Istirahatte kendiliğinden devreye giren nöronal ağlar

GİRİŞ:
Gıyabi ağların keşfi, tanımı, fizyolojisi, sağlıklı erişkinlerden örnekler

METODOLOJİ:
Teknik açıdan gıyabi ağların saptanması, tutarlılık örnekleri

İŞLEVSEL BAĞLILIKLAR:
Grafiksel temsil, fonksiyonel konnektivite hesapları

SAĞLIKLI POPULASYON SONUÇLARINA ÖRNEKLER:
Çocukluk, Yaşlanma

HASTA POPULASYON SONUÇLARINA ÖRNEKLER:
Yapısal bozukluk (Alzheimer), Psikiyatrik bozukluk (Depresyon)

İLERİ DÜZEY METODLAR:
Diğer modalitelerle birleşim: DTI

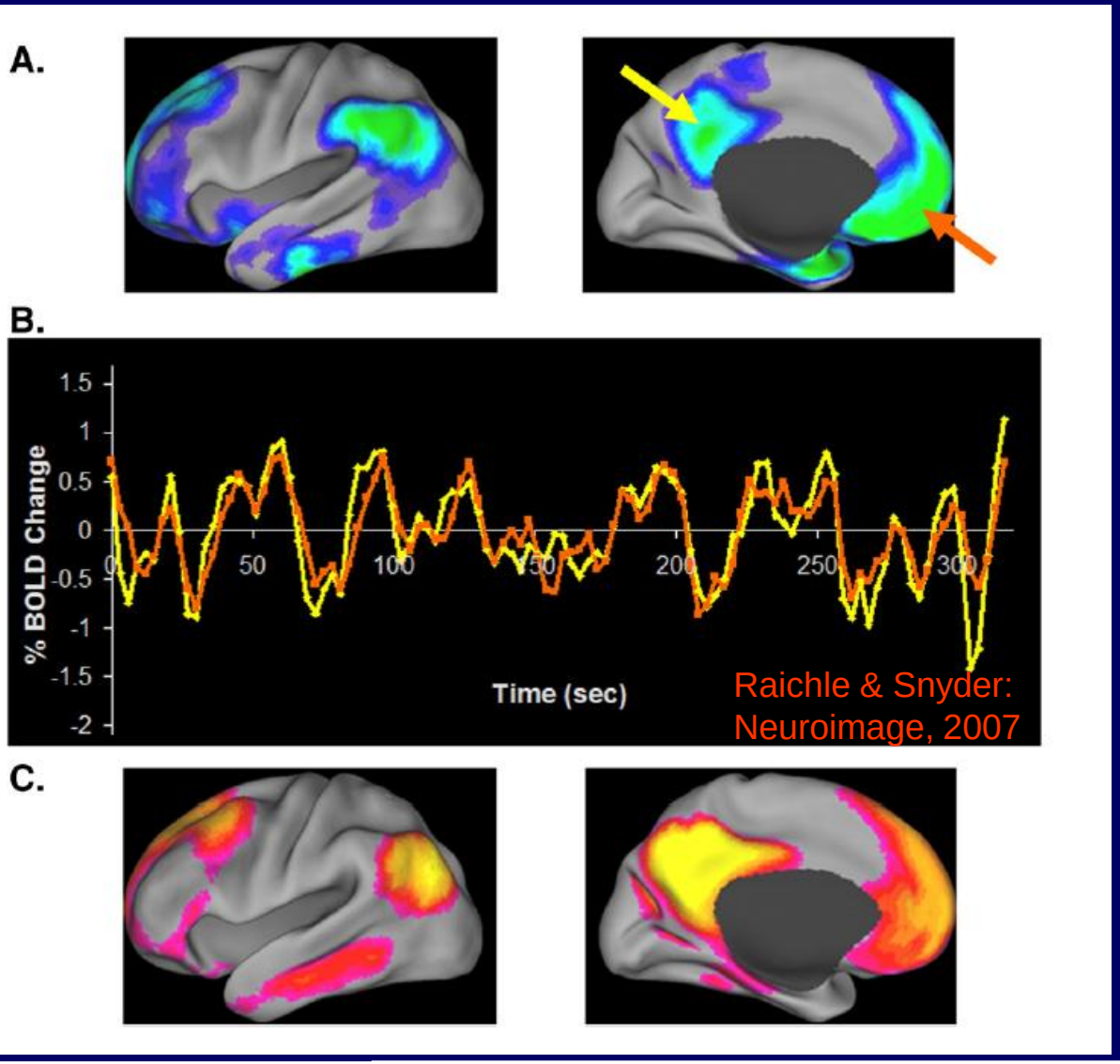
GİRİŞ

Gıyabi ağların keşfi

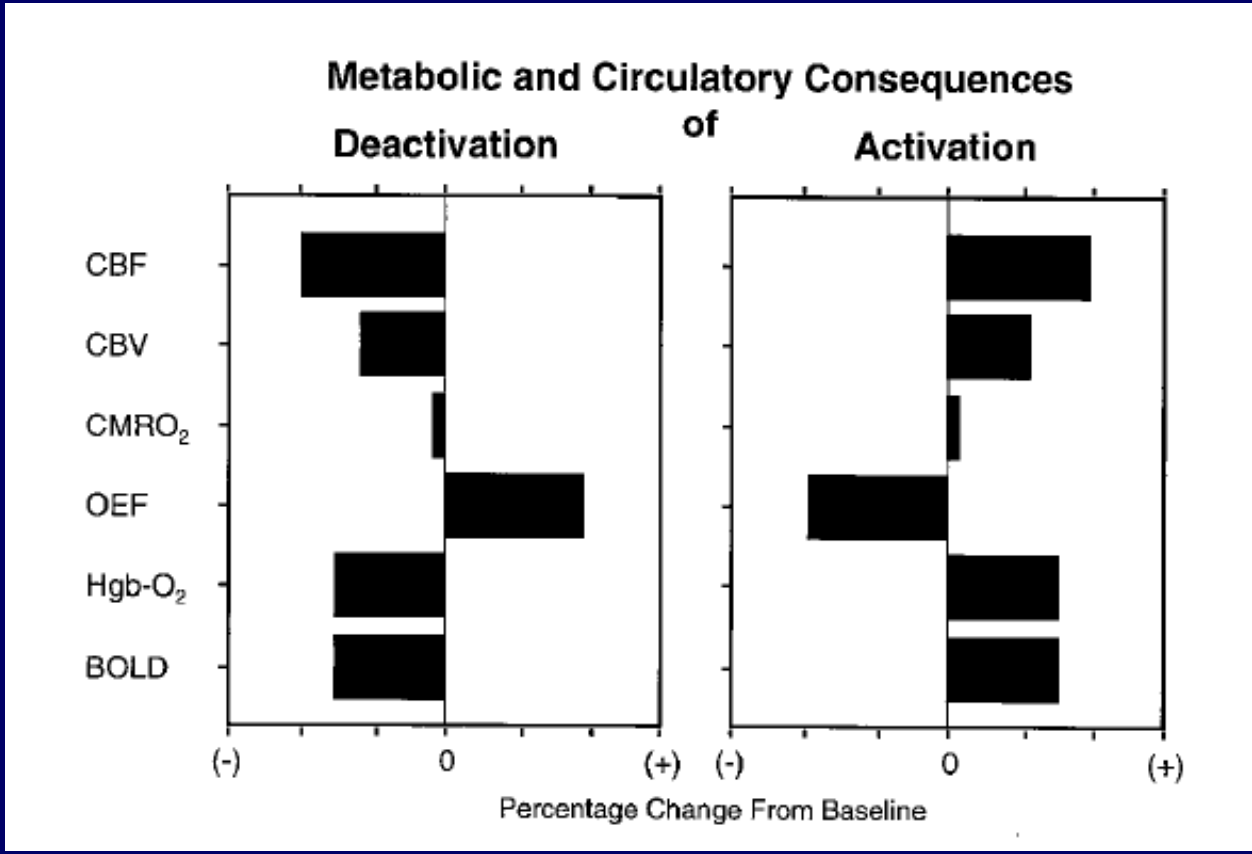
Beynimizdeki bazı bölgeler, istirahat anında, hedefe yönelik davranış durumuna göre daha aktiftir.

Daha da ilginç olan, herhangi bir task verildiğinde, bu bölgelerin aktivitesinin azalmasıdır.

Raichle et.al:
PNAS, 2001



Gıyabi ağlarda istirahat halinin fizyolojisi



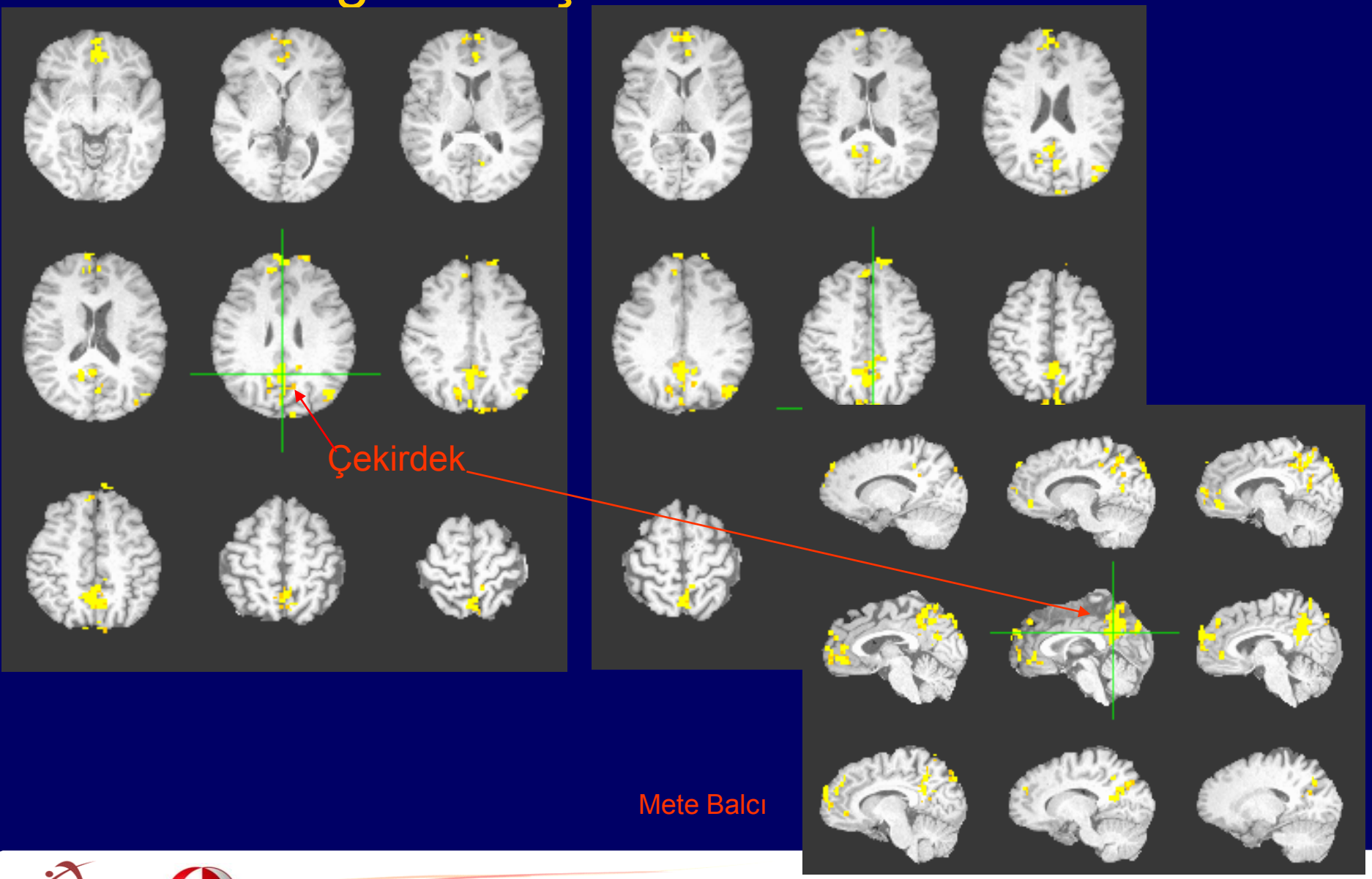
Raichle et.al.:
PNAS, 2001

Beynimiz vücut ağırlığının % 2'si kadar olmasına rağmen tedarik edilen oksijenin % 20'si beyin tarafından harcanır.

Task ile ilgili olan aktivite, %5'lik bir oksijen artışına neden olur.

Çıkarım: Beynin metabolizması, task ile ilgili olmayan durumlar için zaten fazlasıyla yüksektir.

Sağlıklı erişkinlerden örnekler



Sağlıklı erişkinler: bilinç düzeyine ilişkin örnekler

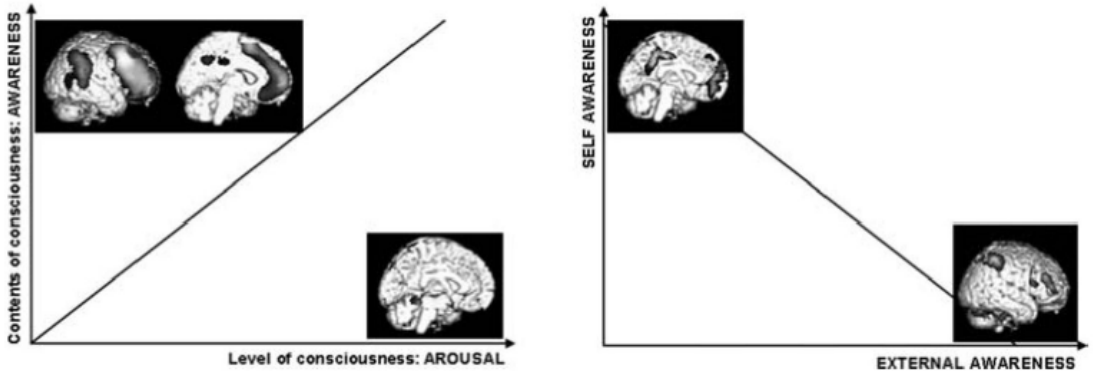


FIGURE 2.
(*Left*) Consciousness has two main components: arousal, or the level of consciousness, and awareness, corresponding to the contents of consciousness per se. Arousal and awareness are usually positively correlated. However, they involve different brain structures. Arousal involves the activity of subcortical structures encompassing brain-stem reticular formation, hypothalamus, and basal forebrain. Awareness is related to the activity of a widespread set of frontoparietal associative areas, both on the convexity and on the midline. (*Right*) Awareness can in turn be divided into two main components: self and external awareness. In healthy volunteers, self- and external awareness are usually negatively correlated. Similarly, the frontoparietal awareness network can in turn be divided into two sub-systems, involved in self- and external awareness. Self-awareness networks encompass the posterior cingulate/precuneal cortices, medial frontal cortex, and bilateral temporoparietal junctions. The external awareness network encompasses lateral frontal and parietal cortices. In healthy volunteers, self- and external awareness networks usually show an anticorrelated pattern of activity.

Boly et.al.:
Ann. N.Y. Sci: 2008

Sağlıklı erişkinler: bilinç düzeyine ilişkin örnekler

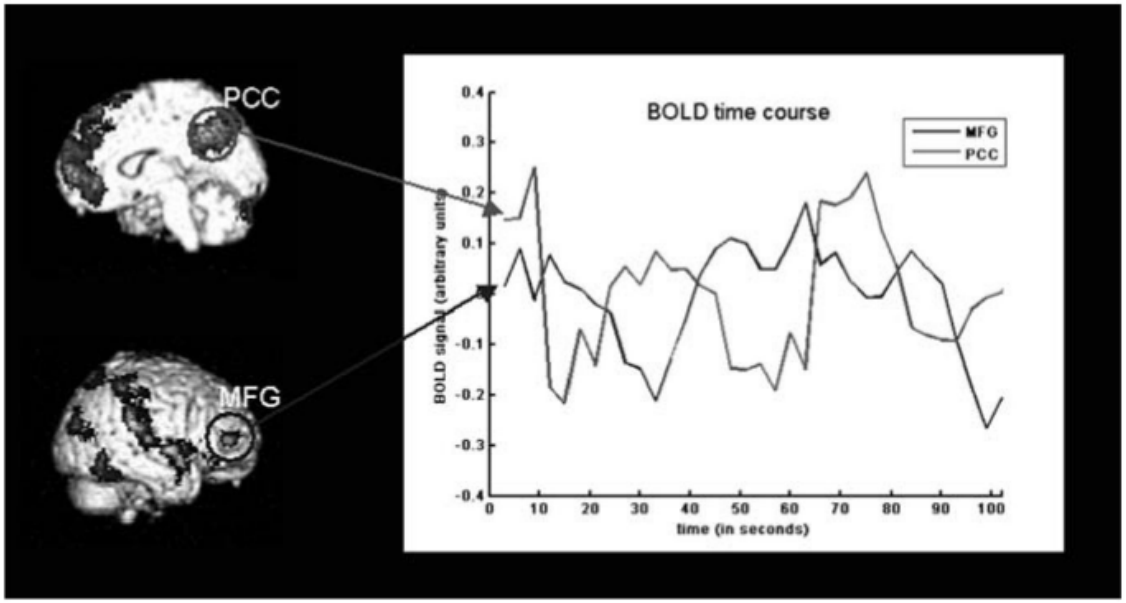


FIGURE 3.
Spontaneous anticorrelations between self- and external awareness networks in the conscious resting state, as observed in an individual volunteer. (*Left*) Areas correlated (*above*) and anticorrelated (*below*) with the blood oxygen level–dependent (BOLD) time course of a seed voxel located in the posterior cingulate/precuneus. (*Right*) Plot of the BOLD time courses of posterior cingulate/precuneus (PCC, red/gray line) and of middle frontal gyrus (MFG, blue/dark line) in the same volunteer. As previously reported, anticorrelations between these area time courses occur in slow frequencies with a period below 0.1 Hz. (In color in *Annals* online.)

Boly et.al.:
Ann. N.Y. Sci: 2008

Sağlıklı erişkinler: bilinç düzeyine ilişkin örnekler

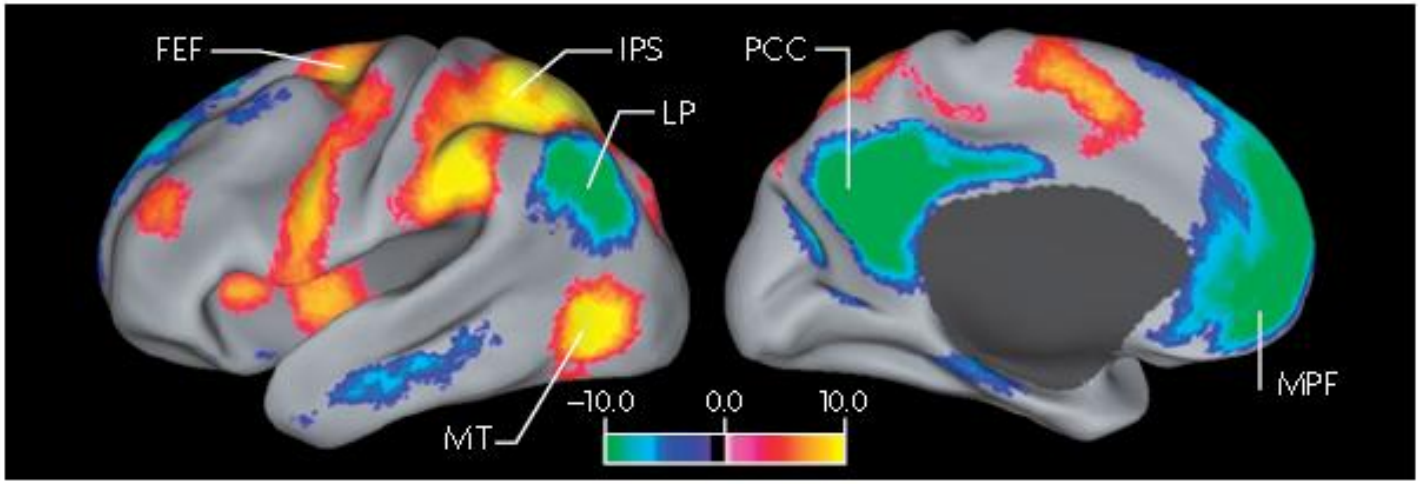
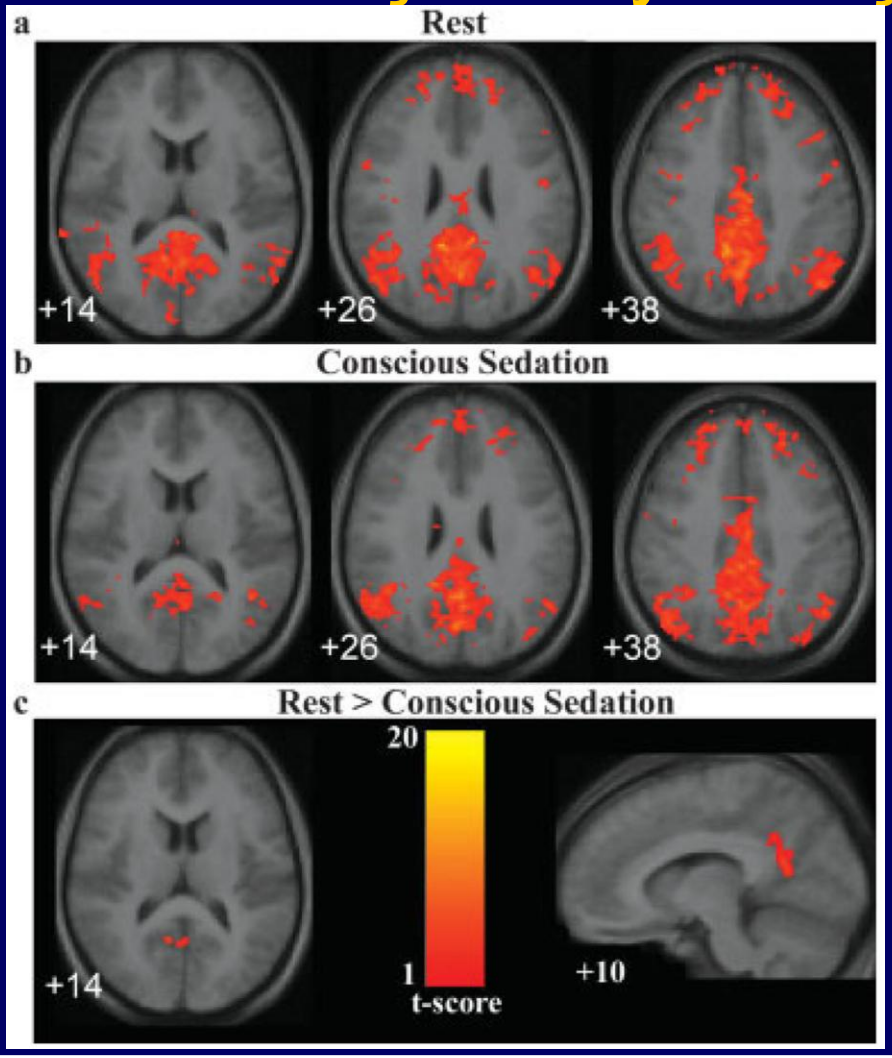
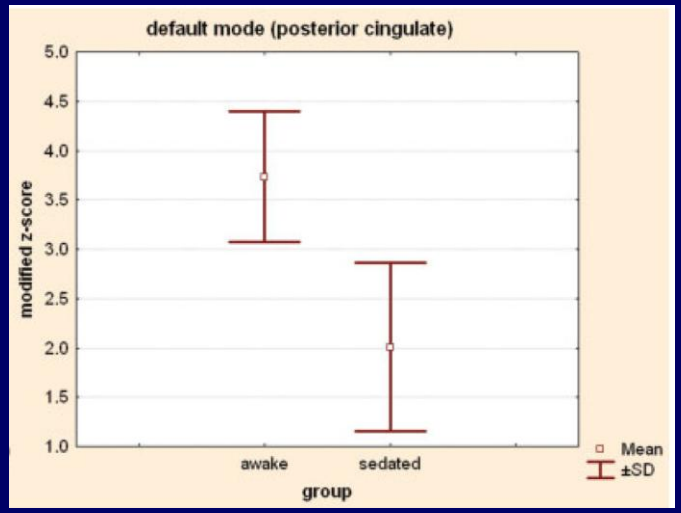


Figure 3 | **Intrinsically defined anticorrelated networks in the human brain.** Positive nodes, shown in warm colours, are significantly correlated with seed regions involved in focused attention and working memory (task-positive seeds) and significantly anticorrelated with seed regions that are routinely de-activated during attention-demanding cognitive tasks (task-negative seeds). Negative nodes, shown in cool colours, are significantly correlated with task-negative seeds and significantly anticorrelated with task-positive seeds. The task-positive seeds are the intra-parietal sulcus (IPS), frontal eye field (FEF) and middle temporal (MT) area . The task-negative seeds are the posterior cingulate/precuneus (PCC), lateral parietal cortex (LP) and medial prefrontal cortex

Fox & Raichle:
Nat revs neurosci: 2007

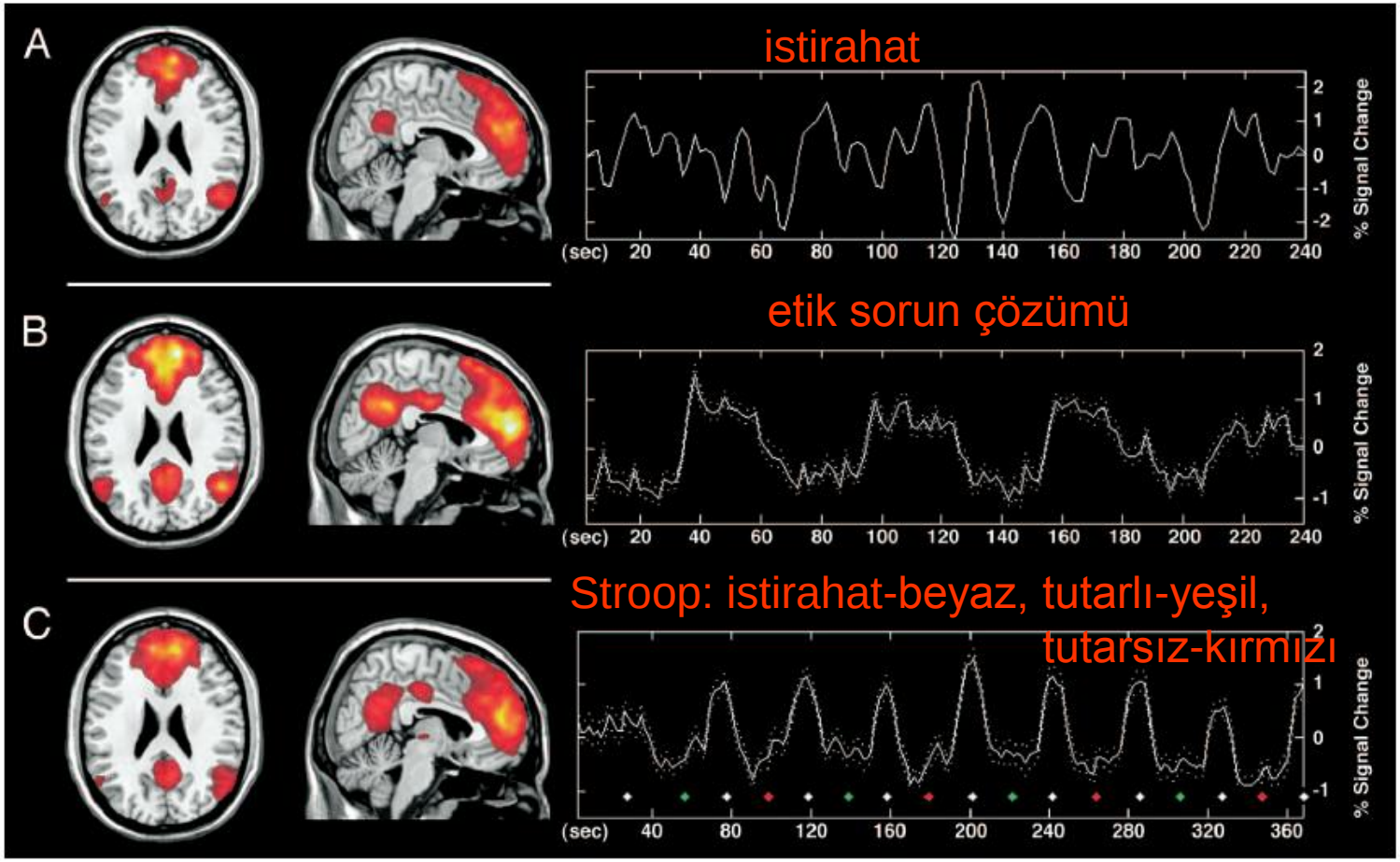
Sağlıklı erişkinler: bilinç düzeyine ilişkin örnekler





Greicius et.al.:
Hum Brain Map.: 200

Sağlıklı erişkinlerden örnekler



Frekans dağılımı: 1/f

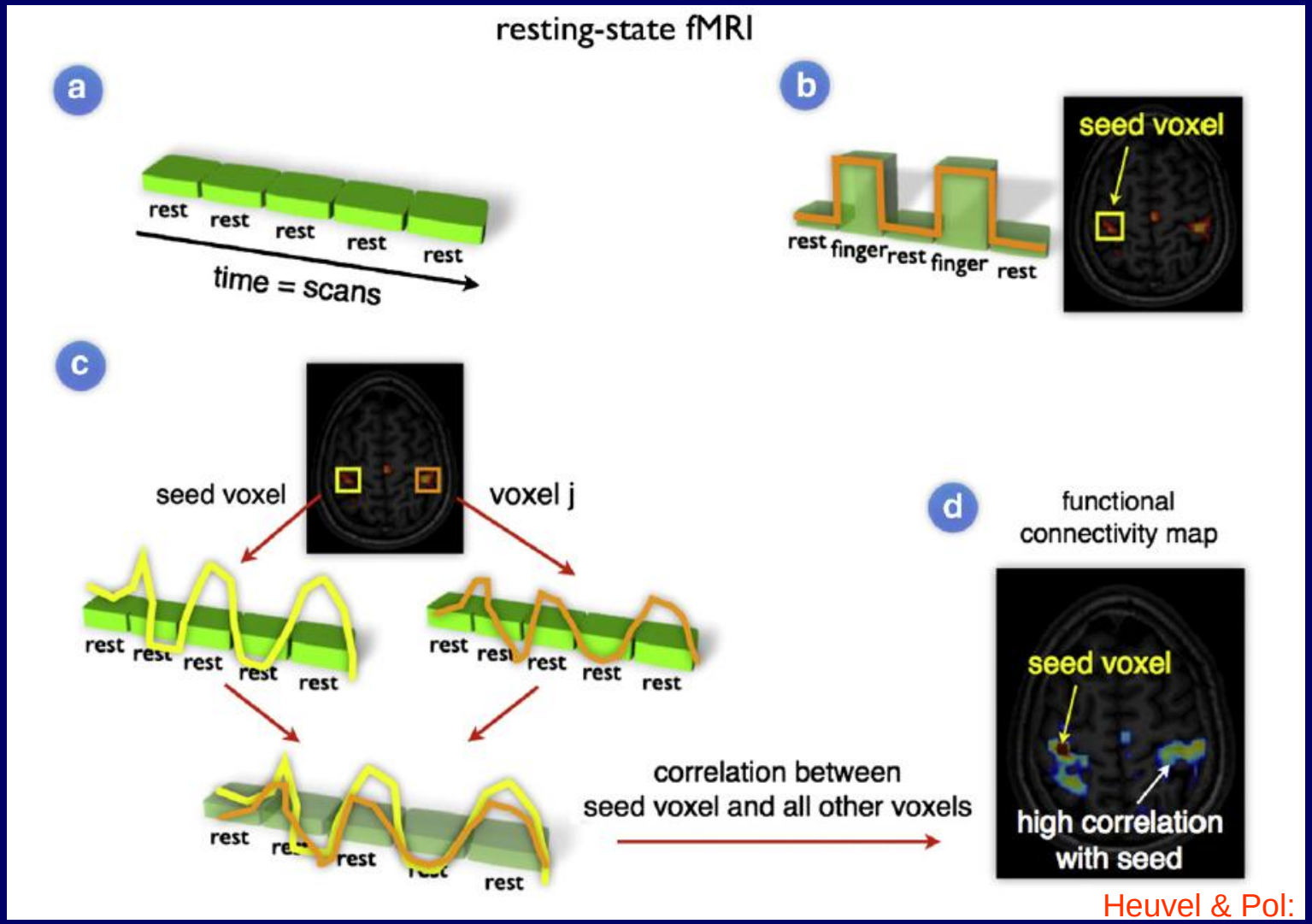
Breakpoint: 0.1 Hz

default mode network function is, in part, associated with self-referential mental processes in humans.

Harrison et. al.: PNAS, 2008

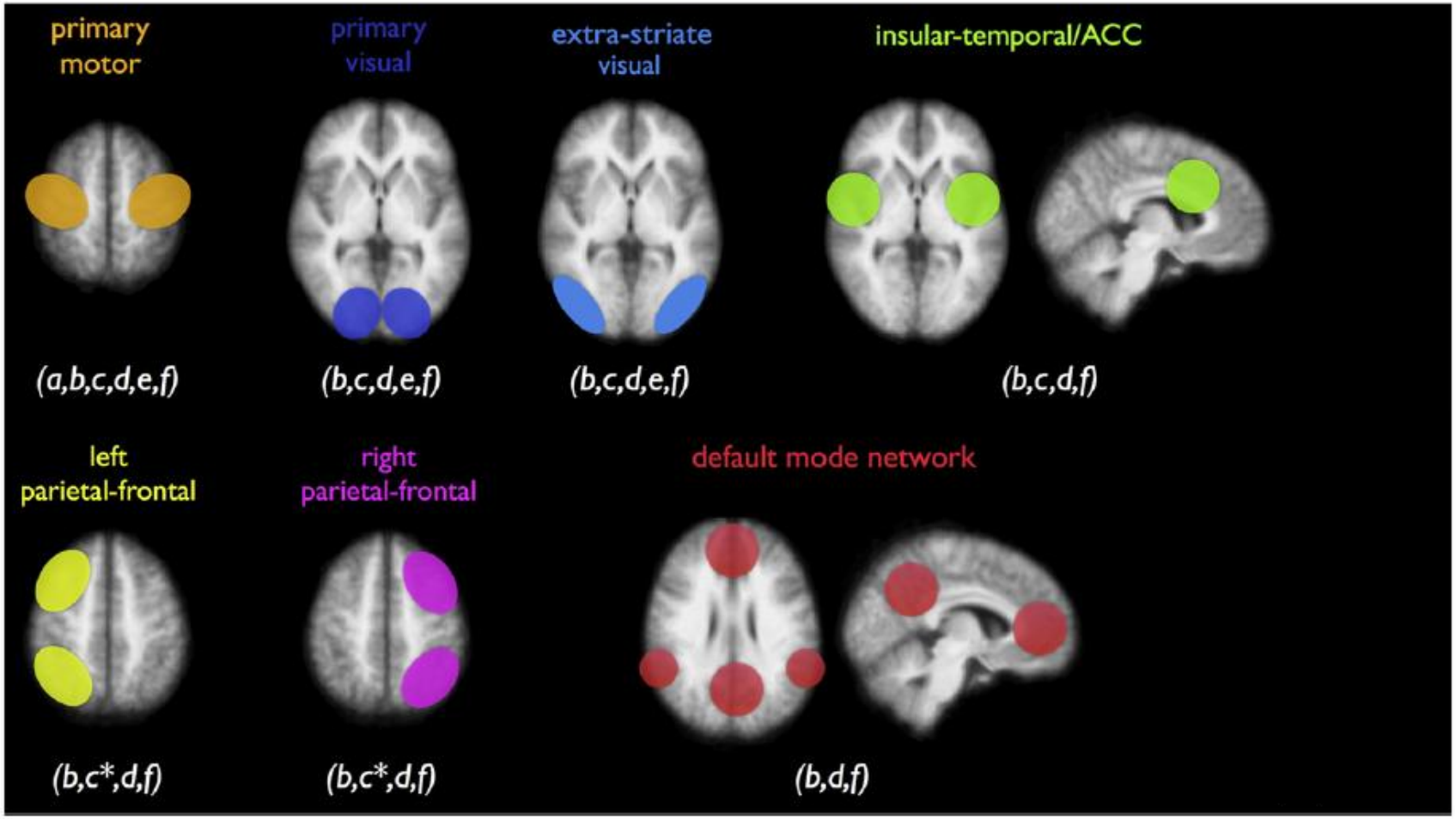
METODOLOJİ

Teknik açıdan gıyabi ağların saptanması



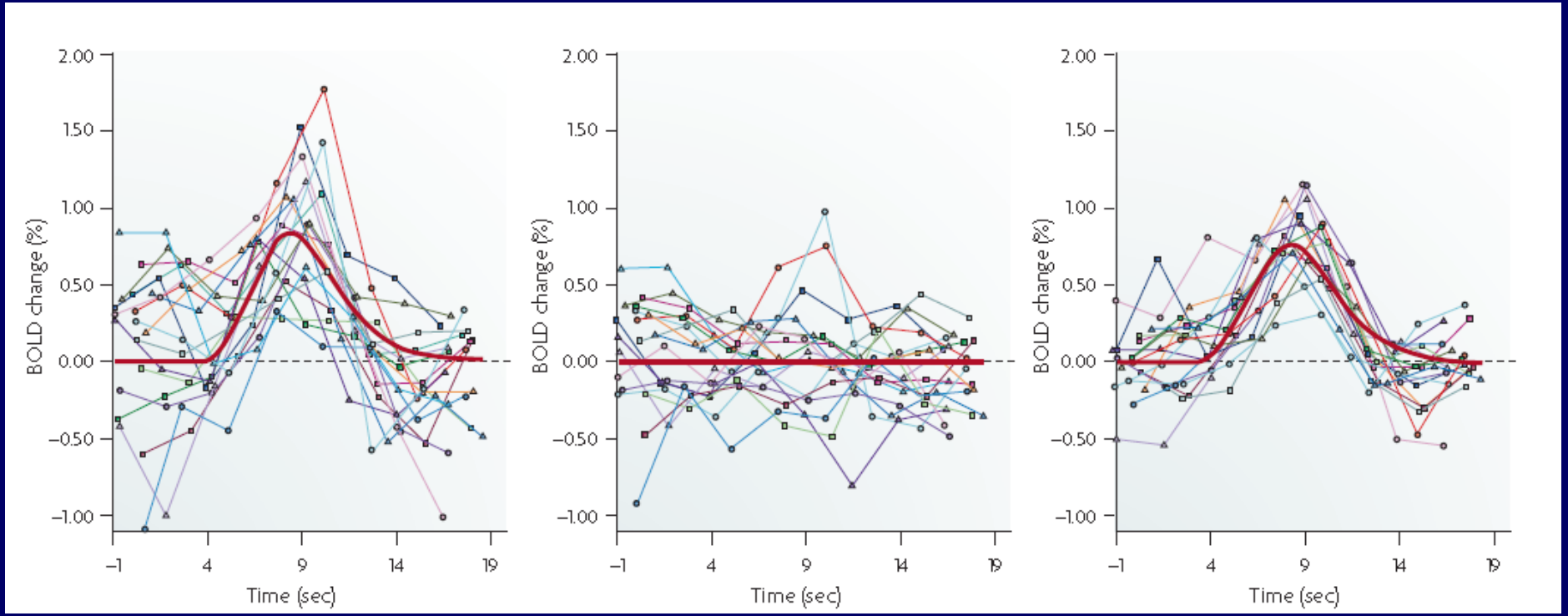
Heuvel & Pol:
Europ. Neuropharm, 2010

Teknik açıdan gıyabi ağların saptanması



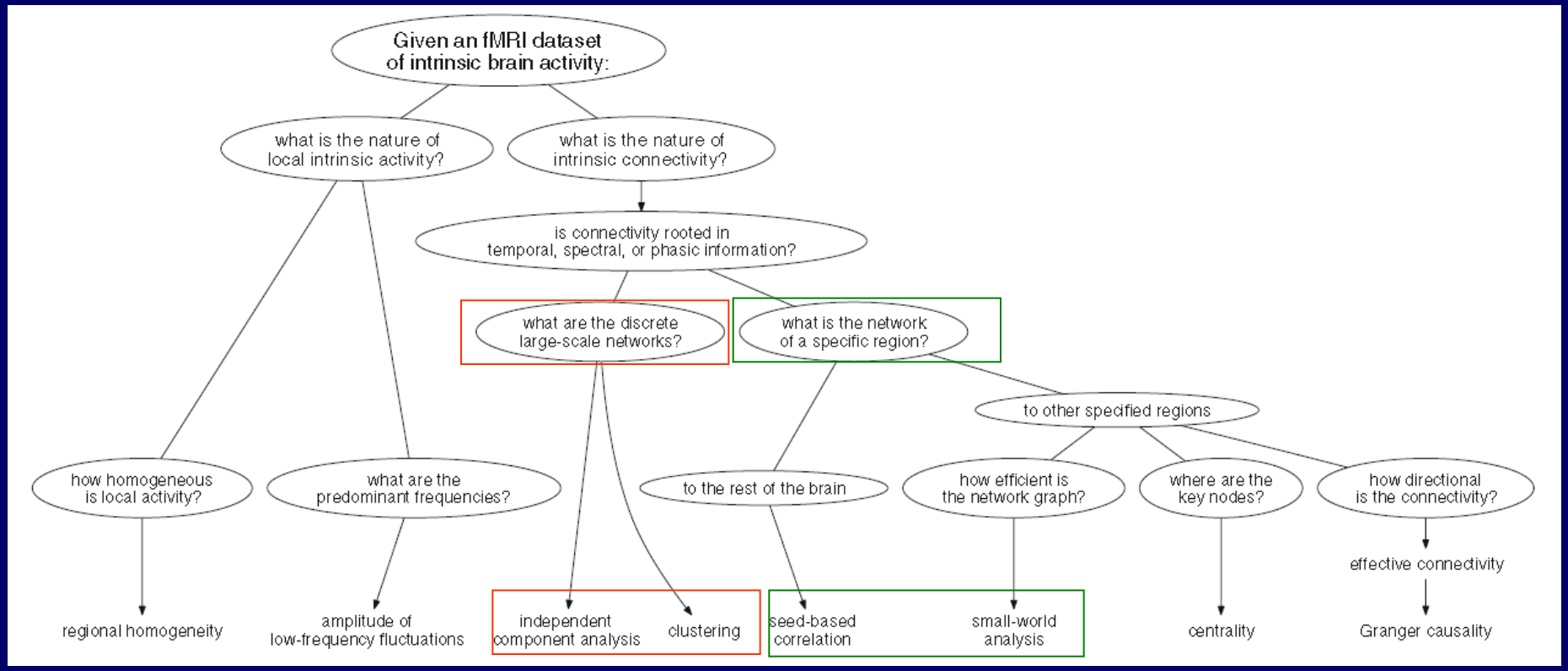
Heuvel & Pol:
Europ. Neuropharm, 2010

Sağlıklı erişkinlerden örnekler



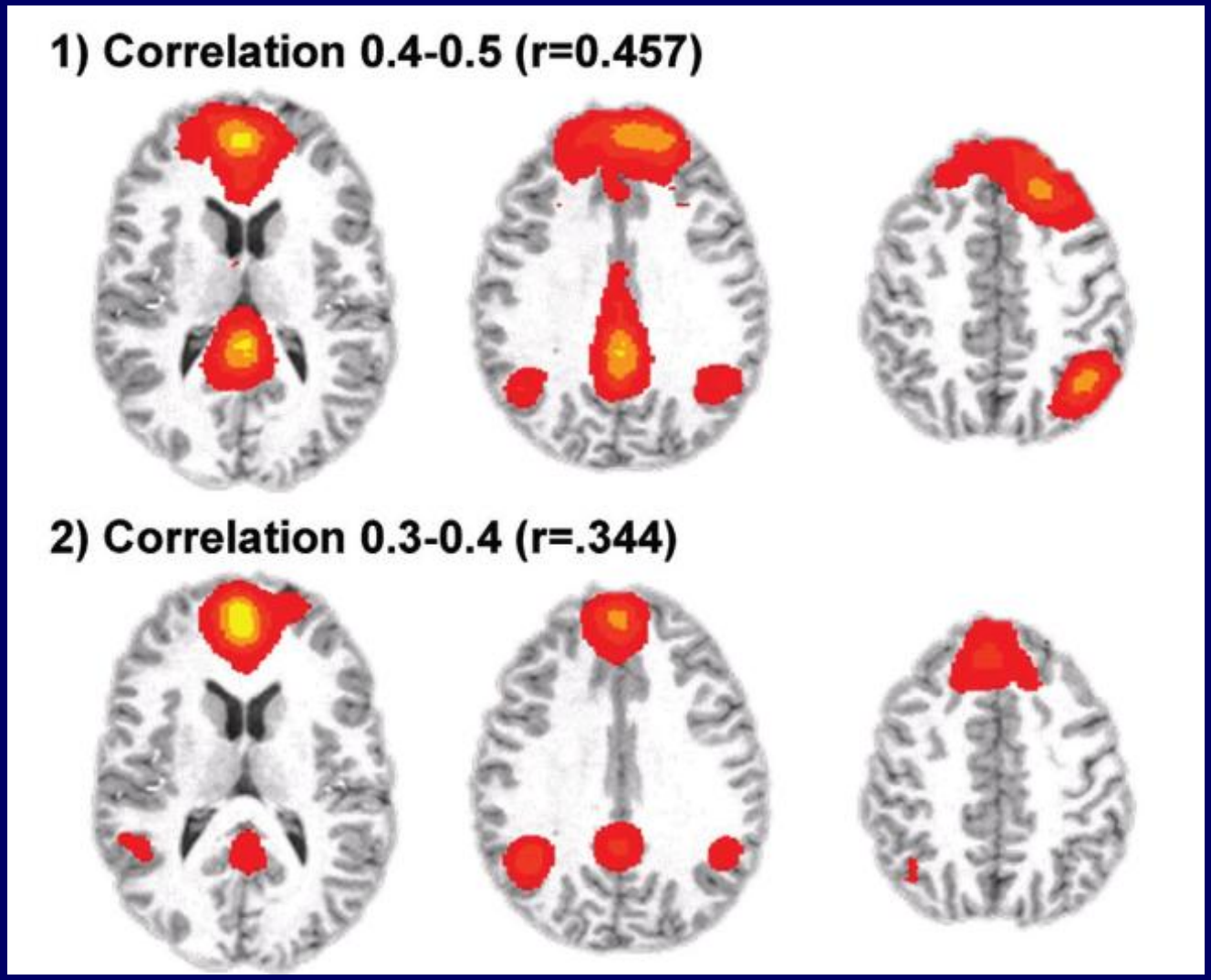
Fox & Raichle:
Nat revs neurosci: 2007

Teknik açıdan gıyabi ağların saptanması



Margulies et.al., 2010

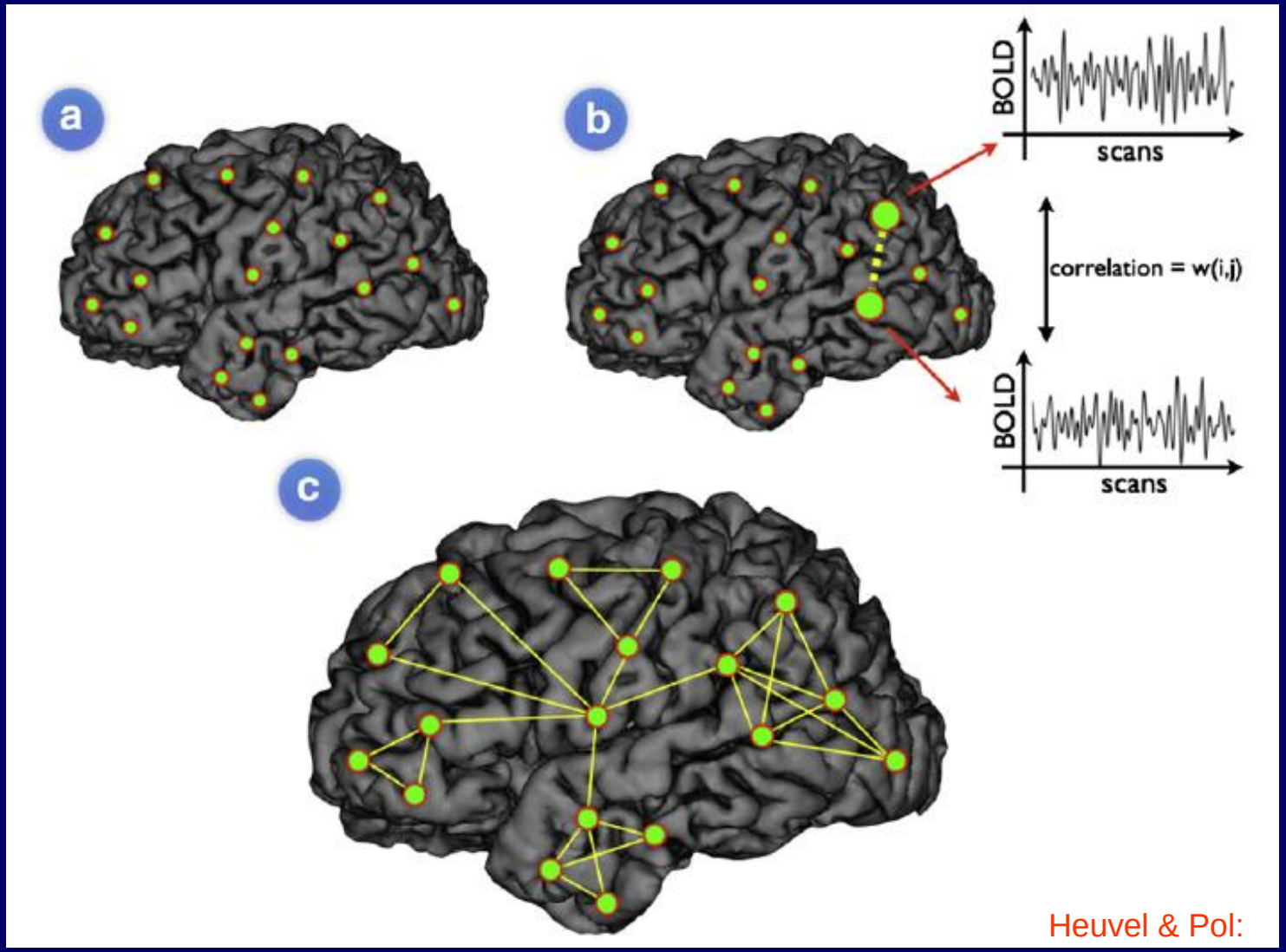
Tutarlılık örnekleri



Franco et. al.:
Hum Brain Map, 2009

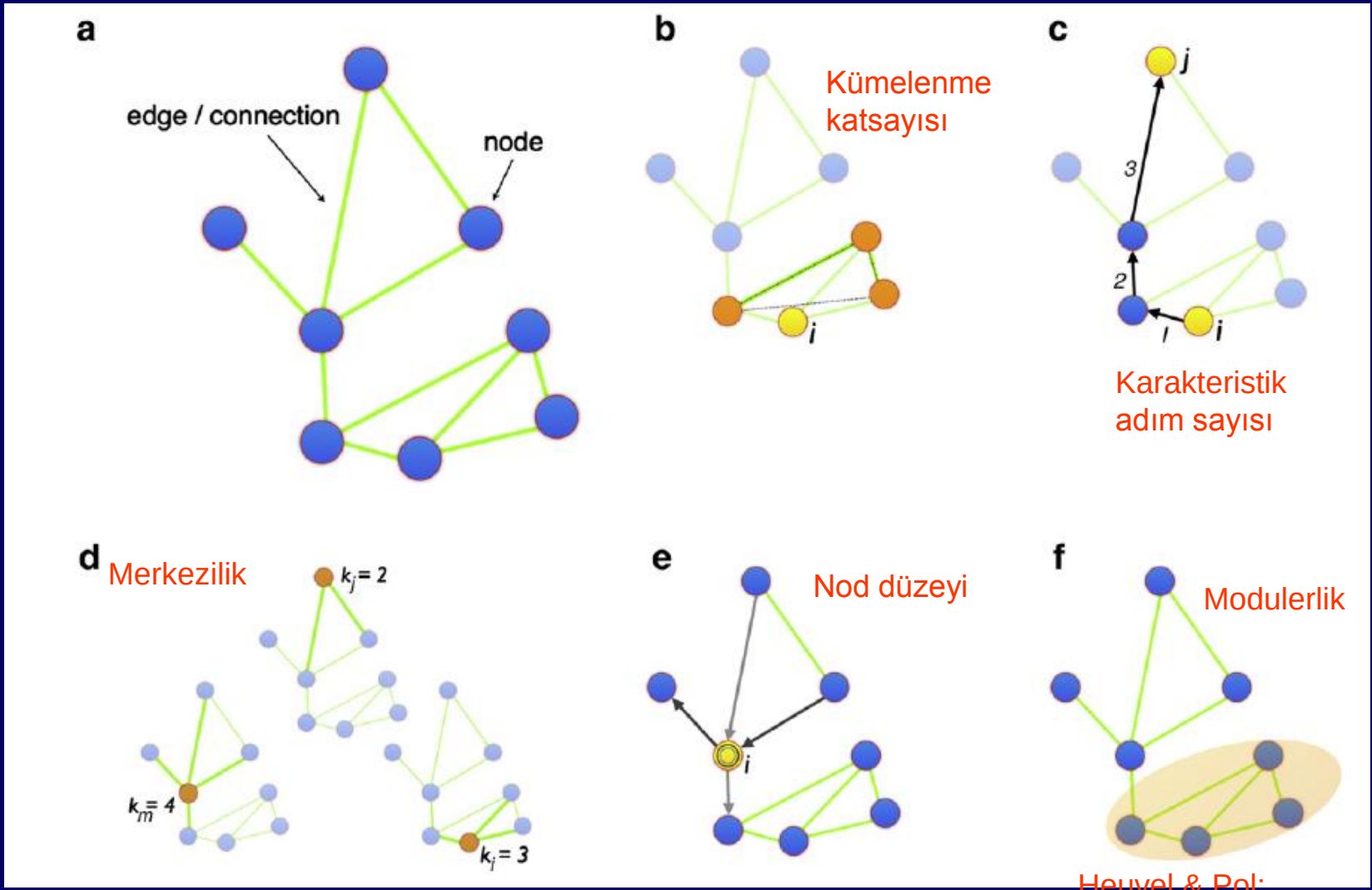
İŞLEVSEL BAĞLILIKLAR

Grafiksel temsil



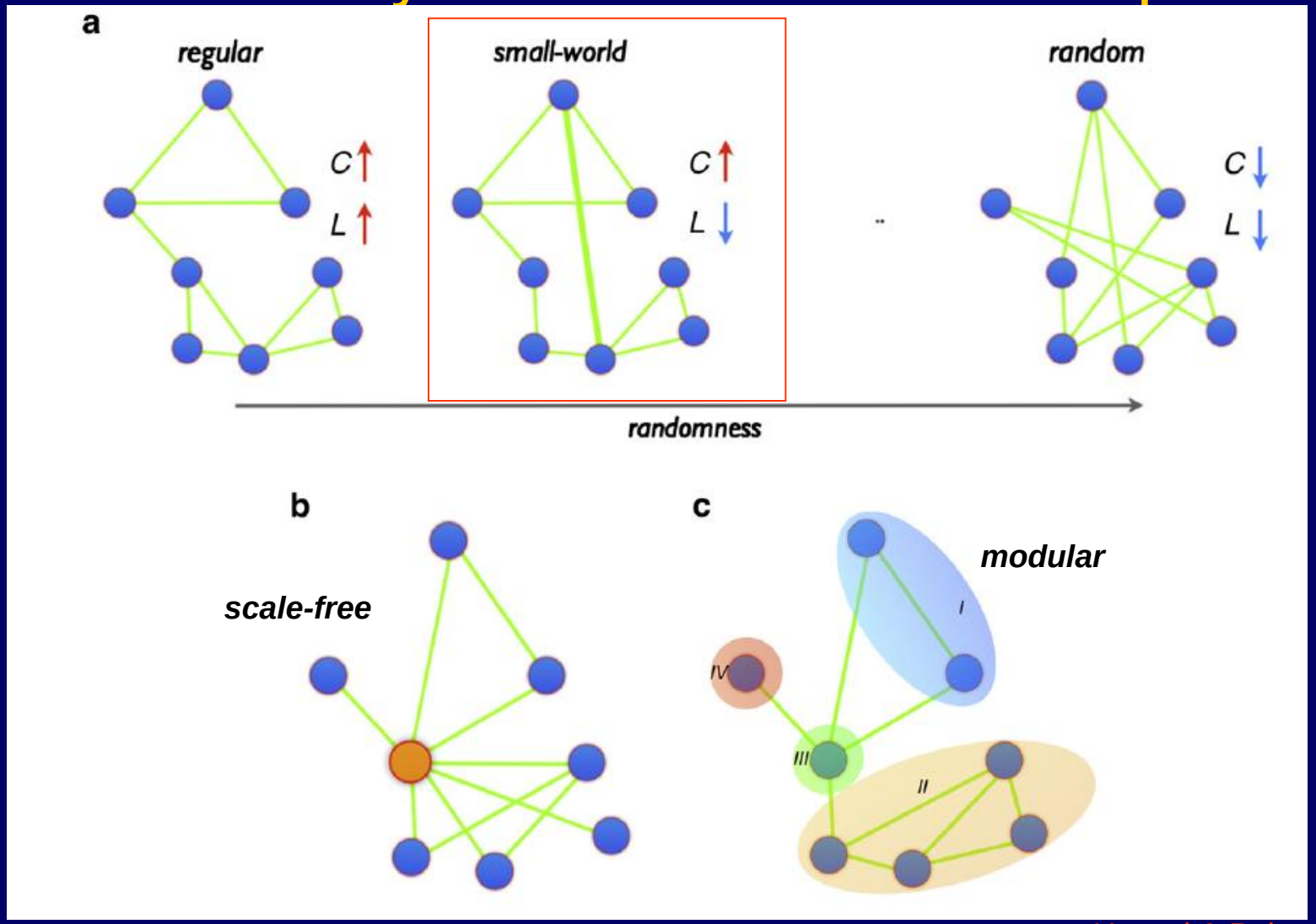
Heuvel & Pol:
Europ. Neuropharm, 2010

Fonksiyonel konnektivite hesapları



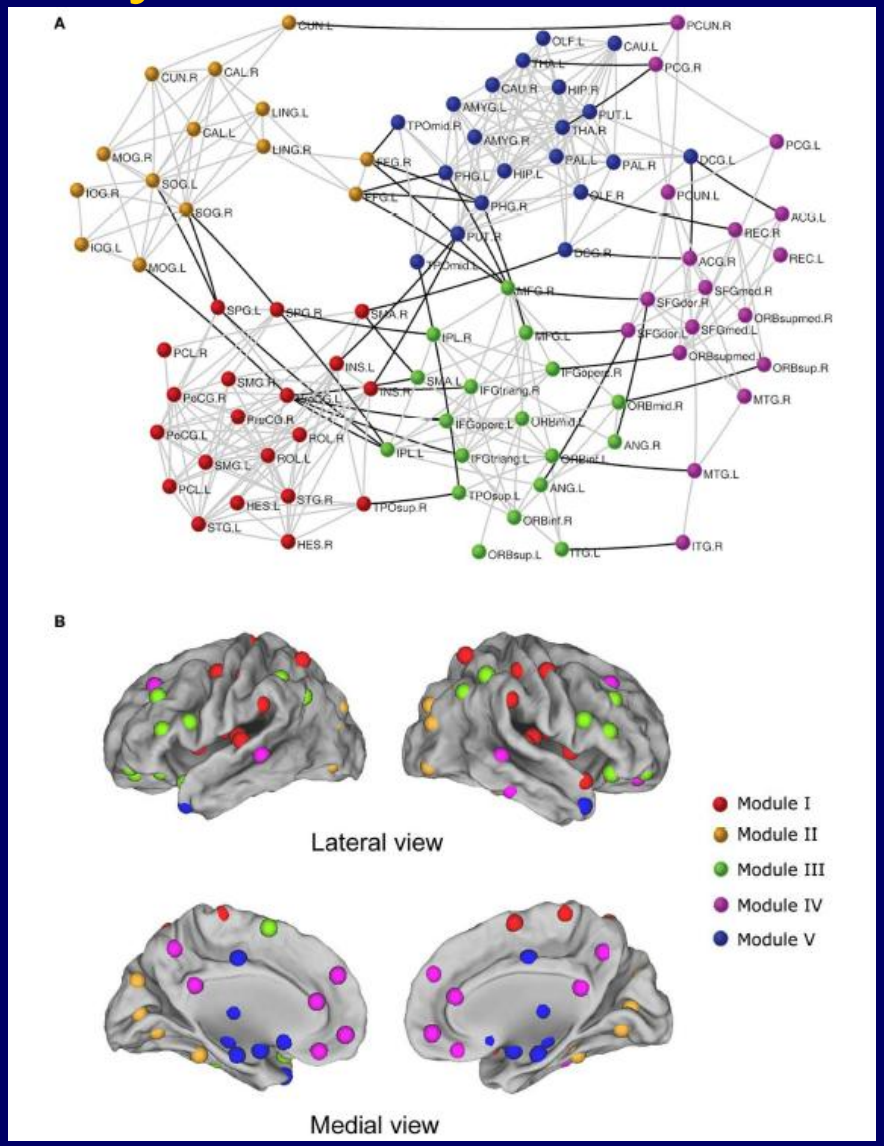
Heuvel & Pol:
Europ. Neuropharm, 2010

Fonksiyonel konnektivite hesapları



Heuvel & Pol:
Europ. Neuropharm, 2010

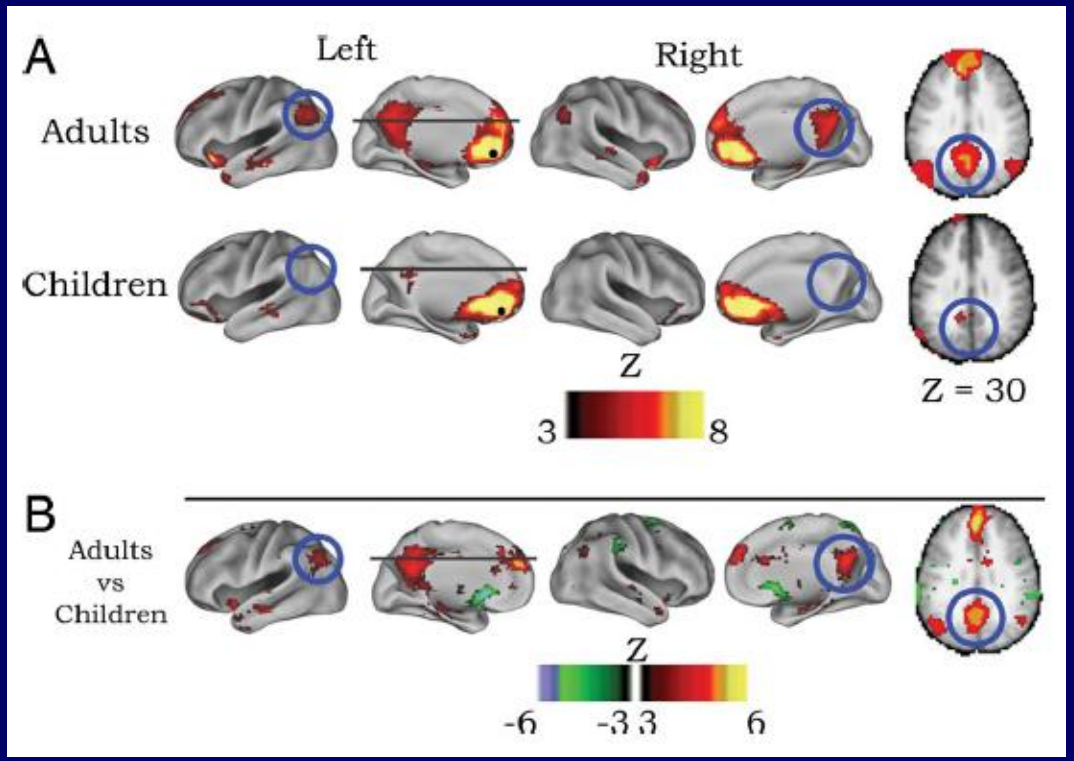
Fonksiyonel konnektivite örneği

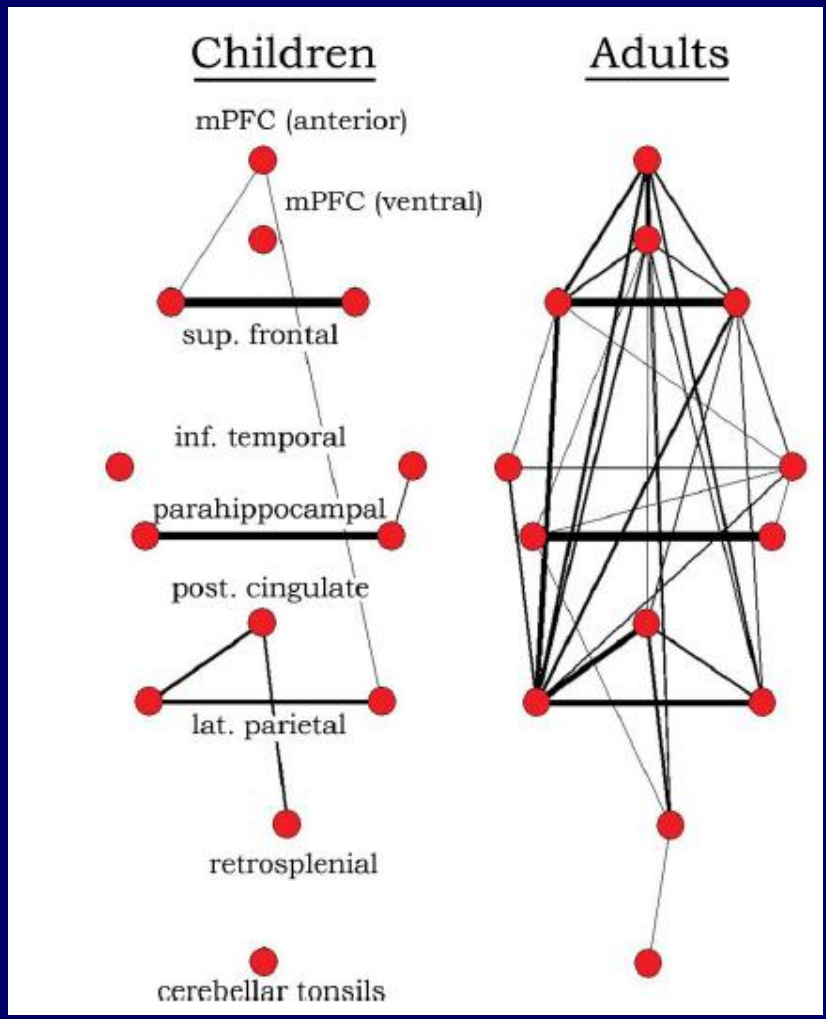


Wang et. al.:
Front. Syst. Neurosci, 2010

SAĞLIKLI POPULASYON SONUÇLARINA ÖRNEKLER

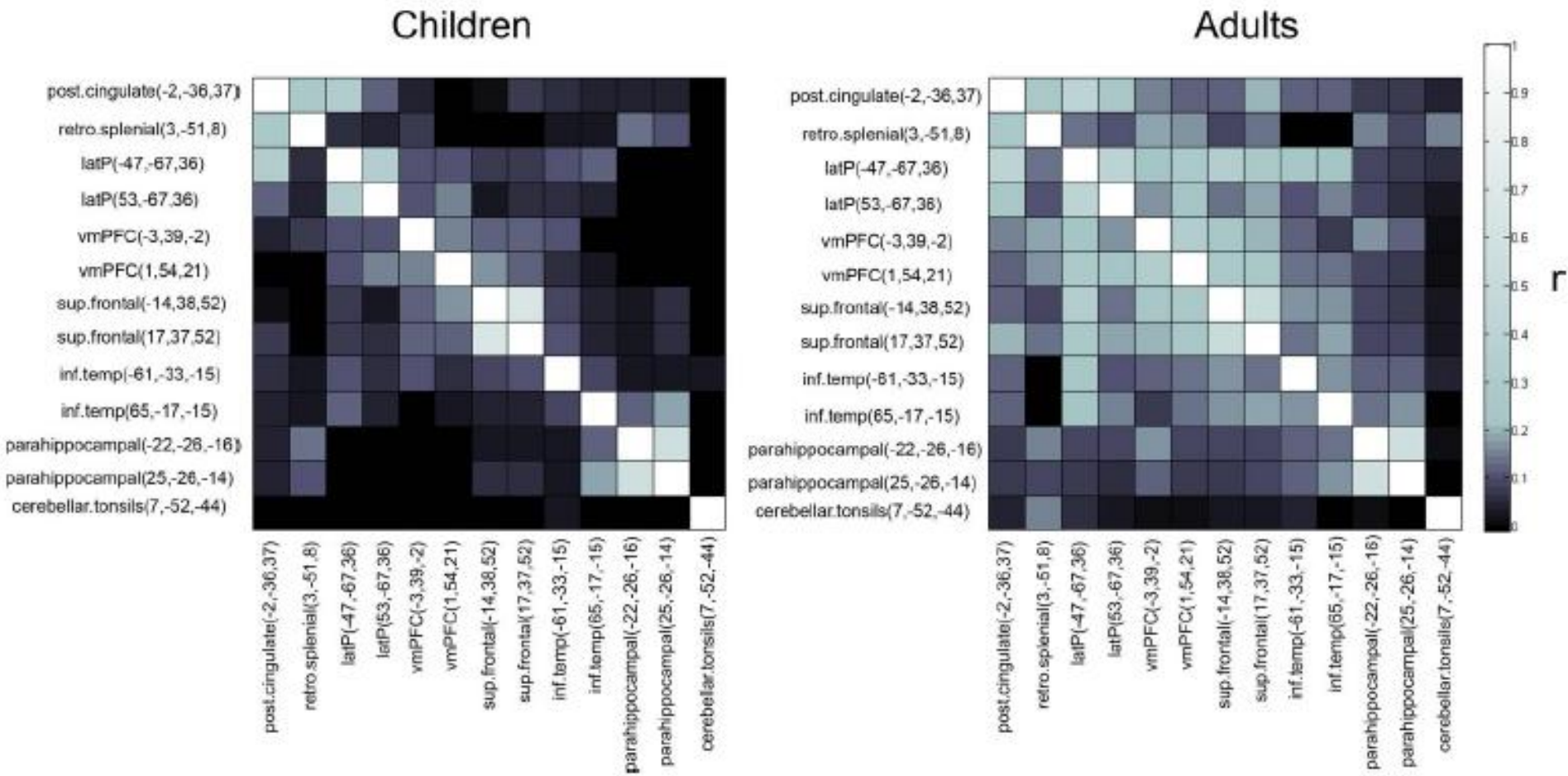
Çocukluk





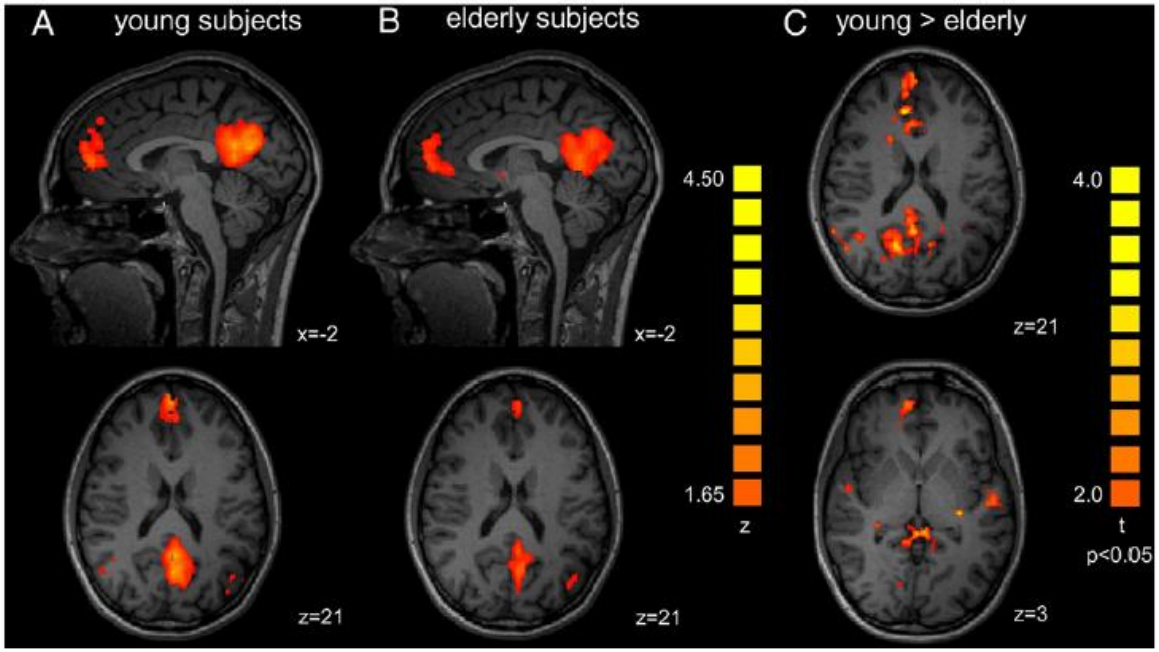
Fair et. al:
PNAS, 2008

Çocukluk



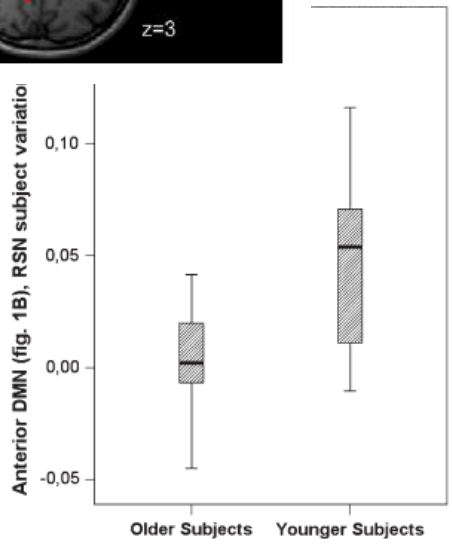
Fair et. al:
PNAS, 2008

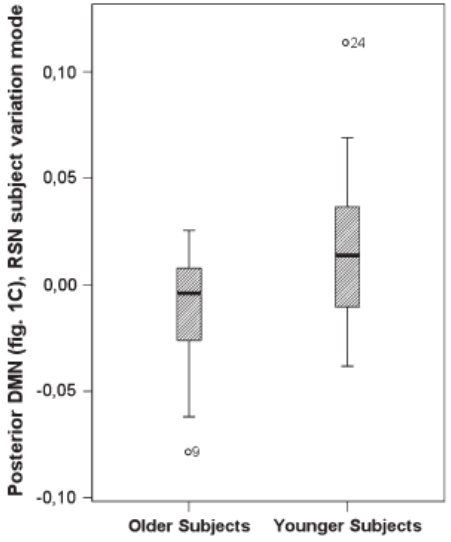
Yaşlanma



Damoiseaux et. al., Cereb cort.,2008

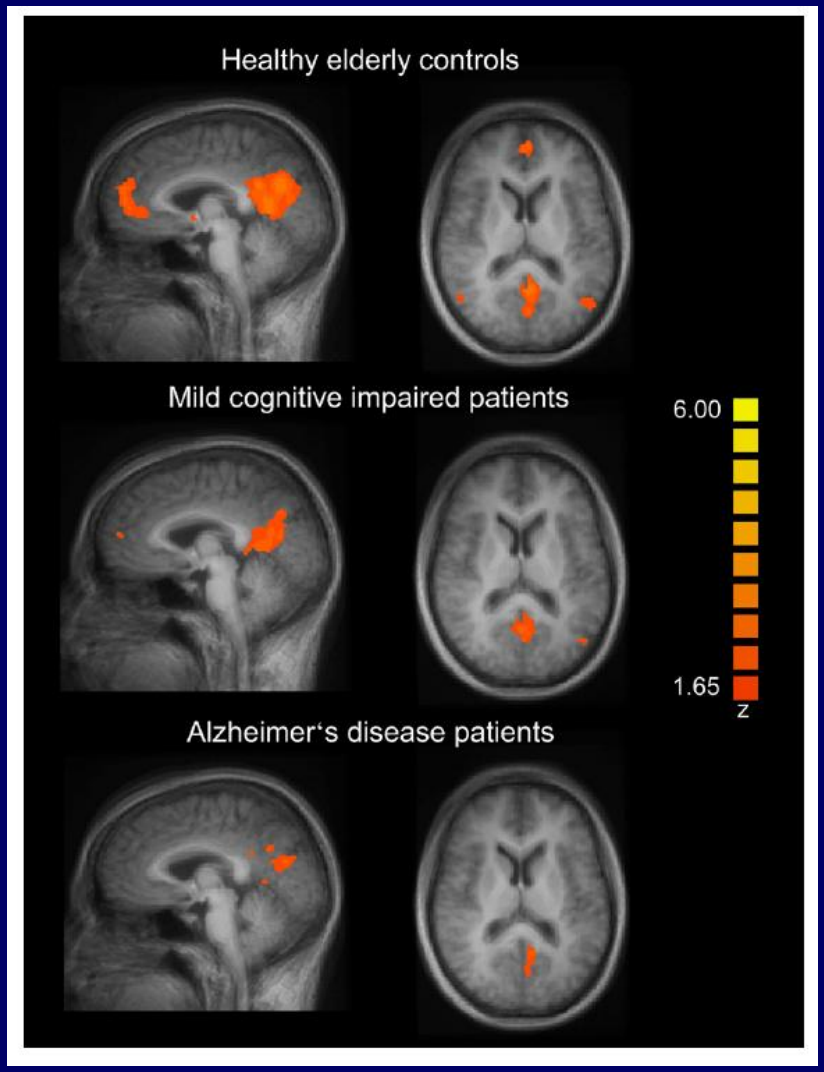
Koch et. al., Neuroimage, 2010





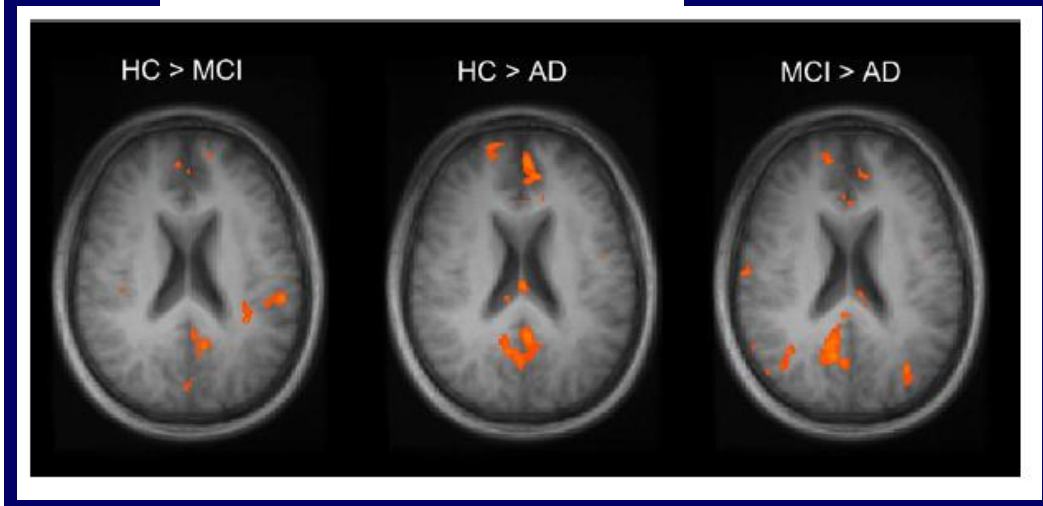
HASTA POPULASYON SONUÇLARINA ÖRNEKLER

Yapısal bozukluk (Alzheimer)



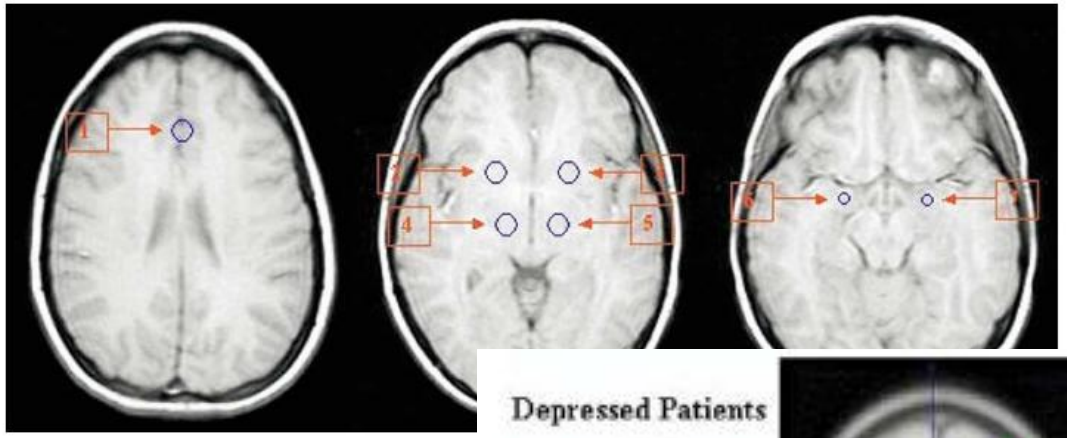
Default mode network region

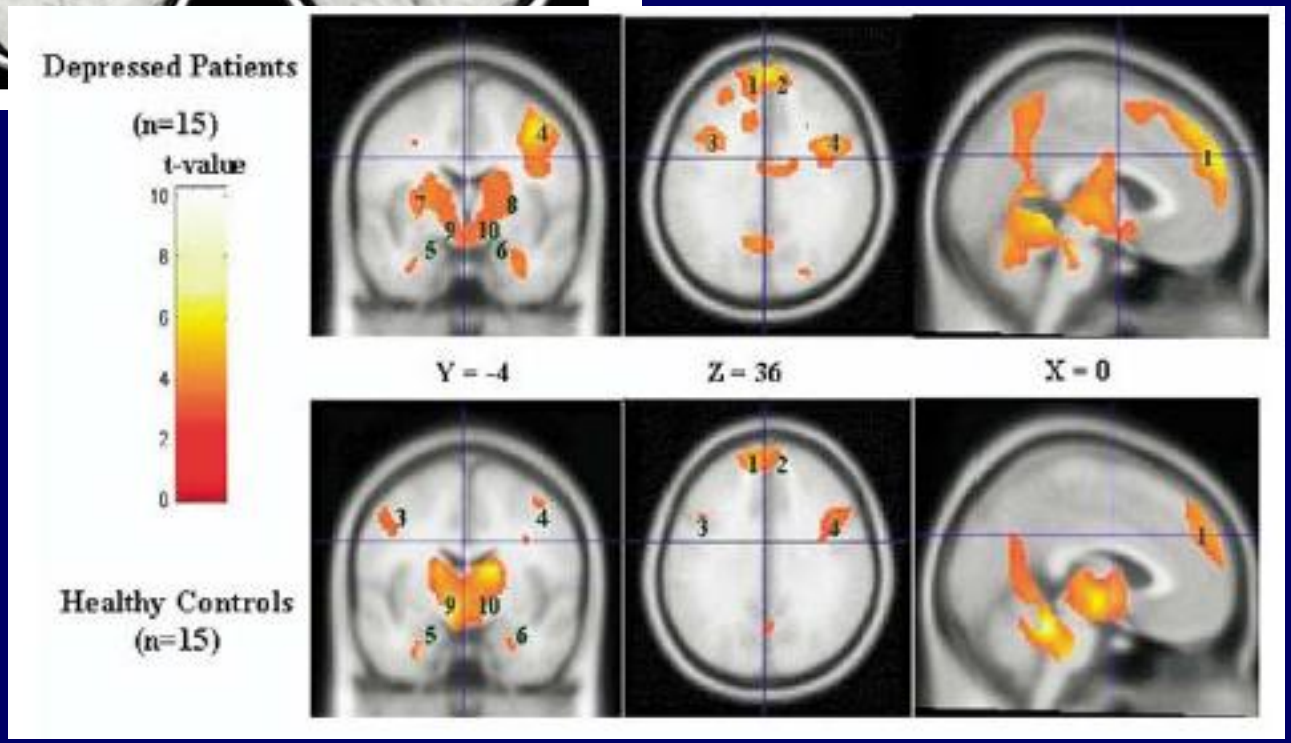
Anterior cingulate cortex (ACC)
Posterior cingulate cortex (PCC)
Left lateral parietal cortex (LPC_L)
Right lateral parietal cortex (LPC_R)
Left superior frontal gyrus (SFG_L)
Right superior frontal gyrus (SFG_R)
Left medial temporal cortex (MTC_L)
Right medial temporal cortex (MTC_R)
Left hippocampus ($HIPP_L$)
Right hippocampus ($HIPP_R$)



Koch et. al:
Nuerobio. Aging, 2010

Psikiyatrik bozukluk (Depresyon)

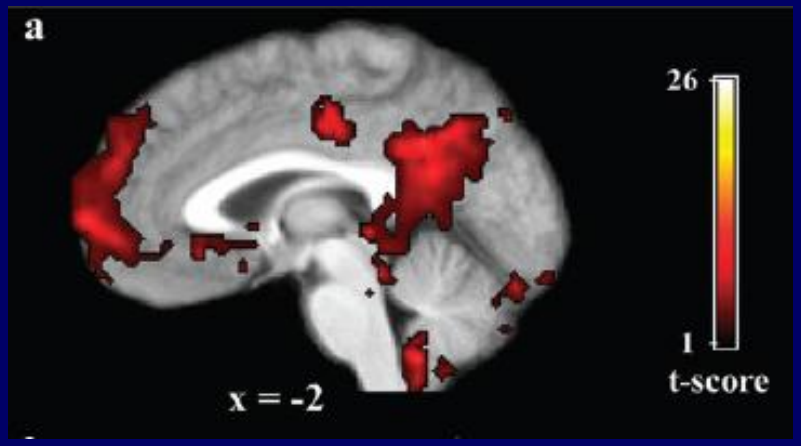


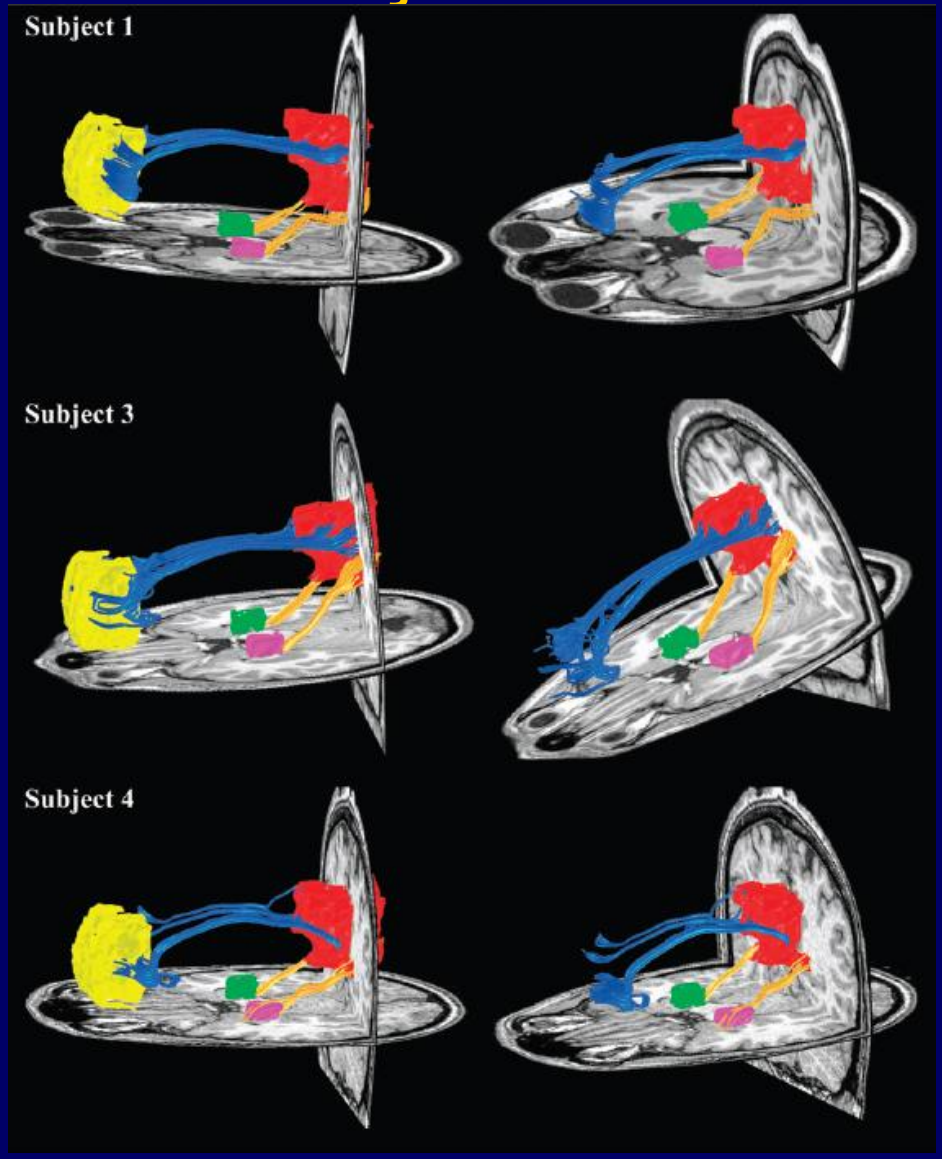


Anand et. al.:
Biol Psych., 2005

İLERİ DÜZEY METODLAR

Diğer modalitelerle birleşim: DTI





Greicius et. al:
Cereb cortex, 2009

Diğer modalitelerle birleşim

Box 3 | **Spontaneous haemodynamic, metabolic and neurotransmitter fluctuations**

Spontaneous low-frequency fluctuations have been observed in numerous haemodynamic and metabolic parameters including oxygen availability[151–153], nicotinamide adenine dinucleotide (NADH) levels[154], cytochrome oxidase activity[155–157], blood volume[155,156] and blood flow[22,111,158,159]. Some of these fluctuations bear similarity to particular aspects of spontaneous blood oxygen level dependent (BOLD) activity. For example, 1/f frequency distributions have been observed in blood flow[159]. Bilateral synchrony has been observed in metabolic fluctuations[155,156], blood volume[155,156] and blood flow[111]. Finally, flow-sensitive imaging in human subjects reveals fluctuations in cerebral blood flow with similar spatial patterns to those seen with BOLD[22,158].

Interestingly, these spontaneous haemodynamic and metabolic fluctuations may or may not be related to underlying changes in electrical activity. For example, a tight coupling was found between spontaneous haemodynamic fluctuations and bursts of electrical activity[111]. However, spontaneous fluctuations in blood volume and cytochrome oxidase activity have been measured under conditions of electrocortical silence[155,156]. Further work is needed to link spontaneous BOLD fluctuations to the primarily invasive recordings of haemodynamic and metabolic fluctuations, although non-invasive techniques, such as near-infrared spectroscopy, are making important advances in this regard[157].

An interesting and potentially related area of research is the examination of spontaneous neurotransmitter release at neuronal synapses[112,113,160]. In this field, the term 'spontaneous' refers not only to activity present in the absence of an explicit task or stimuli, but also to neurotransmitter release present in the absence of neuronal spikes or action potentials. As BOLD is thought to reflect primarily dendritic potentials related to synaptic input[110], this spontaneous neurotransmitter release could be an important component of spontaneous BOLD fluctuations. Support for this comes from the observation that fluctuations in spontaneous neurotransmitter release show a 1/f frequency distribution, similar to that of BOLD[161]. It will be interesting to know if this spontaneous neurotransmitter release is itself related to fluctuations in the power of higher frequency electrical activity recorded with local field potentials.

Fox & Raichle:
Nat revs neurosci: 2007

"Absence of occupation is not rest,
A mind quite vacant is a mind distress'd."
Retirement—William Cowper

"The fact that the body is lying down is no reason for supposing that the mind is at peace. Rest is...far from restful."
Seneca[3] (Seneca, ~60 A.D. (1969))

TEŞEKKÜRLER