often," he says. The ACC is like a cognitive muscle, he adds: the more you use it, the stronger, bigger and more flexible it gets.

Bilinguals, it turns out, exercise their executive control all the time because their two languages are constantly competing for attention. Brain-imaging studies show that when a bilingual person is speaking in one language, their ACC is continually suppressing the urge to use words and grammar from their other language. Not only that, but their mind is always making a judgement about when and how to use the target language. For example, bilinguals rarely get confused between languages, but they may introduce the odd word or sentence of the other language if the person they are talking to also knows it.

"My mother tongue is Polish but my wife is Spanish so I also speak Spanish, and we live in Edinburgh so we also speak English," says Thomas Bak. "When I am talking to my wife in English, I will sometimes use Spanish words, but I never accidentally use Polish. And when I am speaking to my wife's mother in Spanish, I never accidentally introduce English words because she doesn't understand them. It's not something I have to think about, it's automatic, but my executive system is working very hard to inhibit the other languages."

For bilinguals, with their exceptionally buff executive control, the flanker test is just a conscious version of what their brains do subconsciously all day long – it's no wonder they are good at it.

Perhaps we ought to start doing more cognitive exercises to maintain our mental health, especially if we only speak one language.

A superior ability to concentrate, solve problems and focus, better mental flexibility and multitasking skills are, of course, valuable in everyday life. But perhaps the most exciting benefit of bilingualism occurs in ageing, when executive function typically declines: bilingualism seems to protect against dementia.

Psycholinguist Ellen Bialystok made the surprising discovery at York University in Toronto while she was comparing an ageing population of monolinguals and bilinguals.

"The bilinguals showed symptoms of Alzheimer's some four to five years after monolinguals with the same disease pathology," she says.

Being bilingual didn't prevent people from getting dementia, but it delayed its effects, so in two people whose brains showed similar amounts of disease progression, the bilingual would show symptoms an average of five years after the monolingual. Bialystok thinks this is because bilingualism rewires the brain and improves the executive system, boosting people's "cognitive reserve". It means that as parts of the brain succumb to damage, bilinguals can compensate more because they have extra grey matter and alternative neural pathways.

Extra
The woman who lost two languages and only got one back

A burst aneurysm caused bilingual Basia Grzybowska to lose both her English and her Polish. Now she has recovered – partly.

Bilingualism can also offer protection after brain injury. In a recent study of 600 stroke survivors in India, Bak discovered that cognitive recovery was twice as likely for bilinguals as for monolinguals.

Such results suggest bilingualism helps keep us mentally fit. It may even be an advantage that evolution has positively selected for in our brains – an idea supported by the ease with which we learn new languages and flip between them, and by the pervasiveness of bilingualism throughout world history. Just as we need to do physical exercise to maintain the health of bodies that evolved for a physically active hunter-gatherer lifestyle, perhaps we ought to start doing more cognitive exercises to maintain our mental health, especially if we only speak one language.

In recent years, there has been a backlash against the studies showing benefits from bilingualism. Some researchers tried and failed to replicate some of the results; others questioned the benefits of improved executive function in everyday life. Bak wrote a rejoinder to the published criticisms, and says there is now overwhelming evidence from psychological experiments backed by imaging studies that bilingual and monolingual brains function differently. He says the detractors have made errors in their experimental methods.

Bialystok agrees, adding that it is impossible to examine whether bilingualism improves a child's school exam results because there are so many confounding factors. But, she says, "given that at the very least it makes no difference – and no study has ever shown it harms performance – considering the very many social and cultural benefits to knowing another language, bilingualism should be encouraged". As for the financial benefits, one estimate puts the value of knowing a second language at up to $128,000 over 40 years.

It takes three years for a baby to learn a language, but just months for an adult.

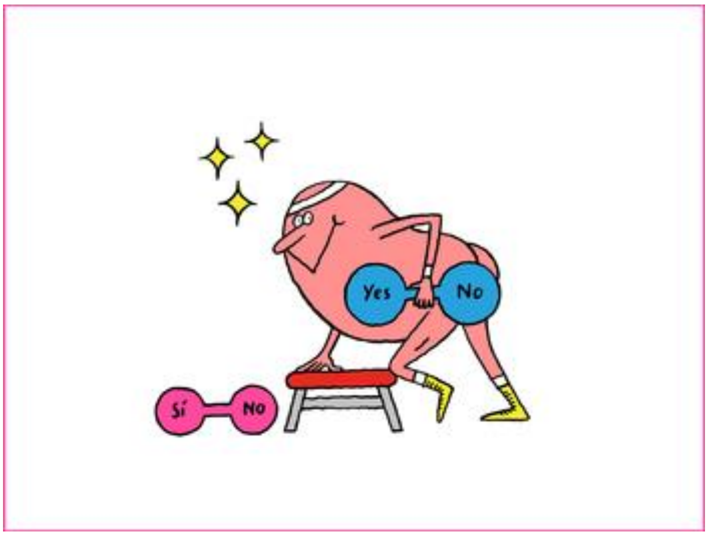
The result of my test in Athanasopoulos's lab suggests that just 45 minutes of trying to understand another language can improve cognitive function. His study is not yet complete, but other research has shown that these benefits of learning a language can be achieved quickly. The problem is, they disappear again unless they are used – and I am unlikely to use the made-up snowflake language ever again! Learning a new language is not the only way to improve executive function – playing video games, learning a musical instrument, even certain card games can help – but because we use language all the time, it's probably the best executive-function exerciser there is. So how can this knowledge be applied in practice?

One option is to teach children in different languages. In many parts of the world, this is already being done: many Indian children, for example, will use a different language in school from their mother or village tongue. But in English-speaking nations, it is rare. Nevertheless, there is a growing movement towards so-called immersion schooling, in which children are taught in another language half the time. The state of Utah has been pioneering the idea, with many of its schools now offering immersion in Mandarin Chinese or Spanish.

"We use a half-day model, so the target language is used to teach in the morning, and then English is used in the afternoon – then this is swapped on other days as some learn better in the morning and some in the afternoon," explains Gregg Roberts, who works with the Utah Office of State Education and has championed immersion language teaching in the state. "We have found that the kids do as well and generally better than monolingual counterparts in all subjects. They are better at concentrating, focusing and have a lot more self-esteem. Anytime you understand another language, you understand your language and culture better. It is economically and socially beneficial. We need to get over our affliction with monolingualism."

The immersion approach is being trialled in the UK now, too. At Bohunt secondary school in Liphook, Hampshire, head teacher Neil Strowger has introduced Chinese-language immersion for a few lessons.

I sit in on an art class with 12-year-olds being taught by two teachers: one speaking English, the other Chinese. The children are engaged but quiet, concentrating on the task of learning multiple ideas. When they speak it is often in Chinese – and there is something rather surreal about watching young people in the UK discussing British graffiti artist Banksy in Mandarin. The children say they chose to learn in Chinese because they thought it would be "fun" and "interesting" and "useful" – a far cry from the dreary French lessons I endured at school.




© Nadine Redlich

The majority of the art class will take their Chinese GCSE exams several years early but Strowger tells me the programme has had many benefits in addition to their grades, including improving students' engagement and enjoyment, increasing their awareness of other cultures so that they are equipped as global citizens, widening their horizons, and improving their job prospects.

What about those of us who have left school? In order to maintain the benefits of bilingualism, you need to use your languages and that can be tricky, especially for older people who may not have many opportunities to practise. Perhaps we need language clubs, where people can meet to speak other languages. Bak has done a small pilot study with elderly people learning Gaelic in Scotland and seen significant benefits after just one week. Now he aims to carry out a much larger trial.

It is never too late to learn another tongue, and it can be very rewarding. Alex Rawlings is a British professional polyglot who speaks 15 languages: "Each language gives you a whole new lifestyle, a whole new shade of meaning," he says. "It's addictive!"

"People say it's too hard as an adult. But I would say it's much easier after the age of eight. It takes three years for a baby to learn a language, but just months for an adult."

As the recent research shows, that's a worthwhile investment of time. Being bilingual could keep our minds working longer and better into old age, which could have a massive impact on how we school our children and treat older people. In the meantime, it makes sense to talk, *hablar*, *parler*, *sprechen*, *beszél*, *berbicara* in as many languages as you can.

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https://www.sciencedaily.com/releases/2013/06/130627161434.htm haberi:

# Habere göre felçli hastaların % 20-30'u afazi yaşıyor. Bu tarz hastalara yönelik yapılan uygulamalı bir çalışmada erken beyin uyarımına maruz bırakılan hastalarda belirgin bir biçimde iyileşme gözlenmiş.

## Early brain stimulation may help stroke survivors recover language function

Date: June 27, 2013
Source: American Heart Association
Summary: Non-invasive brain stimulation may help stroke survivors recover language function. Survivors treated with the technique regained more language function than those who did not get treatment.
Share:
FULL STORY

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Non-invasive brain stimulation may help stroke survivors recover speech and language function, according to new research in the American Heart Association journal *Stroke.*

Between 20 percent to 30 percent of stroke survivors have aphasia, a disorder that affects the ability to grasp language, read, write or speak. It's most often caused by strokes that occur in areas of the brain that control speech and language.

"For decades, skilled speech and language therapy has been the only therapeutic option for stroke survivors with aphasia," said Alexander Thiel, M.D., study lead author and associate professor of neurology and neurosurgery at McGill University in Montreal, Quebec, Canada. "We are entering exciting times where we might be able in the near future to combine speech and language therapy with non-invasive brain stimulation earlier in the recovery. This could result in earlier and more efficient aphasia recovery and also have an economic impact."

In the small study, researchers treated 24 stroke survivors with several types of aphasia at the rehabilitation hospital Rehanova and the Max-Planck-Institute for neurological research in Cologne, Germany. Thirteen received transcranial magnetic stimulation (TMS) and 11 got sham stimulation.

The TMS device is a handheld magnetic coil that delivers low intensity stimulation and elicits muscle contractions when applied over the motor cortex.

During sham stimulation the coil is placed over the top of the head in the midline where there is a large venous blood vessel and not a language-related brain region. The intensity for stimulation was lower intensity so that participants still had the same sensation on the skin but no effective electrical currents were induced in the brain tissue.

Patients received 20 minutes of TMS or sham stimulation followed by 45 minutes of speech and language therapy for 10 days.

The TMS groups' improvements were on average three times greater than the non-TMS group, researchers said. They used German language aphasia tests, which are similar to those in the United States, to measure language performance of the patients.

"TMS had the biggest impact on improvement in anomia, the inability to name objects, which is one of the most debilitating aphasia symptoms," Thiel said.

Researchers, in essence, shut down the working part of the brain so that the stroke-affected side could relearn language. "This is similar to physical rehabilitation where the unaffected limb is immobilized with a splint so that the patients must use the affected limb during the therapy session," Thiel said.

"We believe brain stimulation should be most effective early, within about five weeks after stroke, because genes controlling the recovery process are active during this time window," he said.

Thiel said the result of this study opens the door to larger, multi-center trials. The NORTHSTAR study has been funded by the Canadian Institutes of Health Research and will be launched at four Canadian sites and one German site later in 2013.

The Walter and Marga Boll and Wolf-Dieter-Heiss Foundations funded the current study.

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**Story Source:**

Materials provided by **American Heart Association**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Alexander Thiel, Alexander Hartmann, Ilona Rubi-Fessen, Carole Anglade, Lutz Kracht, Nora Weiduschat, Josef Kessler, Thomas Rommel, and Wolf-Dieter Heiss. **Effects of Noninvasive Brain Stimulation on Language Networks and Recovery in Early Poststroke Aphasia**. *Stroke*, June 27 2013 DOI: 10.1161/STROKEAHA.111.000574

http://www.sciencedaily.com/releases/2014/11/141126144239.htm haberi:

## Habere göre Carnegie Mellon Üniversitesi araştırmacılara beynin bir metnin okunması sürecinde nasıl bir işlem gerçekleştirdiğinin, bu işlemlerin beynin hangi bölgelerinde gerçekleştirildiğinin bilgisayar modelini çıkarmışlar.

## Brain regions that encode words, grammar, story identified

Date: November 26, 2014
Source: Carnegie Mellon University
Summary: Scientists have produced the first integrated computational model of reading, identifying which parts of the brain are responsible for such sub-processes as parsing sentences, determining the meaning of words and understanding relationships between characters. They based their results on brain scan of people reading a Harry Potter book.
Share:
FULL STORY

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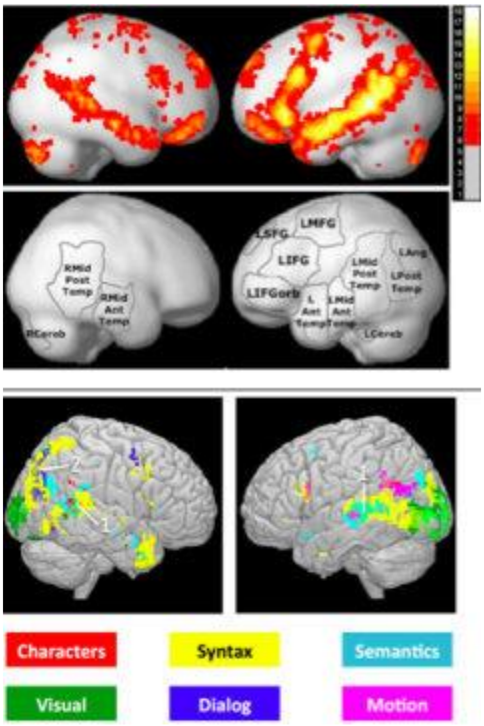

Map of the patterns of representation compared with the regions involved in sentence processing: our method recovers similar regions and differentiates them according to which information process they represent.
*Credit: Leila Wehbe et al; PLoS ONE, 2014; DOI: 10.1371/journal.pone.0112575*

Some people say that reading "Harry Potter and the Sorcerer's Stone" taught them the importance of friends, or that easy decisions are seldom right. Carnegie Mellon University scientists used a chapter of that book to learn a different lesson: identifying what different regions of the brain are doing when people read.

Researchers from CMU's Machine Learning Department performed functional magnetic resonance imaging (fMRI) scans of eight people as they read a chapter of that Potter book. They then analyzed the scans, cubic millimeter by cubic millimeter, for every four-word segment of that chapter. The result was the first integrated computational model of reading, identifying which parts of the brain are responsible for such subprocesses as parsing sentences, determining the meaning of words and understanding relationships between characters.

As Leila Wehbe, a Ph.D. student in the Machine Learning Department, and Tom Mitchell, the department head, recently reported in the online journal *PLOS ONE*, the model was able to predict fMRI activity for novel text passages with sufficient accuracy to tell which of two different passages a person was reading with 74 percent accuracy.

"At first, we were skeptical of whether this would work at all," Mitchell said, noting that analyzing multiple subprocesses of the brain at the same time is unprecedented in cognitive neuroscience. "But it turned out amazingly well and now we have these wonderful brain maps that describe where in the brain you're thinking about a wide variety of things."

Wehbe and Mitchell said the model is still inexact, but might someday be useful in studying and diagnosing reading disorders, such as dyslexia, or to track the recovery of patients whose speech was impacted by a stroke. It also might be used by educators to identify what might be giving a student trouble when learning a foreign language.

"If I'm having trouble learning a new language, I may have a hard time figuring out exactly what I don't get," Mitchell said. "When I can't understand a sentence, I can't articulate what it is I don't understand. But a brain scan might show that the region of my brain responsible for grammar isn't activating properly, or perhaps instead I'm not understanding the individual words."

Researchers at Carnegie Mellon and elsewhere have used fMRI scans to identify activation patterns associated with particular words or phrases or even emotions. But these have always been tightly controlled experiments, with only one variable analyzed at a time. The experiments were unnatural, usually involving only single words or phrases, but the slow pace of fMRI -- one scan every two seconds -- made other approaches seem unfeasible.

Wehbe nevertheless was convinced that multiple cognitive subprocesses could be studied simultaneously while people read a compelling story in a near-normal manner. She believed that using a real text passage as an experimental stimulus would provide a rich sample of the different word properties, which could help to reveal which brain regions are associated with these different properties.

"No one falls asleep in the scanner during Leila's experiments," Mitchell said.

They devised a technique in which people see one word of a passage every half second -- or four words for every two-second fMRI scan. For each word, they identified 195 detailed features -- everything from the number of letters in the word to its part of speech. They then used a machine learning algorithm to analyze the activation of each cubic centimeter of the brain for each four-word segment.

Bit by bit, the algorithm was able to associate certain features with certain regions of the brain, Wehbe said.

"The test subjects read Chapter 9 of Sorcerer's Stone, which is about Harry's first flying lesson," she noted. "It turns out that movement of the characters -- such as when they are flying their brooms -- is associated with activation in the same brain region that we use to perceive other people's motion. Similarly, the characters in the story are associated with activation in the same brain region we use to process other people's intentions."

Exactly how the brain creates these neural encodings is still a mystery, they said, but it is the beginning of understanding what the brain is doing when a person reads.

"It's sort of like a DNA fingerprint -- you may not understand all aspects of DNA's function, but it guides you in understanding cell function or development," Mitchell said. "This model of reading initially is that kind of a fingerprint."

A complementary study by Wehbe and Mitchell, presented earlier this fall at the Conference on Empirical Methods in Natural Language Processing, used magnetoencephalography (MEG) to record brain activity in subjects reading Harry Potter. MEG can record activity every millisecond, rather than every two seconds as in fMRI scanning, but can't localize activity with the precision of fMRI. Those findings suggest how words are integrated into memory -- how the brain first visually perceives a word and then begins accessing the properties of the word, and fitting it into the story context.

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**Story Source:**

Materials provided by **Carnegie Mellon University**. Original written by Byron Spice. *Note: Content may be edited for style and length.*

https://www.sciencedaily.com/releases/2011/08/110831115922.htm
haberi:

## Araştırmacılar kişinin düşünürken kullandığı kavramlarla ilgili kelime kategorileri ile beynindeki etkinlikleri eşleştirdiler.

# Word association: Study matches brain scans with complex thought

Date: September 1, 2011
Source: Princeton University
Summary: Researchers have for the first time matched images of brain activity with categories of words related to the concepts a person is thinking about. The results could lead to a better understanding of how people consider meaning and context when reading or thinking.

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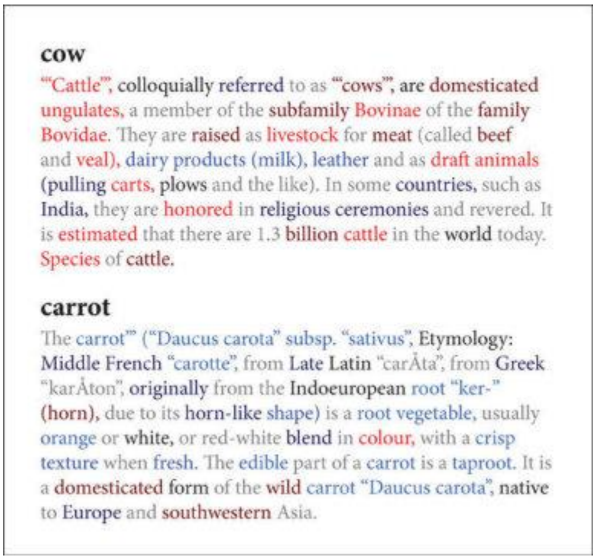

Princeton researchers developed a method to determine the probability of various words being associated with the object a person thought about during a brain scan. They produced color-coded figures that illustrate the probability of words within the Wikipedia article about the object the participant saw during the scan actually being associated with the object. The more red a word is, the more likely a person is to associate it, in this case, with "cow." On the other hand, bright blue suggests a strong correlation with "carrot." Black and grey "neutral" words had no specific association or were not considered at all.
*Credit: Illustration courtesy of Francisco Pereira*

In an effort to understand what happens in the brain when a person reads or considers such abstract ideas as love or justice, Princeton researchers have for the first time matched images of brain activity with categories of words related to the concepts a person is thinking about. The results could lead to a better understanding of how people consider meaning and context when reading or thinking.

The researchers report in the journal *Frontiers in Human Neuroscience* that they used functional magnetic resonance imaging (fMRI) to identify areas of the brain activated when study participants thought about physical objects such as a carrot, a horse or a house. The researchers then generated a list of topics related to those objects and used the fMRI images to determine the brain activity that words within each topic shared. For instance, thoughts about "eye" and "foot" produced similar neural stirrings as other words related to body parts.

Once the researchers knew the brain activity a topic sparked, they were able to use fMRI images alone to predict the subjects and words a person likely thought about during the scan. This capability to put people's brain activity into words provides an initial step toward further exploring themes the human brain touches upon during complex thought.

"The basic idea is that whatever subject matter is on someone's mind -- not just topics or concepts, but also, emotions, plans or socially oriented thoughts -- is ultimately reflected in the pattern of activity across all areas of his or her brain," said the team's senior researcher, Matthew Botvinick, an associate professor in Princeton's Department of Psychology and in the Princeton Neuroscience Institute.

"The long-term goal is to translate that brain-activity pattern into the words that likely describe the original mental 'subject matter,'" Botvinick said. "One can imagine doing this with any mental content that can be verbalized, not only about objects, but also about people, actions and abstract concepts and relationships. This study is a first step toward that more general goal.

"If we give way to unbridled speculation, one can imagine years from now being able to 'translate' brain activity into written output for people who are unable to communicate otherwise, which is an exciting thing to consider. In the short term, our technique could be used to learn more about the way that concepts are represented at the neural level -- how ideas relate to one another and how they are engaged or activated."

The research, which was published Aug. 23, was funded by a grant from the National Institute of Neurological Disease and Stroke, part of the National Institutes of Health.

Depicting a person's thoughts through text is a "promising and innovative method" that the Princeton project introduces to the larger goal of correlating brain activity with mental content, said Marcel Just, a professor of psychology at Carnegie Mellon University. The Princeton researchers worked from brain scans Just had previously collected in his lab, but he had no active role in the project.

"The general goal for the future is to understand the neural coding of any thought and any combination of concepts," Just said. "The significance of this work is that it points to a method for interpreting brain activation patterns that correspond to complex thoughts."

**Tracking the brain's 'semantic threads'**

Largely designed and conducted in Botvinick's lab by lead author and Princeton postdoctoral researcher Francisco Pereira, the study takes a currently popular approach to neuroscience research in a new direction, Botvinick said. He, Pereira and coauthor Greg Detre, who earned his Ph.D. from Princeton in 2010, based their work on various research endeavors during the past decade that used brain-activity patterns captured by fMRI to reconstruct pictures that participants viewed during the scan.

"This 'generative' approach -- actually synthesizing something, an artifact, from the brain-imaging data -- is what inspired us in our study, but we generated words rather than pictures," Botvinick said.

"The thought is that there are many things that can be expressed with language that are more difficult to capture in a picture. Our study dealt with concrete objects, things that are easy to put into a picture, but even then there was an interesting difference between generating a picture of a chair and generating a list of words that a person associates with 'chair.'"

Those word associations, lead author Pereira explained, can be thought of as "semantic threads" that can lead people to think of objects and concepts far from the original subject matter yet strangely related.

"Someone will start thinking of a chair and their mind wanders to the chair of a corporation then to Chairman Mao -- you'd be surprised," Pereira said. "The brain tends to drift, with multiple processes taking place at the same time. If a person thinks about a table, then a lot of related words will come to mind, too. And we thought that if we want to understand what is in a person's mind when they think about anything concrete, we can follow those words."

Pereira and his co-authors worked from fMRI images of brain activity that a team led by Just and fellow Carnegie Mellon researcher Tom Mitchell, a professor of computer science, published in the journal Science in 2008. For those scans, nine people were presented with the word and picture of five concrete objects from 12 categories. The drawing and word for the 60 total objects were displayed in random order until each had been shown six times. Each time an image and word appeared, participants were asked to visualize the object and its properties for three seconds as the fMRI scanner recorded their brain activity.

**Matching words and brain activity with related topics**

Separately, Pereira and Detre constructed a list of topics with which to categorize the fMRI data. They used a computer program developed by Princeton Associate Professor of Computer Science David Blei to condense 3,500 articles about concrete objects from the online encyclopedia Wikipedia into all the topics the articles covered. The articles included a broad array of subjects, such as an airplane, heroin, birds and manual transmission. The program came up with 40 possible topics -- such as aviation, drugs, animals or machinery -- with which the articles could relate. Each topic was defined by the words most associated with it.

The computer ultimately created a database of topics and associated words that were free from the researchers' biases, Pereira said.

"We let the software discern the factors that make up meaning rather than stipulating it ourselves," he said. "There is always a danger that we could impose our preconceived notions of the meaning words have. Plus, I can identify and describe, for instance, a bird, but I don't think I can list all the characteristics that make a bird a bird. So instead of postulating, we let the computer find semantic threads in an unsupervised manner."

The topic database let the researchers objectively arrange the fMRI images by subject matter, Pereira said. To do so, the team searched the brain scans of related objects for similar activity to determine common brain patterns for an entire subject, Pereira said. The neural response for thinking about "furniture," for example, was determined by the common patterns found in the fMRI images for "table," "chair," "bed," "desk" and "dresser." At the same time, the team established all the words associated with "furniture" by matching each fMRI image with related words from the Wikipedia-based list.

Based on the similar brain activity and related words, Pereira, Botvinick and Detre concluded that the same neural response would appear whenever a person thought of any of the words related to furniture, Pereira said. And a scientist analyzing that brain activity would know that person was thinking of furniture. The same would follow for any topic.

**Using images to predict the words on a person's mind**

Finally, to ensure their method was accurate, the researchers conducted a blind comparison of each of the 60 fMRI images against each of the others. Without knowing the objects the pair of scans pertained to, Pereira and his colleagues estimated the presence of certain topics on a participant's mind based solely on the fMRI data. Knowing the applicable Wikipedia topics for a given brain image, and the keywords for each topic, they could predict the most likely set of words associated with the brain image.

The researchers found that they could confidently determine from an fMRI image the general topic on a participant's mind, but that deciphering specific objects was trickier, Pereira said. For example, they could compare the fMRI scan for "carrot" against that for "cow" and safely say that at the time the participant had thought about vegetables in the first example instead of animals. In turn, they could say that the person most likely thought of other words related to vegetables, as opposed to words related to animals.

On the other hand, when the scan for "carrot" was compared to that for "celery," Pereira and his colleagues knew the participant had thought of vegetables, but they could not identify related words unique to either object.

One aim going forward, Pereira said, is to fine-tune the group's method to be more sensitive to such detail. In addition, he and Botvinick have begun performing fMRI scans on people as they read in an effort to observe the various topics the mind accesses.

"Essentially," Pereira said, "we have found a way to generally identify mental content through the text related to it. We can now expand that capability to even further open the door to describing thoughts that are not amenable to being depicted with pictures."

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**Story Source:**

Materials provided by **Princeton University**. Original written by Morgan Kelly. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Matthew Botvinick, Greg Detre, Francisco Pereira. **Generating Text from Functional Brain Images**. *Frontiers in Human Neuroscience*, 2011; 5 DOI: 10.3389/fnhum.2011.0007

https://blogs.wsj.com/health/2012/04/30/the-bilingual-brain-is-sharper-and-more-focused-study-says/ haberi:

**İki dilli beynin üstünlükleri üzerine yapılan araştırma sonuçlarından söz ediyor**. Ancak ABD'lilerin yüzde 80'i tek dilli, İngilizlerde de oran aşağı yukarı aynı . Avrupa Biriği ortalaması ise yüzde 50 civarında. Sonuçlar göre ABD'ni zihinsel faaliyetlerde Avrupa Birliği'ne göre daha geride olması lazım. Oysa Google, Facebook gibi yaratıcı ürünler ABD'de ortaya çıkıyor. ABD'nin açığı kapatmak için "yaratıcı beyinler" ithal ettiği herkesin malumu tabii.

## The Bilingual Brain Is Sharper and More Focused, Study Says

By Robert Lee Hotz
Apr 30, 2012 5:01 pm ET


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The ability to speak two languages can make bilingual people better able to pay attention than those who can only speak one language, a new study suggests.

Scientists have long suspected that some enhanced mental abilities might be tied to structural differences in brain networks shaped by learning more than one language, just as a musician's brain can be altered by the long hours of practice needed to master an instrument.

Now, in a study published in the Proceedings of the National Academy of Sciences, researchers at Northwestern University for the first time have documented differences in how the bilingual brain processes the sounds of speech, compared with those who speak a single language, in ways that make it better at picking out a spoken syllable, even when it is buried in a babble of voices.

That biological difference in the auditory nervous system appears to also enhance attention and working memory among those who speak more than one language, they say.

"Because you have two languages going on in your head, you become very good at determining what is and is not relevant," says Dr. Nina Kraus, a professor of neurobiology and physiology at Northwestern, who was part of the study team. "You are a mental juggler."

In the new study, Kraus and her colleagues tested the involuntary neural responses to speech sounds by comparing brain signals in 23 high school students who were fluent in English and Spanish to those of 25 teenagers who only spoke English. When it was quiet, both groups could hear the test syllable — "da" — with no trouble, but when there was background noise, the brains of the bilingual students were significantly better at detecting the fundamental frequency of speech sounds.

"We have determined that the nervous system of a bilingual person responds to sound in a way that is distinctive from a person who speaks only one language," Kraus says.

Through this fine-tuning of the nervous system, people who can master more than one language are building a more resilient brain, one more proficient at multitasking, setting priorities, and, perhaps, better able to withstand the ravages of age, a range of recent studies suggest.

Indeed, some preliminary research suggests that people who speak a second language may have enhanced defenses against the onset of dementia and delay Alzheimer's disease by an average of four years, as WSJ reported in 2010.

The ability to speak more than one language also may help protect memory, researchers from the Center for Health Studies in Luxembourg reported at last year.

After studying older people who spoke multiple languages, they concluded that the more languages someone could speak, the better: People who spoke three languages were three times less likely to have cognitive problems compared to bilingual people. Those who spoke four or more languages were five times less likely to develop cognitive problems.

Not so long ago, people worried that children who grew up learning two languages at once were at a developmental disadvantage compared with those who focused on only one.

New research suggests that even babies have little trouble developing bilingual skills.

Researchers at the University of British Columbia's Infant Studies Centre reported that babies being raised in a bilingual family show from birth a preference for each of the native languages they heard while still in the womb and can readily distinguish between them.

Moreover, bilingual infants appear to learn the grammars of their two languages as well as babies learning a single language, even when the two languages are as different from one another as English and Japanese, or English and Punjabi.

http://www.sciencedaily.com/releases/2015/04/150428141919.htm haberi:

# Washington Üniversitesi'nde yapılan son bir çalışmada kelime tanıma zorluğu çeken çocuklarla (disleksili) görsel okuma zorluğu çeken çocukların (disgrafili) beyin yapılarının farklı olduğunu ortaya çıkardı...

## Brain differences seen in children with dyslexia, dysgraphia

Date: April 28, 2015
Source: University of Washington
Summary: Structural brain differences between children with dyslexia and dysgraphia and children who are typical language learners have been observed by researchers in a recent study. Researchers say the findings prove that using a single category of learning disability to qualify for special education services is not scientifically supported.

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University of Washington research shows that using a single category of learning disability to qualify students with written language challenges for special education services is not scientifically supported. Some students only have writing disabilities, but some have both reading and writing disabilities.

The study, published online in *NeuroImage: Clinical*, is among the first to identify structural white matter and functional gray matter differences in the brain between children with dyslexia and dysgraphia, and between those children and typical language learners. The researchers say the findings underscore the need to provide instruction tailored to each of these specific learning disabilities, though that is currently not mandated under federal or state law.

"This shows that there's a brain basis for these different disabilities," said co-author Virginia Berninger, a psychologist who heads the UW Learning Disabilities Center, funded by the National Institute of Child Health and Human Development. "So they require different diagnoses, and different instruction. We've got to start acknowledging this."

The study involved 40 children in grades 4 to 9, including 17 diagnosed with dyslexia -- persisting difficulty with word reading and spelling -- and 14 diagnosed with dysgraphia, persisting difficulty with handwriting, along with nine typical language learners. The children were asked to write the next letter in the alphabet following a letter they were shown, to write the missing letter in a word spelling, to rest without any task, and to plan a text about astronauts.

The children used a fiber-optic pen developed at the UW that allowed researchers to record their writing in real time while their active brain connections were measured with functional magnetic resonance imaging, or fMRI.

The three groups differed from each other in written language and cognitive tasks. The control group had more white matter connections, which facilitate functional connections in gray matter for language processing and cognitive thinking. By contrast, children with dyslexia and dysgraphia showed less white matter connections and more functional connections to gray matter locations -- in other words, their brains had to work harder to accomplish the same tasks.

"Their brains were less efficient for language processing," said lead author Todd Richards, a UW professor of radiology.

The results, Berninger said, show that the two specific learning disabilities are not the same because the white matter connections and patterns and number of gray matter functional connections were not the same in the children with dyslexia and dysgraphia -- on either the writing or cognitive thinking tasks.

Federal law guarantees a free and appropriate public education to children with learning disabilities, but does not require that specific types of learning disabilities are diagnosed, or that schools provide evidence-based instruction for dyslexia or dysgraphia. Consequently, the two conditions are lumped together under a general category for learning disabilities, Berninger said, and many schools do not recognize them or offer specialized instruction for either one.

"There's just this umbrella category of learning disability," said Berninger. "That's like saying if you're sick you qualify to see a doctor, but without specifying what kind of illness you have, can the doctor prescribe appropriate treatment?"

"Many children struggle in school because their specific learning disabilities are not identified and they are not provided appropriate instruction," Berninger said. Recent UW research published in February in Computers & Education shows that computerized instruction has tremendous potential to help time-strapped teachers in regular classrooms provide such instruction for children with dyslexia and dysgraphia, but only if they are correctly diagnosed.

"Dyslexia and dysgraphia are not the only kinds of learning disabilities. One in five students in the United States may have some kind of a specific learning disability," Berninger said. "We just can't afford to put 20 percent of children in special education classes. There just aren't the dollars."

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**Story Source:**

Materials provided by **University of Washington**. Original written by Deborah Bach. *Note: Content may be edited for style and length.*

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**Journal Reference**:

T.L. Richards, T.J. Grabowski, P. Boord, K. Yagle, M. Askren, Z. Mestre, P. Robinson, O. Welker, D. Gulliford, W. Nagy, V. Berninger. **Contrasting brain**

**patterns of writing-related DTI parameters, fMRI connectivity, and DTI–fMRI connectivity correlations in children with and without dysgraphia or dyslexia**. *NeuroImage: Clinical*, 2015; DOI: 10.1016/j.nicl.2015.03.018

http://www.medicalnewstoday.com/releases/239350.php haberi:

## Araştırmacılar, beynin ses ve görüntüyü nasıl birleştirdiğini keşfetti.

## Researchers Discover How The Brain Merges Sights And Sounds

Published Thursday 29 December 2011
Adapted Media Release
11

In order to get a better picture of our surroundings, the brain has to integrate information from different senses, but how does it know which signals to combine? New research involving scientists from the Max Planck Institute for Biological Cybernetics, the Bernstein Center for Computational Neuroscience Tubingen, the University of Oxford, and the University of Bielefeld has demonstrated that humans exploit the correlation between the temporal structures of signals to decide which of them to combine and which to keep segregated. This research is published in *Current Biology*.

Multisensory signals originating from the same distal event are often similar in nature. Think of fireworks on New Year's Eve, an object falling and bouncing on the floor, or the footsteps of a person walking down the street. The temporal structures of such visual and auditory events are always almost overlapping (i.e., they correlate), and we often effortlessly assume an underlying unity between our visual and auditory experiences. In fact, the similarity of temporal structure of multiple unisensory signals, rather than merely their temporal coincidence as it has been previously thought, provides a potentially powerful cue for the brain to determine whether or not multiple sensory signals have a common cause.

Cesare Parise from the Max Planck Institute for Biological Cybernetics in Tübingen and Bernstein Center for Computational Neuroscience Tübingen and his colleagues set out to examine the role of signal correlation in multisensory integration by asking people to localize a stream of beeps and flashes. Participants seated in front of a large screen where sounds (streams of noise bursts) and images (streams blurred blobs) were presented from different spatial locations. On some trials only visual or auditory stimuli were presented, while on other trials visual and auditory stimuli were presented in combination. Critically, on combined audiovisual trials, the temporal structure of the visual and auditory stimuli could either be correlated or not. Participants were required to report the spatial position of such stimuli by moving a cursor controlled by a graphic tablet. In line with previous studies, participants were more precise when the auditory and visual streams were presented together than when they were presented in isolation. Notably, precision was even higher when auditory and visual streams were correlated, and closely approached the theoretical maximum.

These results demonstrate that humans optimally combine multiple sensory signals only when they correlate in time. Previous research has demonstrated that optimal integration only occurs when the brain is sure that the signals have a common underlying cause. These results therefore demonstrate that the brain uses the statistical correlation between the sensory signals to infer whether they have a common physical cause, and hence whether they provide redundant information that should be integrated.

The researchers suggest the brain has evolved this ability to combine potentially related information from different senses so it can effectively pick its way through the noisy environments of everyday life.

"It's why at a noisy cocktail party you can tell who is speaking with which voice," says Parise. "Our eyes and ears are continually taking in sensory information and our brains make sense of it all by merging together sights and sounds with similar temporal structures."

In spite of being a pervasive aspect of sensory processing, little is known about the low-level statistical determinants of multisensory integration for signals with complex dynamic temporal patterns. This research highlights the role of a key organizational principle for multisensory perceptual grouping. What at first glance appears to be a logical fallacy, namely inferring causation from correlation, turns out to be the rule in perception.

https://www.sciencedaily.com/releases/2016/02/160225134827.htm haberi:

## Habere göre beyne yapılan cerrahi müdahale sırasında uygulanan soğutma tekniği hem konuşma merkezlerini koruyor hem de bu merkezler üzerinde işaretleme yapmayı kolaylaştırıyor.

## Cooling technique protects speech during brain surgery

Date: February 25, 2016
Source: NYU Langone Medical Center
Summary: A new cooling technique can both protect the brain's speech centers during surgery and pinpoint the areas separately responsible for word formation and speech timing, report scientists.
Share:
FULL STORY

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A new cooling technique can both protect the brain's speech centers during surgery and pinpoint the areas separately responsible for word formation and speech timing. This is according to a study led by researchers from NYU Langone Medical Center and the University of Iowa published in the journal *Neuron* online Feb. 25.

Patients in the study were put under local anesthesia for an initial part of their brain operations, some of which were to remove tumors. This left the patients awake and able to speak as part of an effort to map brain functions, including the speaking ability, to specific brain areas.

The research team showed that the combination of cooling and verbal checks during the initial mapping phase of the surgery enabled neurosurgeons to avoid speech centers when removing tissue later in the operation.

Also during the mapping phase, researchers were able to run 16 surgical patients through word exercises as the team systematically cooled 42 distinct brain sites, all in regions suggested by past studies to play roles in speech signaling. Once mapping was complete, patients received general anesthesia for the remainder of their operation.

"This study confirms that cooling is a safe and effective means of protecting important brain centers during neurosurgery," says study lead investigator Michael Long, PhD, an assistant professor in the Neuroscience Institute at NYU Langone.

All study patients safely recovered from their operation with no damage to their ability to speak, says Long. Focal cooling is a "vast improvement" over older brain-mapping techniques, he notes, which involved electrical stimulation and came with the risk of triggering epileptic seizures during surgery.

"Our study results also represent a major advance in the understanding of the roles played by the areas of the brain that enable us to form words," says Long. "When we lowered the temperature in specific brain areas during brain surgery and asked people to speak, we saw distinct and complementary roles emerge for specific brain regions."

Building on methods first used to study brain circuits that enable birds to sing, surgeons at the University of Iowa gently placed miniature devices on patients' brains during the operations that cooled areas about the size of a quarter by as much as 10 degrees Celsius in less than a minute. This changed brain function in these spots, slowing and blurring speech as patients recited the days of the week and other simple lists. Differences corresponding to each cooled brain region were clear in recordings and confirmed by statistical analysis. Function returned to normal as each area naturally rewarmed.

Specifically, the researchers found that the speech motor cortex directs movement of the muscles, including those in the lips and tongue, which articulate words during speech. The nearby Broca's area was found to plan the actions of the speech motor cortex, including the speed and timing of muscle movements needed to form syllables.

Long says the team will next use the cooling technique to better understand how various brain regions help to interpret words. His ultimate goal, he says, is to develop therapies for people who have lost speaking ability to injury or disease.

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**Story Source:**

Materials provided by **NYU Langone Medical Center**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

Michael A. Long, Kalman A. Katlowitz, Mario A. Svirsky, Rachel C. Clary, Tara McAllister Byun, Najib Majaj, Hiroyuki Oya, Matthew A. Howard, Jeremy D.W. Greenlee. **Functional Segregation of Cortical Regions Underlying Speech Timing and Articulation**. *Neuron*, 2016; DOI: 10.1016/j.neuron.2016.01.032

https://www.sciencedaily.com/releases/2011/08/110801122956.htm haberi:

## Otistik çocukların konuşurken zamirleri niçin karıştırdıklarına dair deneysel bir çalışmayı içeren bir makale...

Elde edilen bulgulardan hareketle bu durumu düzeltebilecek terapiler geliştirilebilir deniliyor.

## New brain imaging research reveals why autistic individuals confuse pronouns

Date: August 1, 2011
Source: Carnegie Mellon University
Summary: A new brain imaging study provides an explanation as to why autistic individuals' use of the wrong pronoun is more than simply a word choice problem. Researchers found that errors in choosing a self-referring pronoun reflect a disordered neural representation of the self, a function processed by at least two brain areas -- one frontal and one posterior.
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FULL STORY

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Autism is a mysterious developmental disease because it often leaves complex abilities intact while impairing seemingly elementary ones. For example, it is well documented that autistic children often have difficulty correctly using pronouns, sometimes referring to themselves as "you" instead of "I."

A new brain imaging study published in the journal *Brain* by scientists at Carnegie Mellon University provides an explanation as to why autistic individuals' use of the wrong pronoun is more than simply a word choice problem. Marcel Just, Akiki Mizuno and their collaborators at CMU's Center for Cognitive Brain Imaging (CCBI) found that errors in choosing a self-referring pronoun reflect a disordered neural representation of the self, a function processed by at least two brain areas -- one frontal and one posterior.

"The psychology of self -- the thought of one's own identity -- is especially important in social interaction, a facet of behavior that is usually disrupted in autism," said Just, a leading cognitive neuroscientist and the D.O. Hebb Professor of Psychology at CMU who directs the CCBI. "Most children don't need to receive any instruction in which pronoun to use. It just comes naturally, unless a child has autism."

For the study, the research team used functional magnetic resonance imaging (fMRI) to compare the brain activation pattern and the synchronization of activation across brain areas in young adults with high-functioning autism with control participants during a language task that required rapid pronoun comprehension.

The results revealed a significantly diminished synchronization in autism between a frontal area (the right anterior insula) and a posterior area (precuneus) during pronoun use in the autism group. The participants with autism also were slower and less accurate in their behavioral processing of the pronouns. In particular, the synchronization was lower in autistic participants' brains between the right anterior insula and precuneus when answering a question that contained the pronoun "you," querying something about the participant's view.

"Shifting from one pronoun to another, depending on who the speaker is, constitutes a challenge not just for children with autism but also for adults with high-functioning autism, particularly when referring to one's self," Just said. "The functional collaboration of two brain areas may play a critical role for perspective shifting by supporting an attention shift between oneself and others.

"Pronoun reversals also characterize an atypical understanding of the social world in autism. The ability to flexibly shift viewpoints is vital to social communication, so the autistic impairment affects not just language but social communication," Just added.

Autism was documented for the first time in 1943, in a landmark article by Dr. Leo Kanner of Johns Hopkins University. In that first article, Kanner noted the puzzling misuse of pronouns by children with the disorder. "When he [the child] wanted his mother to pull his shoe off, he said: 'Pull off your shoe.'" Kanner added that, "Personal pronouns are repeated [by the child with autism] just as heard, with no change to suit the altered situation." Because his mother referred to him as "you," so did the child.

Just's previous brain imaging research in autism has shown that other facets of thinking that are disrupted in autism, such as social difficulties and language impairments, also may be attributed to a reduced communication bandwidth between the frontal and posterior parts of the brain. He refers to this as the "Theory of Frontal-Posterior Underconnectivity." In each of these types of thinking, the processing is done by a set of different brain regions that includes key frontal regions, and the lower frontal-posterior bandwidth limits how well the frontal regions can contribute to the brain's networked computations.

The brain's communication network is its white matter, the 45 percent of the brain that consists of myelinated (insulated) axons that carry information between brain regions. An emerging view is that the white matter is compromised in autism, specifically in the frontal-posterior tracts. In a groundbreaking study published in 2009, Just and his colleagues showed for the first time that compromised white matter in children with reading difficulties could be repaired with extensive behavioral therapy. Their imaging study showed that the brain locations that had been abnormal prior to the remedial training improved to normal levels after the training, and the reading performance in individual children improved by an amount that corresponded to the amount of white matter change. Ongoing research at the CCBI is assessing the white matter in detail, measuring its integrity and topology, trying to pinpoint the difference in the autistic brain's networks.

"This new understanding of what causes pronoun confusion in autism helps make sense of the larger problems of autism as well as the idiosyncrasies," Just said. "Moreover, it points to new types of therapies that may help rehab the white matter in autism."

In addition to Just and Mizuno, a psychology doctoral candidate and first author of the study, the research team included CMU's Yanni Liu, a postdoctoral associate, and Timothy A. Keller, a senior research psychologist; Duquesne University's Diane L. Williams, an assistant professor of speech-language pathology; and the University of Pittsburgh School of Medicine's Nancy J. Minshew, a professor of psychiatry and neurology.

This research was funded by the National Institute of Child Health and Human Development and the Autism Speaks Foundation.

**Story Source:**

Materials provided by **Carnegie Mellon University**. *Note: Content may be edited for style and length.*

**Journal Reference**:

A. Mizuno, Y. Liu, D. L. Williams, T. A. Keller, N. J. Minshew, M. A. Just. **The neural basis of deictic shifting in linguistic perspective-taking in high-functioning autism**. *Brain*, 2011; DOI: 10.1093/brain/awr151

http://www.bbc.co.uk/news/health-23679363?SThisFB haberi:

## Disleksi çocuğun beyin taramasında görülebilir. Habere göre disleksi için çocuğun okumaya başlamasına bile beklemeye gerek yok.

## Dyslexia 'seen in brain scans' of pre-school children

By Michelle Roberts Health editor, BBC News online

- 14 August 2013

Image caption Scans may reveal early markers of dyslexia, experts hope

Brain scans may allow detection of dyslexia in pre-school children even before they start to read, say researchers.

A US team found tell-tale signs on scans that have already been seen in adults with the condition.

And these brain differences could be a cause rather than a consequence of dyslexia - something unknown until now - the Journal of Neuroscience reports.

Scans could allow early diagnosis and intervention, experts hope.

The part of the brain affected is called the arcuate fasciculus.

We do not know how many of these children will go on to develop problems. But anyway, we want to intervene before thatProf John Gabrieli, Lead researcher

### Shrinkage

Among the 40 school-entry children they studied they found some had shrinkage of this brain region, which processes word sounds and language.

They asked the same children to do several different types of pre-reading tests, such as trying out different sounds in words.

Those children with a smaller arcuate fasciculus had lower scores.

It is too early to say if the structural brain differences found in the study are a marker of dyslexia. The researchers plan to follow up groups of children as they progress through school to determine this.

Lead researcher Prof John Gabrieli said: "We don't know yet how it plays out over time, and that's the big question.

"We do not know how many of these children will go on to develop problems. But anyway, we want to intervene before that, and the younger you do that the better. We already know that reading programmes and interventions can really help."

## Early intervention

In the study, the volume of the left arcuate had a particularly strong link with poorer pre-reading test results.

The left arcuate fasciculus connects an area of the brain involved in speech production with another used to understand written and spoken language.

A larger and more organised arcuate fasciculus could aid in communication between those two regions, the researchers say.

Prof Gabrieli said: "This brain area fits with a lot of what we already know. So it's a good candidate."

A few years ago, US doctors described the case of a child who developed dyslexia after radiation treatment for a brain tumour. The same brain region - the arcuate fasciculus - was involved.

A spokeswoman for the British Dyslexia Association said brain imaging was providing "increasing evidence" of notable differences between the brains of people with and without dyslexia.

"It is particularly exciting to envisage a future where this technology could be part of a cluster of indicators that would identify a risk of dyslexic difficulties," she said.

But she said there needed to be far more research to determine if in the future it might be possible to diagnose dyslexia with a brain scan

http://www.sciencedaily.com/releases/2015/04/150416113248.htm haberi:

## Beyindeki konuşma üretimi ve tanıması üzerine bir yazı...

## Mapping language in the brain

Date: April 16, 2015
Source: Drexel University
Summary: 'By studying language in people with aphasia, we can try to accomplish two goals at once: we can improve our clinical understanding of aphasia and get new insights into how language is organized in the mind and brain,' said the lead author of a new study.
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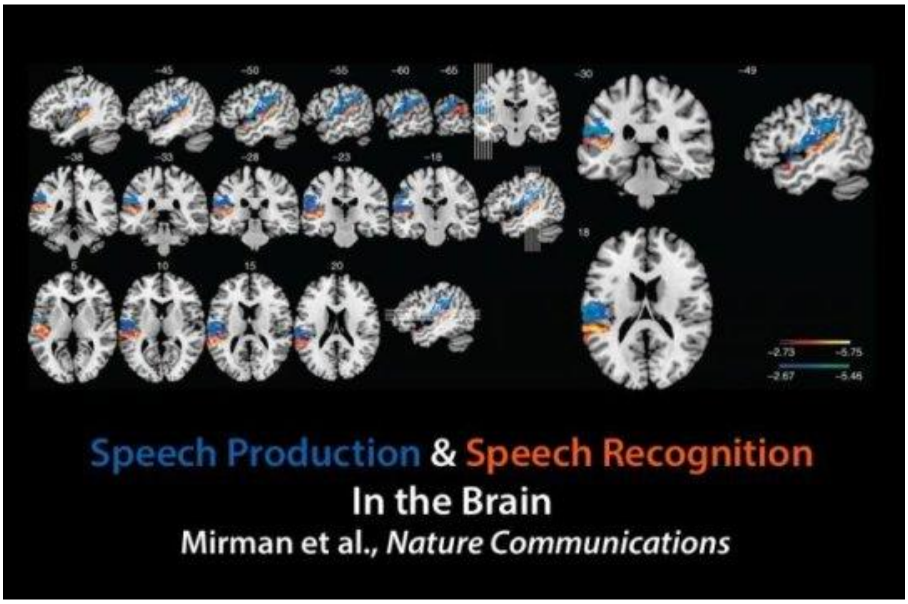


This voxel-lesion symptom map shows supra-threshold voxels for the Speech Production factor (blue-green) and the Speech Recognition factor (red-yellow) with direct total lesion volume control.
*Credit: Mirman et al., Nature Communications*

The exchange of words, speaking and listening in conversation, may seem unremarkable for most people, but communicating with others is a challenge for people who have aphasia, an impairment of language that often happens after stroke or other brain injury. Aphasia affects about 1 in 250 people, making it more common than Parkinson's Disease or cerebral palsy, and can make it difficult to return to work and to maintain social relationships. A new study published in the journal *Nature Communications* provides a detailed brain map of language impairments in aphasia following stroke.

"By studying language in people with aphasia, we can try to accomplish two goals at once: we can improve our clinical understanding of aphasia and get new insights into how language is organized in the mind and brain," said Daniel Mirman, PhD, an assistant professor in Drexel University's College of Arts and Sciences who was lead author of the study.

The study is part of a larger multi-site research project funded by grants from the National Institutes of Health and led by senior author Myrna Schwartz, PhD of the Moss Rehabilitation Research Institute. The researchers examined data from 99 people who had persistent language impairments after a left-hemisphere stroke. In the first part of the study, the researchers collected 17 measures of cognitive and language performance and used a statistical technique to find the common elements that underlie performance on multiple measures.

They found that spoken language impairments vary along four dimensions or factors:

- Semantic Recognition: difficulty recognizing the meaning or relationship of concepts, such as matching related pictures or matching words to associated pictures.
- Speech Recognition: difficulty with fine-grained speech perception, such as telling "ba" and "da" apart or determining whether two words rhyme.
- Speech Production: difficulty planning and executing speech actions, such as repeating real and made-up words or the tendency to make speech errors like saying "girappe" for "giraffe."
- Semantic Errors: making semantic speech errors, such as saying "zebra" instead of "giraffe," regardless of performance on other tasks that involved processing meaning.

**Mapping the Four Factors in the Brain**

Next, the researchers determined how individual performance differences for each of these factors were associated with the locations in the brain damaged by stroke. This procedure created a four-factor lesion-symptom map of hotspots the language-specialized left hemisphere where damage from a stroke tended to cause deficits for each specific type of language impairment. One key area was the left Sylvian fissure: speech production and speech recognition were organized as a kind of two-lane, two-way highway around the Sylvian fissure. Damage above the Sylvian fissure, in the parietal and frontal lobes, tended to cause speech production deficits; damage below the Sylvian fissure, in the temporal lobe, tended to cause speech recognition deficits. These results provide new evidence that the cortex around the Sylvian fissure houses separable neural specializations for speech recognition and production.

Semantic errors were most strongly associated with lesions in the left anterior temporal lobe, a location consistent with previous research findings from these researchers and several other research groups. This finding also made an important comparison point for its opposite factor -- semantic recognition, which many researchers have argued critically depends on the anterior temporal lobes. Instead, Mirman and colleagues found that semantic recognition deficits were associated with damage to an area they call a "white matter bottleneck" -- a region of convergence between multiple tracts of white matter that connect brain regions required for knowing the meanings of words, objects, actions and events.

"Semantic memory almost certainly involves a widely distributed neural system because meaning involves so many different kinds of information," said Mirman. "We think the white matter bottleneck looks important because it is a point of convergence among multiple pathways in the brain, making this area a vulnerable spot where a small amount of damage can have large functional consequences for semantic processing."

In a follow-up article soon to be published in the journal *Neuropsychologia*, Mirman, Schwartz and their colleagues also confirmed these findings with a re-analysis using a new and more sophisticated statistical technique for lesion-symptom mapping.

These studies provide a new perspective on diagnosing different kinds of aphasia, which can have a big impact on how clinicians think about the condition and how they approach developing treatment strategies. The research team at the Moss Rehabilitation Research Institute works closely with its clinical affiliate, the MossRehab Aphasia Center, to develop and test approaches to aphasia rehabilitation that meet the individualized, long-term goals of the patients and are informed by scientific evidence.

According to Schwartz, "A major challenge facing speech-language therapists is the wide diversity of symptoms that one sees in stroke aphasia. With this study, we took a major step towards explaining the symptom diversity in relation to a few primary underlying processes and their mosaic-like representation in the brain. These can serve as targets for new diagnostic assessments and treatment interventions."

Studying the association between patterns of brain injury and cognitive deficits is a classic approach, with roots in 19th century neurology, at the dawn of cognitive neuroscience. Mirman, Schwartz and their colleagues have scaled up this approach, both in terms of the number of participants and the number of performance measures, and combined it with 21st century brain imaging and statistical techniques. A single study may not be able to fully reveal a system as complex as language and brain, but the more we learn, the closer we get to translating basic cognitive neuroscience into effective rehabilitation strategies.

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**Story Source:**

Materials provided by **Drexel University**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Daniel Mirman, Qi Chen, Yongsheng Zhang, Ze Wang, Olufunsho K. Faseyitan, H. Branch Coslett, Myrna F. Schwartz. **Neural organization of spoken language revealed by lesion–symptom mapping**. *Nature Communications*, 2015; 6: 6762 DOI: 10.1038/ncomms7762

https://www.sciencedaily.com/releases/2012/03/120307094653.htm haberi:

## Bilim adamları şimdi, zebra ispinozu olarak adlandırılan bir erkek kuşun beyindeki bir bölgedeki 2.000 genin, kuşun şarkı söylemesiyle önemli ölçüde bağlantılı olduğunu keşfettiler.

Scientists ID 2,000 Genes in Zebra Finch Brain Linked to Singing: May Teach Us About Human Speech Disorders

## Scientists ID 2,000 genes in zebra finch brain linked to singing: May teach us about human speech disorders

Date: March 7, 2012
Source: University of California - Los Angeles
Summary: The song of a small bird is providing valuable insights into human speech and speech disorders. Scientists have now discovered that some 2,000 genes in a brain region of a male bird called the zebra finch are significantly linked to singing. More than 1,500 of these genes in a critical part of the bird's song circuitry are reported for the first time.
Share:
FULL STORY

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Zebra finches.
*Credit: UCLA*

Can the song of a small bird provide valuable insights into human stuttering and speech-related disorders and conditions, including autism and stroke? New research by UCLA life scientists and colleagues provides reason for optimism.

The scientists discovered that some 2,000 genes in a region of the male zebra finch's brain known as "Area X" are significantly linked to singing. More than 1,500 genes in this region, a critical part of the bird's song circuitry, are being reported for the first time. Previously, a group of scientists including the UCLA team had identified some 400 genes in Area X. All the genes' levels of expression change when the bird sings.

"We did not know before that all of these genes are regulated by singing," said Stephanie White, a UCLA associate professor of integrative biology and physiology and senior author of the new study. She believes the 2,000 genes -- at least some of which she believes are also shared by humans -- are likely important for human speech.

The research is published in the online edition of the journal Neuron, a leading neuroscience journal, and will appear in an upcoming print edition.

"A method that (UCLA co-author) Steve Horvath developed lets us see what genes are changing together and, therefore, which genes are linked in a network," White said. "We can see which are the hub genes that are the most connected to other genes, as in a social network -- the popular kids. We can also identify the genetic equivalent of the lonely kids. Steve's analysis lets us group the genes together and see who is interacting with whom."

Many more genes are involved in vocalization than scientists had previously known. While language is uniquely human, it has components -- such as the ability to create new sounds -- that songbirds and other animals share with us. The zebra finch may create new sounds using the same genes as humans, said White, who is also a member of UCLA's Brain Research Institute.

Male zebra finches learn to sing a courtship song between 35 days and 100 days after hatching, at which point they are sexually mature. Area X is located in the male finch's basal ganglia, beneath the brain's cortex. Only males have the full set of circuitry that allows them to mimic sounds. Female zebra finches don't learn the courtship song and don't have a brain region similar to Area X. Humans don't have an Area X either.

"In your brain, I know that the basal ganglia is involved in your speech, but I don't know exactly which cells," White said. "If I knew which cells, I could see what the genes are. We can't do that in humans, but we can in zebra finches -- and we have."

Two genes that seem to be especially important are FoxP2, a "master gene" that directs many other genes to turn on and off and which is critical for both human speech and birdsong, and reelin, a gene that is suspected of causing autism susceptibility in humans. Autistic children often have language difficulties. Both reelin and FoxP2 may play a critical role in human speech and speech disorders.

"No one had ever thought that reelin has a role in vocalization," White said. "We have now found that it is likely important for vocal learning."

A study published in 2001 revealed a single mutation in FoxP2 in each member of a family in England with a severe speech disorder. Over four generations, half the members of this family had the speech and language disorder, and each of these family members had the mutation. Those family members without the disorder didn't have the mutation.

Recent neuroscience research has provided insights into the connection between the brain and our behavior, including the ways in which our behavior can influence gene expression.

"Everybody knows the brain controls our behavior, but in neuroscience, more recently, we have been learning that our behaviors also control our brain and change the way our brain operates," White said. "If you're a professional pianist, for example, you actually expand the territory in your brain that is devoted to playing the piano. When you practice the piano, a suite of genes gets turned on. When you practice hitting a tennis serve or a baseball, a suite of genes gets turned on. Our findings suggest different suites of genes get activated for different behaviors.

"How does behavior change the brain? One way is by changing the expression of genes. A specific behavior can activate many, many genes. How we behave can, over time, actually change genes in our brain and affect how we subsequently behave."

White's laboratory showed in earlier research that when adult male zebra finches sing, there is a dramatic decrease in the amount of FoxP2 in Area X.

In the current study, Julie Miller, a UCLA assistant researcher in integrative biology and physiology who conducts research in White's laboratory, let 27 male zebra finches sing as much as they wanted (18 of them sang) for two hours in the morning -- an activity that reduces FoxP2.

She then removed Area X from the zebra finches' basal ganglia. She also removed the tissue next to Area X, which is still part of the basal ganglia and contains the same genes but is not important for singing; this tissue is involved in movements such as flying and perching.

Miller and Austin Hilliard, a graduate student in UCLA's neuroscience interdepartmental program who also conduct research in White's lab, then studied whether the same genes were changing in Area X and in the other tissue. Genes can be "on" or "off," but there are degrees, like with a light dimmer, White noted.

"You ask, 'Is it the same suite of molecules going up and down when the bird sings as when the bird hops?' The answer is no; they are very different," White said. "We know exactly what neurons are controlling this behavior. We can isolate them."

Overall, the scientists studied 20,000 genes in Area X (to determine which genes are involved in song) and outside of Area X (to learn which genes are involved in flying and perching).

"When we looked across the two parts of the basal ganglia -- Area X, which is important for song, and just outside of Area X, which is important for other behaviors -- we saw surprisingly similar overall levels of gene expression," White said. "There was no significant difference. It was just how those genes are changing relative to one another that was different."

There are approximately 9,000 species of birds, approximately half of which are songbirds. Dolphins, elephants and some bat species also mimic vocalizations, White said.

There are important similarities between the human brain and the songbird's brain.

"I'm very interested in human behavior," White said, "but humans are too complicated to study rigorously at the cellular and synaptic level. To study problems of speech, we need a model that specializes in learned sounds, like the songbird."

In future research, White's laboratory will study the role of reelin in the zebra finch and in mice. She and her colleagues will also continue to study FoxP2. She also plans to study hundreds of genes that move together.

In addition to White, Miller and Hilliard, study co-authors included Elizabeth Fraley, a UCLA graduate student in UCLA's molecular, cellular and integrative physiology interdepartmental program who conducts research in White's laboratory, and Steve Horvath, UCLA professor of human genetics and biostatistics.

The research was federally funded by the National Institutes of Health's National Institute of Mental Health.

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**Story Source:**

Materials provided by **University of California - Los Angeles**. Original written by Stuart Wolpert. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Austin T. Hilliard, Julie E. Miller, Elizabeth R. Fraley, Steve Horvath, Stephanie A. White. **Molecular Microcircuitry Underlies Functional Specification in a Basal Ganglia Circuit Dedicated to Vocal Learning**. *Neuron*, 2012; 73 (3): 537 DOI: 10.1016/j.neuron.2012.01.005

http://www.sciencedaily.com/releases/2015/04/150425215617.htm haberi:

## MRI çekimleri çocukların okuması ve beyin faaliyetleri arasındaki ilişkiyi gösterdi...

## MRI shows association between reading to young children and brain activity

Date: April 25, 2015
Source: American Academy of Pediatrics
Summary: There is evidence that reading to young children is in fact associated with differences in brain activity supporting early reading skills.

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Among the advice new parents receive is to read to their babies early and often. The hope is that sharing books together will help children's language development and eventually, turn them into successful readers.

Now there is evidence that reading to young children is in fact associated with differences in brain activity supporting early reading skills. The research will be presented Saturday, April 25 at the Pediatric Academic Societies (PAS) annual meeting in San Diego.

"We are excited to show, for the first time, that reading exposure during the critical stage of development prior to kindergarten seems to have a meaningful, measurable impact on how a child's brain processes stories and may help predict reading success," said study author John Hutton, MD, National Research Service Award Fellow, Division of General and Community Pediatrics, Reading and Literacy Discovery Center, Cincinnati Children's Hospital Medical Center. "Of particular importance are brain areas supporting mental imagery, helping the child 'see the story' beyond the pictures, affirming the invaluable role of imagination."

Professional organizations such as the American Academy of Pediatrics and advocacy groups have encouraged parents to read to their children from birth to foster early learning and create connections in the brain that promote language development. Direct evidence of effects on the brain, however, were not previously available.

To show whether reading to preschoolers affects brain networks that support reading skills, Dr. Hutton and his colleagues studied 19 healthy preschoolers ages 3-5 years old, 37 percent of whom were from low-income households. Each child's primary caregiver completed a questionnaire designed to measure cognitive stimulation in the home. The questionnaire looked at three areas: parent-child reading, including access to books, frequency of reading and variety of books read; parent-child interaction, including talking and playing; and whether parents taught specific skills such as counting and shapes.

The children then underwent functional magnetic resonance imaging (fMRI), which measured brain activity while they were listening to age-appropriate stories via headphones. The children were awake and non-sedated during fMRI, and there was no visual stimulus. Researchers were interested in whether there would be differences in brain activation supporting comprehension of the stories in areas known to be involved with language.

Results showed that greater home reading exposure was strongly associated with activation of specific brain areas supporting semantic processing (the extraction of meaning from language). These areas are critical for oral language and later for reading.

Brain areas supporting mental imagery showed particularly strong activation, suggesting that visualization plays a key role in narrative comprehension and reading readiness, allowing children to "see" the story. "This becomes increasingly important as children advance from books with pictures to books without them, where they must imagine what is going on in the text," Dr. Hutton said.

The associations between home reading exposure and brain activity remained robust after controlling for household income.

"We hope that this work will guide further research on shared reading and the developing brain to help improve interventions and identify children at risk for difficulties as early as possible, increasing the chances that they will be successful in the wonderful world of books," Dr. Hutton concluded.

Dr. Hutton will present "Parent-Child Reading Increases Activation of Brain Networks Supporting Emergent Literacy in 3-5 Year-Old Children: An fMRI study" on April 25. To view the study abstract, go to http://www.abstracts2view.com/pas/view.php?nu=PAS15L1_1355.8

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**Story Source:**

Materials provided by **American Academy of Pediatrics**. *Note: Content may be edited for style and length.*

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**Cite This Page**:

American Academy of Pediatrics. "MRI shows association between reading to young children and brain activity." ScienceDaily. ScienceDaily, 25 April 2015. <www.sciencedaily.com/releases/2015/04/150425215617.htm>.

https://www.sciencedaily.com/releases/2017/05/170502112607.htm haberi:

## Dil, beynin zamanı algılamasını nasıl biçimlendiriyor?

"İki dilli kişiler dilleri arasında hızla ve çoğunlukla bilinçsizce ileri geri giderler; bu da kod değiştirme olarak adlandırılan bir olgudur.

Fakat farklı diller farklı dünya görüşlerini, çevremizdeki dünyayı organize etmenin farklı yollarını temsil ediyor. Ve zaman açısından bir olgu. Örneğin, İsveççe ve İngilizce konuşanlar, kısa mesafeli, uzun bir düğün vb. Fiziksel mesafelere atıfta bulunarak etkinlik sürelerini işaretlemeyi tercih ederler. Zamanın geçişi, mesafe uzaklığı olarak algılanır.

Ancak, Yunanca ve İspanyolca konuşanlar fiziksel büyüklüklere atıfta bulunarak zamanı işaretleme eğiliminde, örneğin küçük bir mola, büyük bir düğün. Zamanın geçişi büyüyen hacim olarak algılanır."

## Language shapes how the brain perceives time

Date: May 2, 2017
Source: Lancaster University
Summary: Language has such a powerful effect, it can influence the way in which we experience time, according to a new study. Linguists have discovered that people who speak two languages fluently think about time differently depending on the language context in which they are estimating the duration of events.
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FULL STORY

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How does our language affect our perception of time?
*Credit: © spaxiax / Fotolia*

Language has such a powerful effect, it can influence the way in which we experience time, according to a new study.

Professor Panos Athanasopoulos, a linguist from Lancaster University and Professor Emanuel Bylund, a linguist from Stellenbosch University and Stockholm University, have discovered that people who speak two languages fluently think about time differently depending on the language context in which they are estimating the duration of events.

The finding, reported in the '*Journal of Experimental Psychology: General*', published by the American Psychological Association, reports the first evidence of cognitive flexibility in people who speak two languages.

Bilinguals go back and forth between their languages rapidly and, often, unconsciously -- a phenomenon called code-switching.

But different languages also embody different worldviews, different ways of organizing the world around us. And time is a case in point. For example, Swedish and English speakers prefer to mark the duration of events by referring to physical distances, e.g. a short break, a long wedding, etc. The passage of time is perceived as distance travelled.

But Greek and Spanish speakers tend to mark time by referring to physical quantities, e.g. a small break, a big wedding. The passage of time is perceived as growing volume.

The study found that bilinguals seemed to flexibly utilize both ways of marking duration, depending on the language context. This alters how they experience the passage of time.

In the study, Professor Bylund and Professor Athanasopoulos asked Spanish-Swedish bilinguals to estimate how much time had passed while watching either a line growing across a screen or a container being filled.

At the same time, participants were prompted with either the word 'duración' (the Spanish word for duration) or 'tid' (the Swedish word for duration).

**The results were clear-cut**

When watching containers filling up and prompted by the Spanish prompt word, bilinguals based their time estimates of how full the containers were, perceiving time as volume. They were unaffected by the lines growing on screens.

Conversely, when given the Swedish prompt word, bilinguals suddenly switched their behaviour, with their time estimates becoming influenced by the distance the lines had travelled, but not by how much the containers had filled.

"By learning a new language, you suddenly become attuned to perceptual dimensions that you weren't aware of before," says Professor Athanasopoulos. "The fact that bilinguals go between these different ways of estimating time effortlessly and unconsciously fits in with a growing body of evidence demonstrating the ease with which language can creep into our most basic senses, including our emotions, our visual perception, and now it turns out, our sense of time.

"But it also shows that bilinguals are more flexible thinkers, and there is evidence to suggest that mentally going back and forth between different languages on a daily basis confers advantages on the ability to learn and multi-task, and even long term benefits for mental well-being."

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**Story Source:**

Materials provided by **Lancaster University**. *Note: Content may be edited for style and length.*

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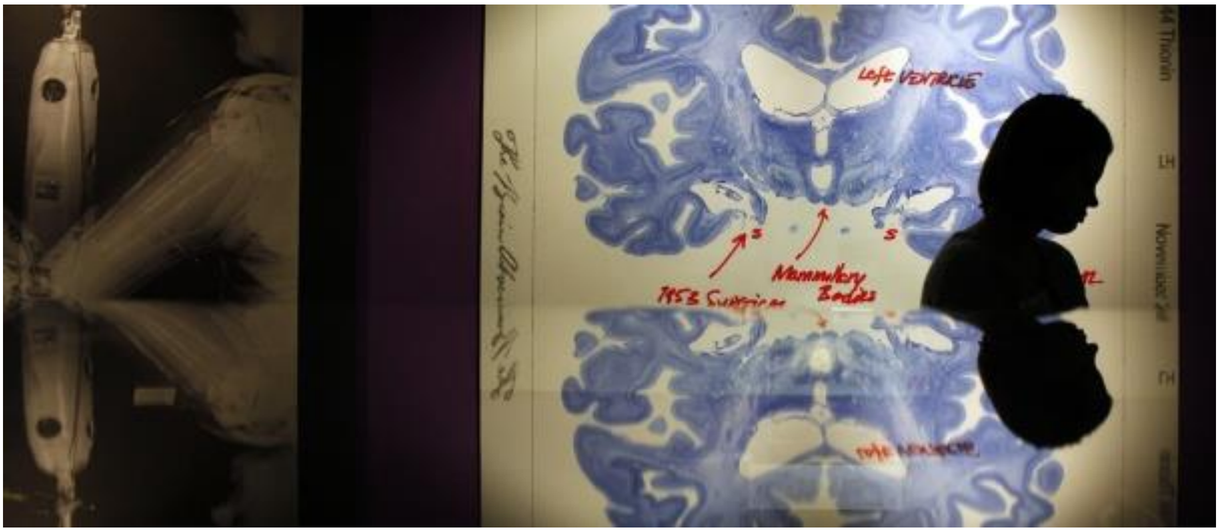
**Journal Reference**:

Emanuel Bylund and Panos Athanasopoulos. **The Whorfian Time Warp: Representing Duration Through the Language Hourglass**. *Journal of Experimental Psychology: General*, 2017 DOI: 10.1037/xge0000314.supp https://www.weforum.org/agenda/2016/02/how-being-bilingual-rewires-your-brain/?utm_content=bufferf1bc7&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer haberi:

## İki dilli olmak beyninizi nasıl değiştirir?

Pınar Yeşil Yıldırım Hanımın paylaşımından

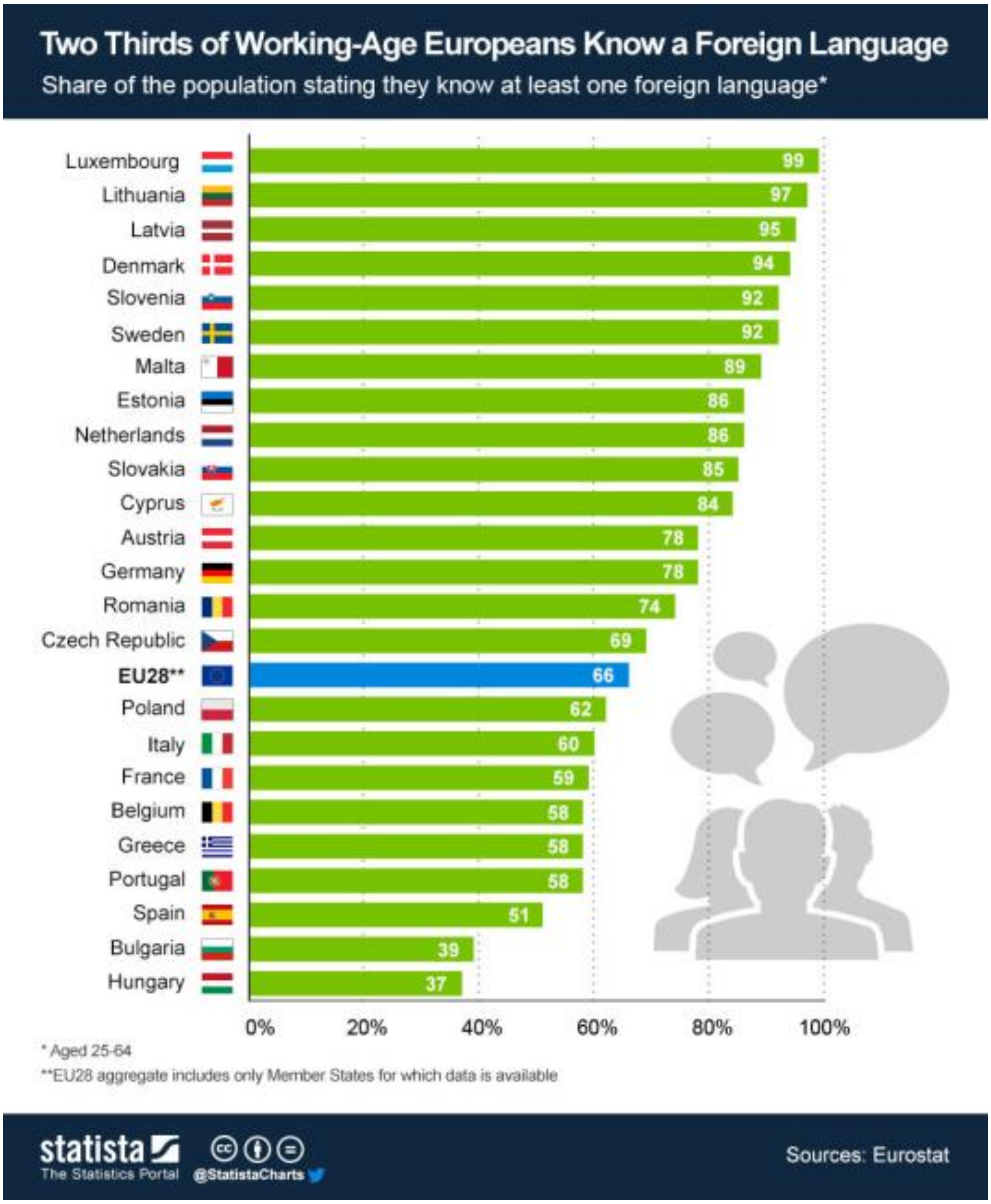
## Being bilingual alters your brain. Here's how



A woman walks past a display of a brain.
Image: REUTERS/Brian Snyder
This article is published in collaboration with Quartz
19 Feb 2016

It's well known that being bilingual has cognitive benefits: switching between two languages has been compared to mental gymnastics. But now, research suggests that mastering two languages can fundamentally alter the structure of your brain, rewiring it to work differently than the brains of those who only speak one language.

"Bilinguals are a really a model of cognitive control," Pennsylvania State University cognitive scientist Judith F. Kroll told Quartz, citing bilinguals' ability to both hold two languages in their head and expertly switch between them at the right times. Kroll presented her work at the American Association for the Advancement of Science meeting held in Washington, DC last weekend (Feb. 13). If you speak two languages and have ever found this task to be difficult—choosing the "right" tongue based on the context you're in—it's because both languages are always "on" in the brains of bilinguals, as Kroll and other cognitive scientists have seen. In other words, the brain is continually processing information in both languages.




The mental struggle of selecting and switching between two languagesactually helps reshape the brain's networks, according to Kroll. One study looked at four-month old, eight-month old, and one-year old infants—60 of whom were bilingual and 60 monolingual—and found that, as they grew older, infants who were exposed to both Spanish and Catalan started looking at speakers' mouths instead of their eyes when listening to someone talk. The monolingual infants, however, only looked at mouths more than eyes when they were listening to someone speak their native tongue.

Kroll told Quartz this study is a great example of how being bilingual can improve speakers' cognitive abilities. "Babies who are listening to two languages [growing up] become attuned to those two languages right away," said Kroll. "It's not confusing them or messing them up developmentally—the opposite is true."

This rewiring doesn't happen the same way in every bilingual brain—it's different for each person, just as each person has their own language experience. But Kroll's research demonstrates that no matter how effortlessly other bilinguals may seem to switch between their two tongues, there's a lot going on under the hood. That should come as a small relief for anyone attempting to pick up a new language.

http://www.sciencedaily.com/releases/2015/02/150209143443.htm haberi:

**Araştırmacılar kekemelerin beynindeki Broca bölgesinin hayatları boyunca anormal gelişitiğini tespit ettiler. Ancak kekemelik ile bu anormallik arasında bir ilişki olup olmadığı noktasında bir veri elde yok. Araştırmada 6 ile 48 yaş arasındaki 116 erkek beyninin MR çekimleri yapılmış.**

## Brain develops abnormally over lifespan of people who stutter

Date: February 9, 2015
Source: University of Alberta
Summary: The largest-ever MRI imaging study of stuttering is the first to examine brain changes across the lifespan.

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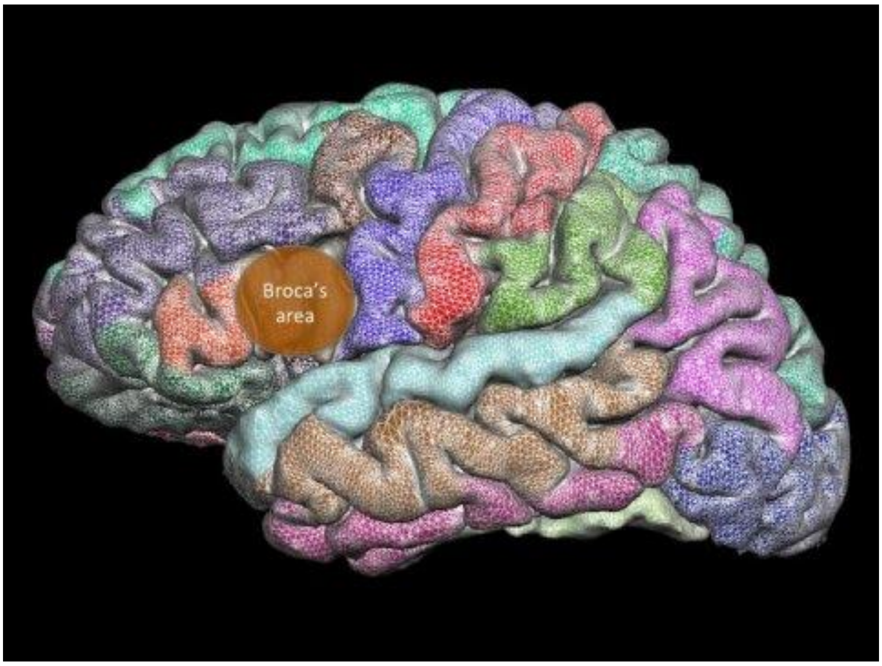


Broca's area, the region of the brain responsible for speech production, develops abnormally in people who stutter.
*Credit: Deryk Beal/University of Alberta*

A region of the brain thought to control speech production develops abnormally in children who stutter--a pattern that persists into adulthood, according to new University of Alberta research.

In the first study to use MRI imaging to examine brain development in both children and adults who stutter, researchers at the U of A's Institute for Stuttering Treatment and Research (ISTAR) found abnormal development of grey matter in Broca's area, the region of the frontal lobe responsible for speech. It was the only abnormality found in the 30 regions of the brain the research team investigated.

"In every other region of the brain we studied, we saw a typical pattern of brain matter development. These findings implicate Broca's area as a crucial region associated with stuttering," said Deryk Beal, ISTAR executive director and an assistant professor in the Faculty of Rehabilitation Medicine.

Beal's team, which included collaborators from the University of Toronto, studied MRI images of the brains of 116 males between the ages of six and 48 years--both the largest group and widest age range for such a study. Roughly half the participants stuttered; the rest served as a control group.

**Brain abnormality persists with age in people who stutter**

The research team observed a steady, and expected, decline in the cortical thickness of grey matter in the control group--a decline not observed in people who stutter. This decline in thickness, Beal explained, is actually a good thing because it reflects how the brain gets more efficient as we age, requiring fewer neural resources.

"One interpretation of this finding could be that this area, in people who stutter, does not operate as efficiently within the brain network for speech production," Beal said.

Though the results confirm that this region of the brain develops abnormally in people who stutter, scientists still cannot say definitively that Broca's region is responsible for stuttering.

"It's like the chicken and the egg," Beal explained. "We don't know if the changes we are seeing in this region of the brain are the result of a reaction in the brain to stuttered speech or some other difference in how the brain is operating elsewhere, or indeed if these changes are the cause of the disorder."

Beal's team previously discovered that children who stutter have less grey matter volume, a finding that was more like a "snapshot" in time showing how kids who stutter differ from those without the speech disorder. This newer research is a "huge improvement," he says, like "having a flipbook of how the brain changes over the lifespan instead of just one image at a specific age."

Beal said the findings support the need for an even larger long-term study of brain development from infancy to adulthood to look at how brain growth in speech areas differs between children who stutter, those who don't, and kids who stutter and later recover.

"That will help us know how the brains of kids who stutter and recover change to help them cure themselves. We can then start to change our treatments so that they impact all kids in this way."

The study was published in the journal *Frontiers in Human Neuroscience* in an early online release, and received funding from the SickKids Foundation, the Canadian Institutes of Health Research and the National Institute on Deafness and Other Communication Disorders.

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**Story Source:**

Materials

provided by **University of Alberta**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Deryk Scott Beal, Jason P. Lerch, Brodie Cameron, Rhaeling Henderson, Vincent L. Gracco and Luc F. De Nil. **The trajectory of gray matter development in Broca's area is abnormal in people who stutter**. *Frontiers in Human Neuroscience*, 2015 DOI: 10.3389/fnhum.2015.00089

http://psychcentral.com/news/2014/04/21/brain-appears-hardwired-for-some-aspects-of-language/68787.html haberi:

**Haberde anılan araştırma sonucu, dil evrensellerinin insan beyninde kodlandığını gösteriyor. Araştırmayla ilgili İngilizce örnekler benzer ama sırası değiştirilmiş ses dizisinin beyin tarafından nasıl ayırt edildiğini anlamaya yönelik: blif, bnif, bdif, lbif...**

Araştırma sonuçları Northeastern Üniversitesi'nden psikolog Dr. Iris Berent ve Harvard Tıp Fakültesi araştırmacıları tarafından PLOS ONE'da yayınlanmış.

"Therefore, the result shows that language universals are encoded in human brains."

## Brain Appears Hardwired for Some Aspects of Language

By Rick Nauert PhD
~ 2 min read


A new study discovers that human brains share common linguistic restrictions on the sound pattern of language.

The understanding that language is hard-wired helps to explain why language is so constrained. For example, people blog, they don't lbog, and they schmooze, not mshooze.

The groundbreaking study is published in *PLOS ONE* by psychologist Dr. Iris Berent of Northeastern University and researchers at Harvard Medical School.

Investigators discovered the brains of individual speakers are sensitive to language universals. Syllables that are frequent across languages are recognized more readily than infrequent syllables.

Experts say that language universals have been the subject of intense research, but their basis had remained elusive. Indeed, the similarities between human languages could result from a host of reasons that are tangential to the language system itself.

Syllables like lbog, for instance, might be rare due to sheer historical forces, or because they are just harder to hear and articulate.

A more interesting possibility, however, is that these facts could stem from the biology of the language system.

Could the unpopularity of lbogs result from universal linguistic principles that are active in every human brain? To address this question, Berent and her colleagues examined the response of human brains to distinct syllable types — either ones that are frequent across languages (e.g., blif, bnif), or infrequent (e.g., bdif, lbif).

In the experiment, participants heard one auditory stimulus at a time (e.g., lbif), and were then asked to determine whether the stimulus includes one syllable or two while their brain was simultaneously imaged.

Results showed the syllables that were infrequent and ill-formed, as determined by their linguistic structure, were harder for people to process.

Remarkably, a similar pattern emerged in participants' brain responses: worse-formed syllables (e.g., lbif) exerted different demands on the brain than syllables that are well-formed (e.g., blif).

The localization of these patterns in the brain further sheds light on their origin.

If the difficulty in processing syllables like lbif were solely due to unfamiliarity, failure in their acoustic processing, and articulation, then such syllables are expected to only exact cost on regions of the brain associated with memory for familiar words, audition, and motor control.

In contrast, if the dislike of lbif reflects its linguistic structure, then the syllable hierarchy is expected to engage traditional language areas in the brain.

While syllables like lbif did, in fact, tax auditory brain areas, they exerted no measurable costs with respect to either articulation or lexical processing.

Instead, it was Broca's area — a primary language center of the brain — that was sensitive to the syllable hierarchy.

These results show for the first time that the brains of individual speakers are sensitive to language universals: the brain responds differently to syllables that are frequent across languages (e.g., bnif) relative to syllables that are infrequent (e.g., lbif).

Researchers say that this was a remarkable finding given that participants (English speakers) had never encountered most of those syllables before.

Therefore, the result shows that language universals are encoded in human brains.

The fact that the brain activity engaged Broca's area — a traditional language area — suggests that this brain response might be due to a linguistic principle.

This result opens up the possibility that human brains share common linguistic restrictions on the sound pattern of language.

This proposal is further supported by a second study that recently appeared in the *Proceedings of the National Academy of Science*, also co-authored by Berent.

This study shows that, like their adult counterparts, newborns are sensitive to the universal syllable hierarchy.

The findings from newborns are particularly striking because they have little to no experience with any such syllable.

Together, these results demonstrate that the sound patterns of human language reflect shared linguistic constraints that are hardwired in the human brain already at birth.

Source: Northeastern University

https://www.sciencedaily.com/releases/2016/05/160510134304.htm haberi :

## Araştırmacılar dinleme durumundaki beyin aktivitesini 5 dakika içinde dinleyerek yetişkin öğrenicinin ikinci dili ne hızda öğrendiğini tahmin edebildiler.

# Brain pattern predicts how fast an adult learns a new language

Date: May 10, 2016
Source: University of Washington
Summary: A five-minute measurement of resting-state brain activity predicted how quickly adults learned a second language, report scientists.

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This is the first to use patterns of resting-state brain rhythms to predict subsequent language learning rate.
*Credit: © aaabbc / Fotolia*

Some adults learn a second language better than others, and their secret may involve the rhythms of activity in their brains.

New findings by scientists at the University of Washington demonstrate that a five-minute measurement of resting-state brain activity predicted how quickly adults learned a second language.

The study, published in the June-July issue of the journal *Brain and Language*, is the first to use patterns of resting-state brain rhythms to predict subsequent language learning rate.

"We've found that a characteristic of a person's brain at rest predicted 60 percent of the variability in their ability to learn a second language in adulthood," said lead author Chantel Prat, a faculty researcher at the Institute for Learning & Brain Sciences and a UW associate professor of psychology.

At the beginning of the experiment, volunteers -- 19 adults aged 18 to 31 years with no previous experience learning French -- sat with their eyes closed for five minutes while wearing a commercially available EEG (electroencephalogram) headset. The headset measured naturally occurring patterns of brain activity.

The participants came to the lab twice a week for eight weeks for 30-minute French lessons delivered through an immersive, virtual reality computer program. The U.S. Office of Naval Research -- who funded the current study -- also funded the development of the language training program.

The program, called Operational Language and Cultural Training System (OLCTS), aims to get military personnel functionally proficient in a foreign language with 20 hours of training. The self-paced program guides users through a series of scenes and stories. A voice-recognition component enables users to check their pronunciation.

Watch a video demonstration of the language software: https://youtu.be/piA6dMkBroQ

To ensure participants were paying attention, the researchers used periodic quizzes that required a minimum score before proceeding to the next lesson. The quizzes also served as a measure for how quickly each participant moved through the curriculum.

At the end of the eight-week language program, participants completed a proficiency test covering however many lessons they had finished. The fastest person learned twice as quickly but just as well as the slower learners.

The recordings from the EEG headsets revealed that patterns of brain activity related to language processes were linked the most strongly to the participants' rate of learning.

So, should people who don't have this biological predisposition not even try to learn a new language? Prat says no, for two reasons.

"First, our results show that 60 percent of the variability in second language learning was related to this brain pattern -- that leaves plenty of opportunity for important variables like motivation to influence learning," Prat said.

Second, Prat said it's possible to change resting-state brain activity using neurofeedback training -- something that she's studying now in her lab. Neurofeedback is a sort of brain training regimen, through which individuals can strengthen the brain activity patterns linked to better cognitive abilities.

"We're looking at properties of brain function that are related to being ready to learn well. Our goal is to use this research in combination with technologies such as neurofeedback training to help everyone perform at their best," she said.

Ultimately, neurofeedback training could help people who want to learn a second language but lack the desirable brain patterns. They'd do brain training exercises first, and then do the language program.

"By studying individual differences in the brain, we're figuring out key constraints on learning and information processing, in hopes of developing ways to improve language learning, and eventually, learning more generally," Prat said.

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**Story Source:**

Materials provided by **University of Washington**. Original written by Molly McElroy. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Chantel S. Prat, Brianna L. Yamasaki, Reina A. Kluender, Andrea Stocco. **Resting-state qEEG predicts rate of second language learning in adults**. *Brain and Language*, 2016; 157-158: 44 DOI: 10.1016/j.bandl.2016.04.007

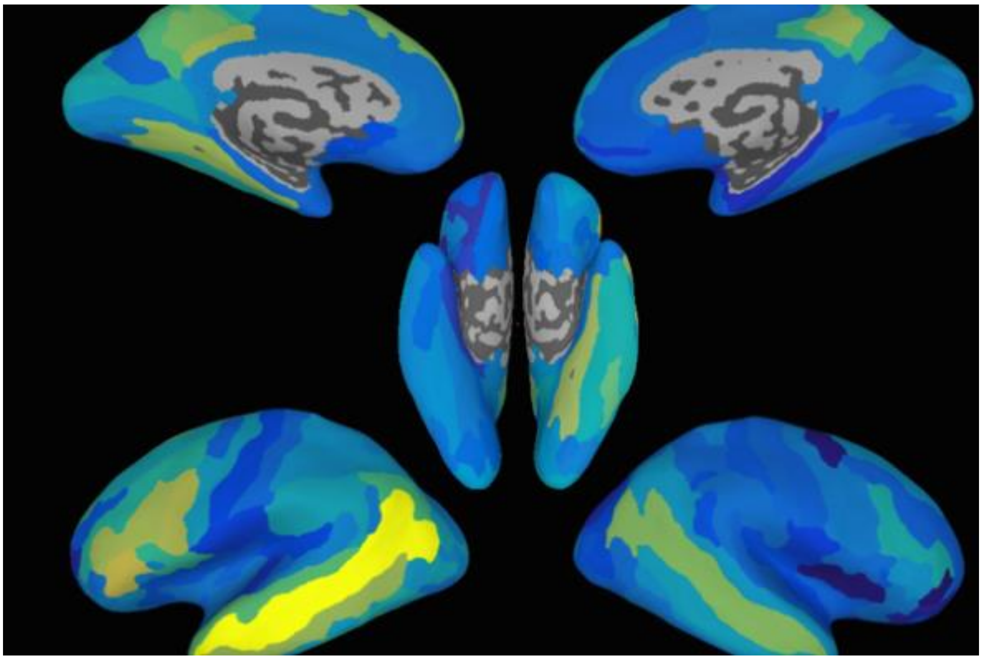
http://blogs.scientificamerican.com/guest-blog/how-the-brain-decodes-sentences/?WT.mc_id=SA_TW_MB_BLOG haberi:

## Beyin cümleleri nasıl kodluyor?

## How the Brain Decodes Sentences

New research advances neuroscientists' understanding of the complexities of language processing

By Rajeev Raizada on September 20, 2016



These brain maps show how accurately it was possible to predict neural activation patterns for new, previously unseen sentences, in different regions of the brain. The brighter the area, the higher the accuracy. The most accurate area, which can be seen as the bright yellow strip, is a region in the left side of the brain known as the Superior Temporal Sulcus. This region achieved statistically significant sentence predictions in 11 out of the 14 people whose brains were scanned. Although that was the most accurate region, several other regions, broadly distributed across the brain, also produced significantly accurate sentence predictions *Credit: University of Rochester graphic / Andrew Anderson and Xixi Wang. Used with permission*

Words, like people, can achieve a lot more when they work together than when they stand on their own. Words working together make sentences, and sentences can express meanings that are unboundedly rich. How the human brain represents the meanings of sentences has been an unsolved problem in neuroscience, but my colleagues and I recently published work in the journal *Cerebral Cortex* that casts some light on the question. Here, my aim is to give a bigger-picture overview of what that work was about, and what it told us that we did not know before.

To measure people's brain activation, we used fMRI (functional Magnetic Resonance Imaging). When fMRI studies were first carried out, in the early 1990s, they mostly just asked which parts of the brain "light up," i.e. which brain areas are active when people perform a given task.

However, in the last decade or so, a different approach has been rapidly gaining in popularity and influence: instead of just asking which areas light up, neuroscientists try to do what is known as "neural decoding": we observe a pattern of brain activation, and then try to figure out what gave rise to it. As an analogy, consider walking through a forest and seeing an animal footprint in the mud. By looking at the pattern in the mud, i.e. the shape of the footprint, we might be able to figure out which animal made it. But in order to do that, we first need to learn what the footprints of different animals tend to look like, and, harder still, learn how to decode these footprints even when the mud is smudged or the imprint is faint.

Neural decoding is very similar. Instead of deducing which animal gave rise to a pattern in the mud, which draws on what one might know about the footprints of familiar animals, we instead decode what stimuli (words and sentences, in this case) might have given rise to a given brain pattern, based on the patterns we've seen in the past from known words and sentences.

The new aspect of our study was that neural decoding had not previously been achieved at the level of entire sentences. To give a rough idea of why sentence-level decoding is difficult, let us return to the animal footprint analogy. Suppose the person inside the MRI scanner were just reading a single word at a time. This would be like seeing just one footprint in the mud, and trying to figure out which animal it came from. In contrast, when the person in the scanner is reading an entire sentence, brain activation patterns from several words are present at the same time. Decoding that is like if several different species of animal all ran over the same piece of wet mud together, and then our task was to try to identify as many of those animals as possible from the compound mass of tracks.

However, our study also went beyond that. We built a computer model that didn't only learn the "neural footprints" of specific words. The model also used information about different sensory, emotional, social and other aspects of the words, so that it could learn to predict brain patterns for new words, and also for new sentences made out of recombinations of the words. Extending our animal footprint metaphor, this would be as if we were trained to recognize the footprints of a deer and of a cow, and then we get confronted for the first time with a footprint that we have never seen before, e.g. that of a moose. If we have a model that tells us that a moose is a bit like a cow-sized deer, then that model can predict that a moose footprint will be a bit like a cow-footprint-sized deer-print. That prediction isn't exactly right, but it isn't far off either. It's good enough to do a lot better than a random guess.

Along similar lines, our computer model could predict the brain patterns for a new sentence that it had not been trained on, as long as it had been trained on enough of the words in that sentence in different contexts. For example, our model could predict the brain pattern for "The family played at the beach," using the patterns that it had been trained on for other sentences sharing some of the same words, such as "The young girl played soccer" and "The beach was empty."

This process of using a computer model to extract information from brain data is, in many ways, the same as other types of technology that are becoming woven into our everyday lives. Computer models which extract meaningful information from large patterns of data are developed in the field of research known as "machine learning", also often referred to as "data science." When you point your phone camera at someone and it draws a box around their face, the phone is taking in lots of data—millions of pixels—and extracting the meaningful information of where the face is.

Voice-recognition software such as Siri takes in lots of data about rapidly changing air vibrations (speech sounds) and extracts words from them. Neural decoding takes in brain data in the form of three-dimensional pixels that depict brain activation on fMRI scans, (called "voxels") and extracts information from them. In our study, that information consisted of the meanings of words and sentences, which people were reading while their brains were being scanned.

To decode information about sets of words, we needed an interdisciplinary team of people. The study was led by Andy Anderson, a postdoctoral research fellow in my lab. Andy has expertise that spans all the required domains: computational models of the meanings of words, machine learning, and brain imaging. Another key member of the team was Dr. Jeffrey Binder of the Medical College of Wisconsin a neurologist and world-renowned investigator of how the brain represents meaning.

But the full team was much larger than that: our paper has nine authors, all of whom played different and crucial roles, and the authors span six different nationalities, from both industry and academia. Our funding came in part from two different government agencies (the Intelligence Advanced Research Projects Activity and the National Science Foundation). Scientific advances these days often get made by large collaborative teams, made up of people from many different countries of origin.

Decoding sentences from the brain may well be intriguing, but why does it matter? There are two answers to this question. One answer is that the human brain literally makes us who we are, and language is one of the most fundamental aspects of human cognition.

Beyond the intrinsic scientific interest, such work may also one day have practical applications. Our study extracts meaning from people's brains, and there are many people with traumatic brain injuries who have meaning in trapped in their heads that they are unable to express themselves verbally, e.g. patients with damage to a brain region called Broca's area .

Our study also used computer models to represent meaning. Existing computer models work much better than they did just a few years ago, as can be seen from the success of systems such as Siri and Google Translate. But these existing models also have many imperfections, as can also been seen from those same computer systems, which all too often produce garbled output. By far the best representer of meaning in the world is the human brain. In seeking to understand how the brain achieves that, we might be able to make our computer models of meaning work better.

These practical pay-offs won't come tomorrow, or even next year. The question of how the brain represents meaning is extremely difficult, and our new paper, although an advance, leaves many problems still unaddressed. To tackle difficult problems, science needs to work with a long time horizon. Just as the words in a sentence work together to build a richer meaning, many individual scientific studies jointly help us better to understand our world.

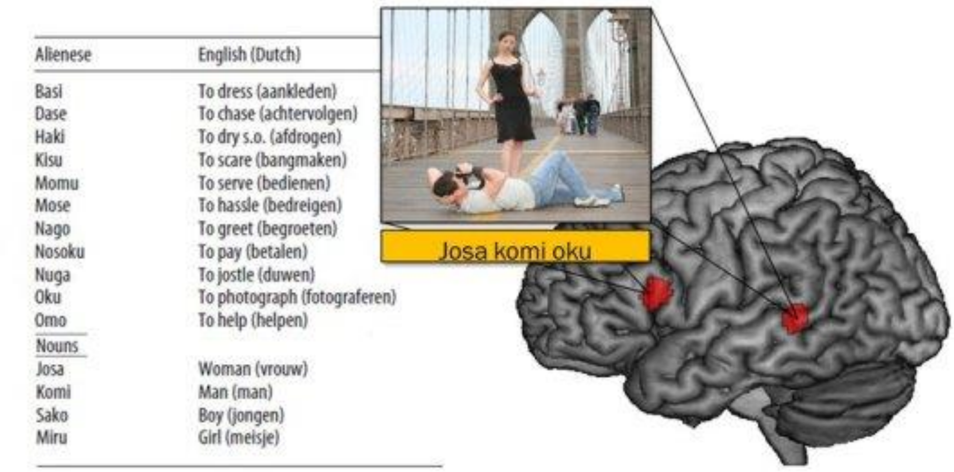
https://www.sciencedaily.com/releases/2016/06/160629125943.htm haberi:

# Dil öğrenirken beynimizde neler oluyor sorusuna cevap niteliği taşıyan bir araştırma...

Araştırmaya göre öğrencinin hem doğal dili hem de yeni öğrendiği dil için aynı beyin bölgesini kullandığı belirlenmiş.

## Watching the brain during language learning

Language scientist observe how new grammar integrates in the brain
Date: June 29, 2016
Source: Max Planck Institute for Psycholinguistics
Summary: For the first time, researchers have captured images of the brain during the initial hours and days of learning a new language. They use an artificial language with real structures to show how new linguistic information is integrated into the same brain areas used for your native language.




In a new study from researchers at the Donders Institute and Max Planck Institute for Psycholinguistics, these skills were observed through brain imaging as native speakers of Dutch learned an artificial miniature language 'Alienese'.
*Credit: Image courtesy of Max Planck Institute for Psycholinguistics*

Learning a new language is a difficult task. It requires skills for memorizing new words, learning how to put those words together in a grammatical way, and integrating them with existing linguistic knowledge. In a new study from researchers at the Donders Institute and Max Planck Institute for Psycholinguistics, these skills were observed through brain imaging as native speakers of Dutch learned an artificial miniature language 'Alienese'.

**Reuse grammatical characteristics**

The major discovery was that the brain cares whether or not the grammatical properties of the new language (in this case, word order) resemble the grammatical properties of your native language. If they are similar, your brain uses its own grammar in learning the new language. And if the word order of the new language differs from your mother tongue, your brain needs to build a new grammatical repertoire. For the first time, researchers have shown that it helps the brain if it can reuse characteristics of our mother tongue when learning a new language.

**Josa komi oku**

Alienese consisted of a set of words like josa 'woman', komi 'man', and oku 'to photograph'. These words could be combined in a particular order, which either did or did not conform for Dutch word order. For instance, both sentences Komi oku josa (man photograph woman) and Josa komi oku (woman man photograph) have the meaning "The man photographs the woman." The former sentence conforms to Dutch word order (and English), but the latter does not. Participants read sentences with familiar and unfamiliar word orders accompanied by pictures depicting the meaning (see image).

**Language brain network**

When the unfamiliar word orders (josa komi oku) were repeated, brain activation increased within regions of the brain network known to be involved for your native language. Lead author of the study Kirsten Weber proposes, "The enhanced activity might reflect a brain mechanism to build and strengthen a neural network to process novel word order regularities." When the familiar word order (komi oku josa) was repeated, brain activation decreased in language-related regions. "That we found suppressed activation on the other hand, supports our ideas that a known structure in a novel language quickly behaves like a structure in your native language. Processing a known structure is easier for the brain second time round. As a whole, our study shows that we seem to use the same brain areas for native and new language structures and that Alienese was in the process of being integrated into the participants existing language brain networks."

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**Story Source:**

Materials provided by **Max Planck Institute for Psycholinguistics**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Kirsten Weber, Morten H. Christiansen, Karl Magnus Petersson, Peter Indefrey, and Peter Hagoort. **fMRI Syntactic and Lexical Repetition Effects Reveal the Initial Stages of Learning a New Language**. *Journal of Neuroscience*, June 2016 DOI: 10.1523/JNEUROSCI.3180-15.2016

http://www.latimes.com/science/sciencenow/la-sci-sn-pentagon-neural-prosthetic-memory-20140709-story.html haberi:

**Habere göre travma sonrası bellek sorunu yaşayan askerlerin belleklerini onarmaya yardımcı olacak bir beyin implantı geliştirilmiş. Dolaylı olarak bunun dil ve bellek ilişkisi bağlamında sonuçları oalacaktır diye düşünüyoruz.**

## Pentagon spurs new work on a brain implant to aid memory problems

July 9, 2014


This drawing depicts an implantable neural device that could record and stimulate neurons within the brain to help restore memory. The Defense Advanced Research Projects Agency is funding development of the device. (Lawrence Livermore National Laboratory)
Alan Zarembo and Melissa HealyContact Reporters
Fixing broken memories with an implanted electronic device?

It sounds like science fiction: A device that can be surgically installed in the brain to help form, store and recall memories.

But the Pentagon is betting tens of millions of dollars that so-called neuroprosthetics will someday be used by victims of traumatic brain injuries and other conditions to overcome memory problems.

Its first beneficiaries may be wounded warriors. But if the effort succeeds, healthy people too may one day clamor for implantable brain gear that can turbocharge human cognition.

The Defense Advanced Research Projects Agency announced this week that it has contracted with UCLA and the University of Pennsylvania to lead a four-year effort to develop such a device. Teams of scientists from the two institutions will be aided by neural technology experts at Lawrence Livermore National Lab, and by a pair of giants in the design and manufacture of brain-stimulating devices, Medtronic Inc. and Neuropace Inc.

“This is just not cocktail party talk,” Geoffrey Ling, director of DARPA’s biological technologies office, said in a conference call with reporters. “We have so much hope that this new program is going to do wonderful things to restore our injured service members,” he said.

Vanessa Tolosa, an engineer at Lawrence Livermore National Laboratory, holds a silicon wafer containing implantable neural devices. The military hopes such devices could someday help people form, store and recall memories. (Lawrence Livermore National Laboratory)

The research program, known as Restoring Active Memory, will focus on declarative memory — the ability to record and recall times, places and other facts necessary for daily living. Although the program is driven by the need to help service members who suffered traumatic brain injuries — often the result of roadside bombs used in the recent wars — the first human test subjects will be people with memory difficulties caused by epilepsy.

The Restoring Active Memory initiative extends the efforts of a burgeoning field that is exploring the potential of "brain-machine interfaces" to compensate for injury, illness or disability — and one day, perhaps, to enhance human performance. Just as cochlear implants bypass faulty auditory nerves to allow hearing in the deaf, new technologies and better understanding of the central nervous system are allowing scientists to test devices that reroute motor commands around severed spinal cords and cause muscles in the legs and arms to move.


But building an actual memory aid for the forgetful will be an even more daunting task, said Satinderpall Pannu, project leader at Lawrence Livermore Labs. "The first challenge is understanding how memory really works," he said — a process scientists are just beginning to nail down.

For that, researchers at UCLA and University of Pennsylvania will rely on an army of healthy volunteers willing to perform memory tasks while their brains are imaged and recorded. And they will turn to a group of patients who already have some experience with neural implants.

Electronic devices are already implanted in the brains of tens of thousands of people with Parkinson’s disease and epilepsy. For those with Parkinson's, deep brain stimulator devices are implanted in regions of the brain that control movement, to tame such symptoms as tremors, stiffness, slowed speech and walking problems. A much smaller population of patients with seizure disorders that don't respond to medications have devices implanted in a wide range of brain regions to monitor seizure activity and short-circuit the electrical storms that disrupt their functioning.

A UCLA research team led by Dr. Itzkah Fried, a neurosurgeon, will collect data from epilepsy patients that use such devices with the aim of developing a model of memory formation that could be used to test a wireless memory device.

All of those subjects will help investigators map the widespread pattern of neural activity and pinpoint the exact clusters of brain cells that fire — or misfire — when we make, store and retrieve memories.

"We don't have the Rosetta Stone for the memory system," said Michael J. Kahana, director of University of Pennsylvania's computational memory lab and a lead investigator on the project. "The DARPA project is trying to dramatically accelerate that effort to decipher that Rosetta Stone. We're poised to do it. With this multisite effort, we might just be able to pull it off."

The information gleaned will in turn guide the design of devices much more advanced than brain stimulators now in use. Starting as early as 2017, the Pentagon initiative aims to build and test in humans at least two devices. They would sense and interpret signaling in the brain associated with normal, healthy memory formation, then use that information to bridge gaps in the neural circuitry to restore or improve memory formation and recall.

The UCLA team will focus on a part of the brain known as the entorhinal area, an important gateway to the hippocampus, where memories are formed and stored. Fried's research has shown that stimulating the entorhinal area enhances memory.

UCLA will receive up to $15 million over the next four years, with funding dependent on progress.

The University of Pennsylvania team is to receive $22.5 million over the next four years. There, scientists from a wide range of disciplines are exploring the contributions that other parts of the brain contribute to memory, including the frontal, temporal and parietal cortices.

"Memory depends on the interplay between activity in widespread brain areas," where memories take on context and meaning, and are embellished with sensory and emotional dimensions, Kahana said. "Memory is about weaving together all those myriad experiences and tagging them with geotags and time tags so that you can find them again when you want them."

**Follow @LATMelissaHealy for more news about cutting-edge brain research and @AlanZarembo for stories about the military and health.**

http://www.sfgate.com/health/article/UCSF-study-shows-how-the-brain-sorts-sound-to-5190015.php haberi:

## Dilin seslerini ortamdaki diğer seslerden ayırarak onlara ayrı bir anlam yüklemek insan beyninin anlaşılması gereken özelliklerinden...Bu araştırma, perdeyi biraz daha aralamış görünüyor...

"California Üniversitesi-San Francisco'da yapılan bir araştırma beynin dili oluşturmak için sesleri nasıl sıraladığını (türlerine ayırdığını) gösterdi."

## UCSF study shows how the brain sorts sound to make language

New research reveals complex process of turning meaningless sounds into meaningful words

By Erin Allday

Updated 12:24 am, Friday, January 31, 2014

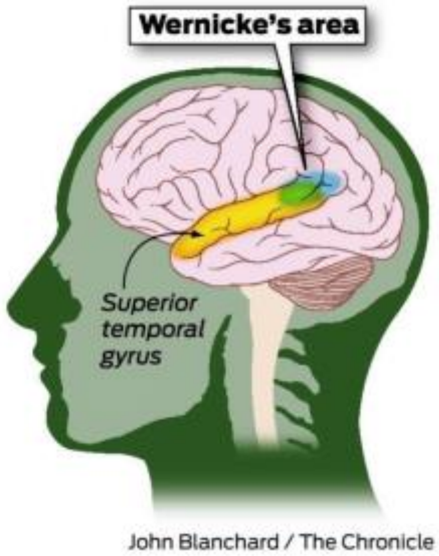
Scientists at UCSF have uncovered some tantalizing clues into the complex process of how the brain hears and interprets human voices, and transforms an influx of meaningless sounds into language.

Their work, which was published online Thursday, involved studying the brains of patients with epilepsy undergoing testing to help stop their seizures.

Neuroscientists have known for more than a century that one small part of the brain - called Wernicke's area, located in a region called the superior temporal gyrus - plays a critical role in how humans process language. But it's been difficult to develop a deeper, more detailed understanding of that process, partly because scientists lacked the tools to study in real time how the brain responds to split-second sounds.

The UCSF team, which also included linguists from UC Berkeley, found that when patients listened to random sentences read out loud, their brains quickly and with great precision sorted the sounds based on very clear criteria.

The brain, it seems, immediately filters language sounds into broad groupings, with small neighborhoods of neurons activating at certain sounds. The scientists were able to build brain maps of these sound neighborhoods, showing that the same neurons "lit up" each time patients heard, for example, a specific type of vowel or consonant.




"When we hear sounds or language, our brain is actually organizing this information through very particular filters - neurons that are detecting certain sounds," said Dr. Edward Chang, a UCSF neurosurgeon and lead scientist of the brain research. "The cool thing about it is you see this real clear heterogeneity in how those neurons correspond to speech. There's definitely an organization to it."

### Sorting it all out

The work offers new insight into "functional organization," or how the brain collects, sorts and analyzes the massive amounts of data it's constantly flooded with. With language in particular, humans are bombarded by sounds and the brain must instantaneously sort out what's meaningful from what's not, and then collect and process the important data into familiar words and sentences.

All of that work is done in seconds, and for the most part without any conscious effort on the listener's part.

The UCSF study suggests what may be the first step in that complex process. The research is a "beautiful example" of the kind of discoveries scientists can make by taking electrical recordings directly from the brain, said Dr. Josef Parvizi, a Stanford neurologist who has done similar work on patients with epilepsy.

### 'Remarkable' findings

"Of course there have been tons of studies in the past, but the tools were not sophisticated and not precise," Parvizi said. "With this type of direct recording from the human brain, what Eddie (Chang)'s group is finding is remarkable."

The study involved six patients with epilepsy who were already scheduled to undergo a procedure at UCSF to treat their seizures. The procedure involves removing a piece of the skull and applying electrodes to the surface of the brain.

## Seizure activity

The electrodes measure seizure activity and help surgeons identify which parts of the brain are involved in seizures. After several days of collecting measurements, surgeons then remove the part of the brain affected by seizures, assuming it's not critical to survival or quality of life.

Over the past five or so years, scientists have been using patients undergoing these procedures to study other brain activity. Since the patients are already exposing their brains for therapeutic purposes, and since they're going to be stuck in a hospital for several days with not much to do, they make rare but ideal subjects for real-time studies of the brain.

## The study

In Chang's study, the patients listened to 500 English phrases recorded by 400 different speakers. While they listened, doctors recorded the electrical activity in their brains and mapped when and where neurons fired.

The scientists found that sounds were organized based on how they're formed in the mouth. So, for example, sounds like "S" and "Z" that linguists call "fricatives" - formed by partially obstructing the airway and creating friction in the vocal tract - were grouped together. Also grouped were sounds called "plosives" - including the consonants "P" and "B" - that involve using the lips or tongue to block air before releasing it all at once.

Chang said he and other neuroscientists he worked with were surprised by the results. Intuition would suggest, he said, that the brain sorts sounds similar to how people read - so, perhaps, the consonant sound "B" would have its own spot in the brain, and so would the vowel sound "ah."

## Affirms assumptions

But linguists have suspected for decades that the broader groupings - the fricatives, plosives and other descriptors known as "phonetic features" - were at the foundation of language comprehension. The new work is among the first to offer physiological evidence of an old linguistic assumption, said UC Berkeley linguist Keith Johnson, who worked with Chang on the language research.

## 'How learning occurs'

"We've had this notion that the brain must be organized this way, because language seems to pattern this way when we look at how it changes over time," Johnson said. "So the finding that the brain is organized around (phonetic) features like that is significant. It's firming up theories about how language is organized in the brain."

Chang said their work could someday help doctors and linguists better understand language disorders and problems like dyslexia, and may even help people improve their ability to learn a second language.

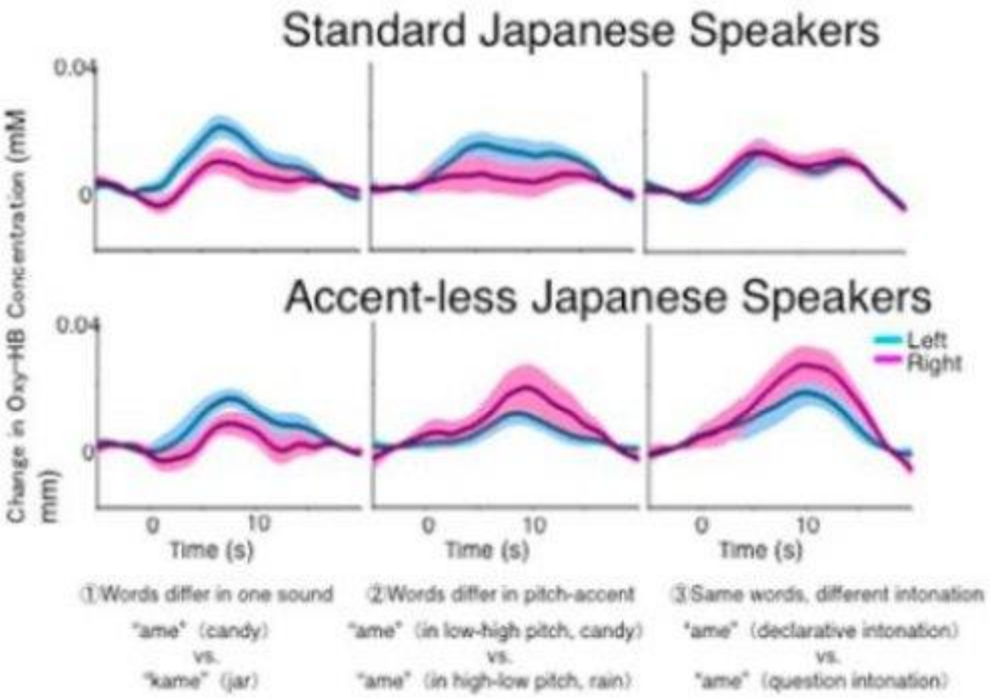
"Our hope is that with this more complete knowledge of the building blocks and fundamental aspects of language, we can meaningfully think about how learning occurs," Chang said. "We can maybe even explain why some of this goes awry."

https://www.sciencedaily.com/releases/2013/10/131018132054.htm haberi:

## Öğrendiğimiz ağızlar konuşma dilini işleyen beyin bölgesini biçimlendiriyor.

## Learning dialects shapes brain areas that process spoken language

Date: October 18, 2013
Source: RIKEN
Summary: Using advanced imaging to visualize brain areas used for understanding language in native Japanese speakers, a new study finds that the pitch-accent in words pronounced in standard Japanese activates different brain hemispheres depending on whether the listener speaks standard Japanese or one of the regional dialects.




This is a graph showing brain activity in the right and left hemispheres measured as changes in blood oxygen concentration using Near Infrared Spectroscopy. Middle panels a show brain responses to words that differ in pitch-accent "ame" (candy in low-high pitch) vs. "a'me"(rain, in high-low pitch) Standard Japanese speakers showed higher activation in the left hemisphere (blue line) whereas the difference in accent-less Japanese speakers did not show a statistically significant left-dominant activation.
*Credit: RIKEN*

Using advanced imaging to visualize brain areas used for understanding language in native Japanese speakers, a new study from the RIKEN Brain Science Institute finds that the pitch-accent in words pronounced in standard Japanese activates different brain hemispheres depending on whether the listener speaks standard Japanese or one of the regional dialects.

In the study published in the Journal Brain and Language, Drs. Yutaka Sato, Reiko Mazuka and their colleagues examined if speakers of a non-standard dialect used the same brain areas while listening to spoken words as native speakers of the standard dialect or as someone who acquired a second language later in life.

When we hear language our brain dissects the sounds to extract meaning. However, two people who speak the same language may have trouble understanding each other due to regional accents, such as Australian and American English. In some languages, such as Japanese, these regional differences are more pronounced than an accent and are called dialects.

Unlike different languages that may have major differences in grammar and vocabulary, the dialects of a language usually differ at the level of sounds and pronunciation. In Japan, in addition to the standard Japanese dialect, which uses a pitch-accent to distinguish identical words with different meanings, there are other regional dialects that do not.

Similar to the way that a stress in an English word can change its meaning, such as "pro'duce" and "produ'ce," identical words in the standard Japanese language have different meanings depending on the pitch-accent. The syllables of a word can have either a high or a low pitch and the combination of pitch-accents for a particular word imparts it with different meanings.

The experimental task was designed to test the participants' responses when they distinguish three types of word pairs: (1) words such as /ame'/ (candy) versus /kame/ (jar) that differ in one sound, (2) words such as /ame'/ (candy) versus /a'me/ (rain) that differ in their pitch accent, and (3) words such as 'ame' (candy in declarative intonation) and /ame?/ (candy in a question intonation).

RIKEN neuroscientists used Near Infrared Spectroscopy (NIRS) to examine whether the two brain hemispheres are activated differently in response to pitch changes embedded in a pair of words in standard and accent-less dialect speakers. This non-invasive way to visualize brain activity is based on the fact that when a brain area is active, blood supply increases locally in that area and this increase can be detected with an infrared laser.

It is known that pitch changes activate both hemispheres, whereas word meaning is preferentially associated with the left-hemisphere. When the participants heard the word pair that differed in pitch-accent, /ame'/ (candy) vs /a'me/ (rain), the left hemisphere was predominantly activated in standard dialect speakers, whereas in accent-less dialect speakers did not show the left-dominant activation. Thus, standard Japanese speakers use the pitch-accent to understand the word meaning. However, accent-less dialect speakers process pitch changes similar to individuals who learn a second language later in life.

The results are surprising because both groups are native Japanese speakers who are familiar with the standard dialect. "Our study reveals that an individual's language experience at a young age can shape the way languages are processed in the brain," comments Dr. Sato. "Sufficient exposure to a language at a young age may change the processing of a second language so that it is the same as that of the native language."

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**Story Source:**

Materials

provided by **RIKEN**. *Note: Content may be edited for style and length.*

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**Journal Reference**:

1. Yutaka Sato, Akira Utsugi, Naoto Yamane, Masatoshi Koizumi, Reiko Mazuka. **Dialectal differences in hemispheric specialization for Japanese lexical pitch accent**. *Brain and Language*, 2013; DOI: 10.1016/j.bandl.2013.09.008