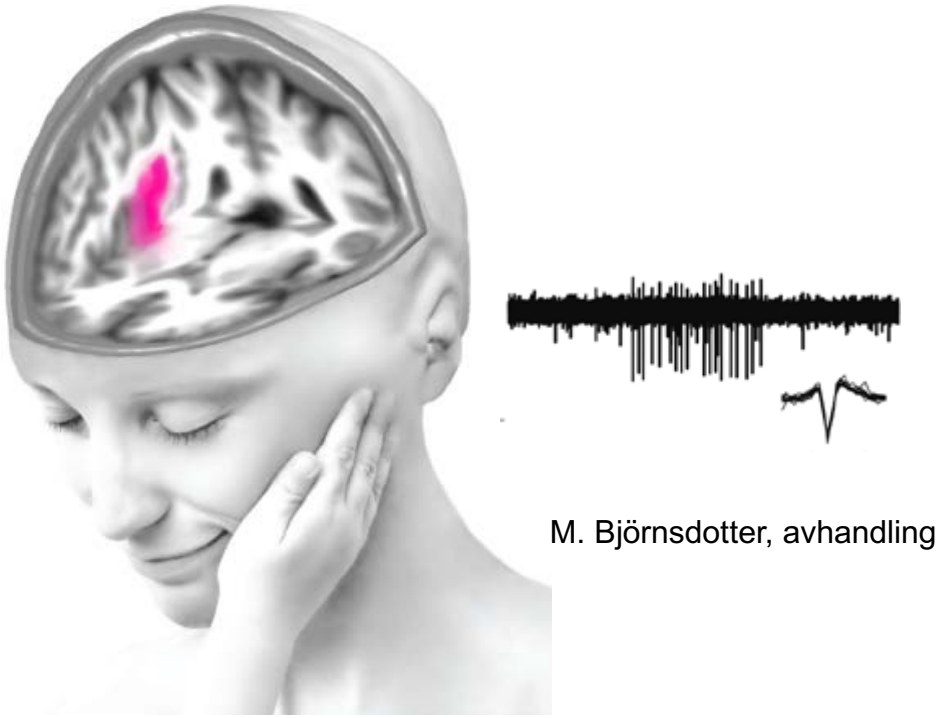
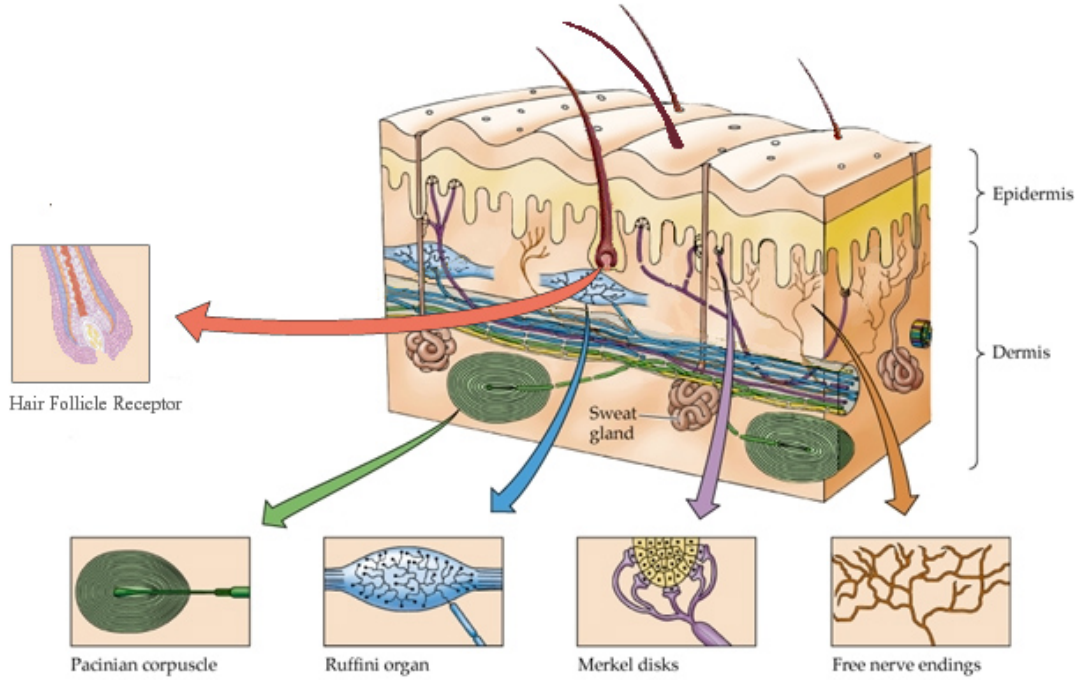
Nerver för njutning



M. Björnsdotter, avhandling

Håkan Olausson
Centrum för Social och Affektiv Neurovetenskap
Linköpings universitet

Känselreceptorer enligt läroböcker



courtesy of http://www.hhp.uh.edu/clayne/6397/Unit4_files/image019.jpg

- Hudberöring. Snabbt ledande nerver, tjockt isolerande fettskikt (Aβ)

- Smärta och temperatur. Långsamt ledande nerver, inget isolerande fettskikt (C)

Omyeliniserade (C) nerver för beröring

- Finns hos katter, kaniner och primater

- Människor:

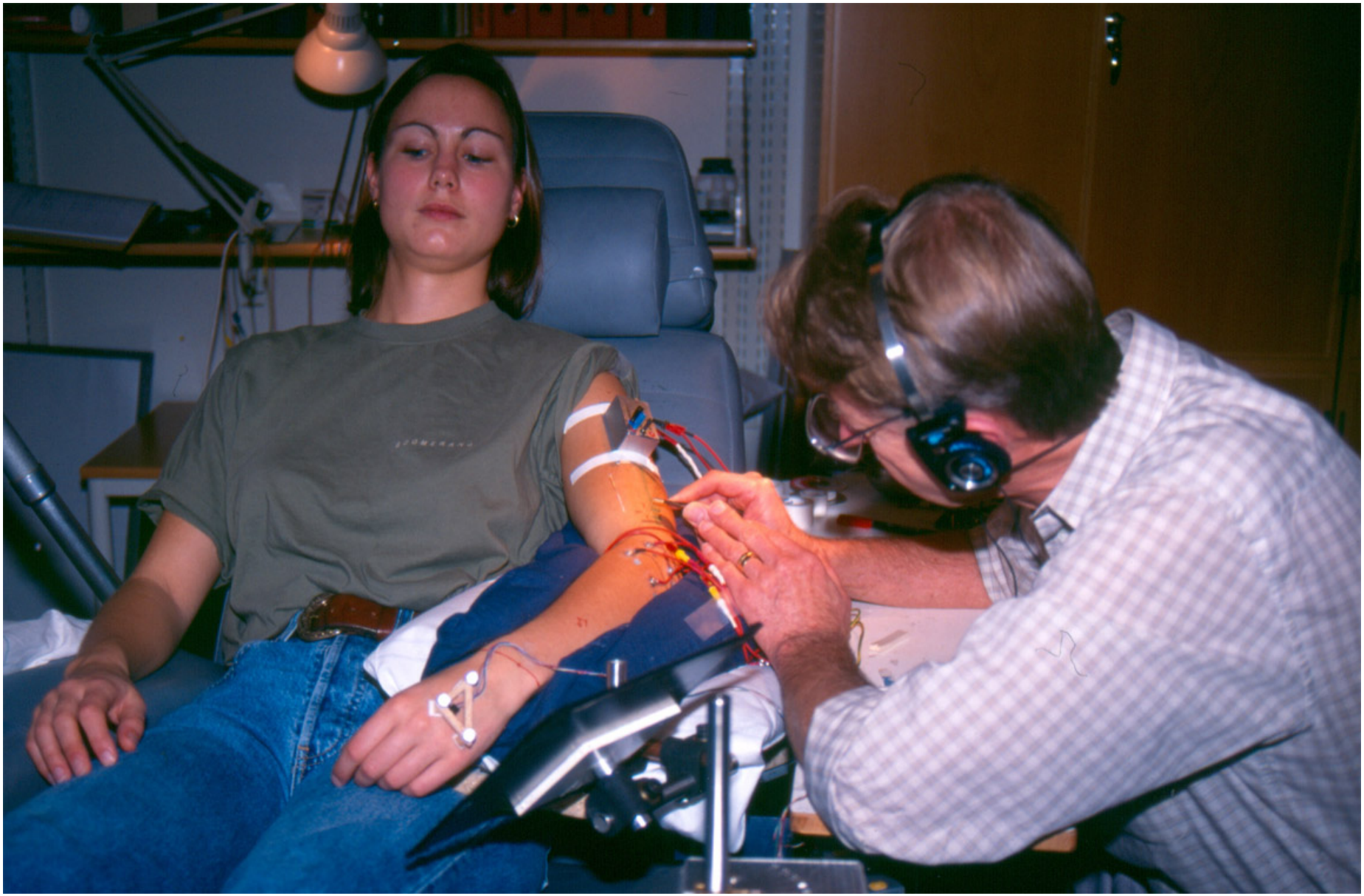
  C-nerver för beröring har försvunnit under evolutionen?

  Vanlig beröringskänsel försvinner när A-nerver blockeras

  C-nerver är långsamma – ingen ”andra beröringsvåg”

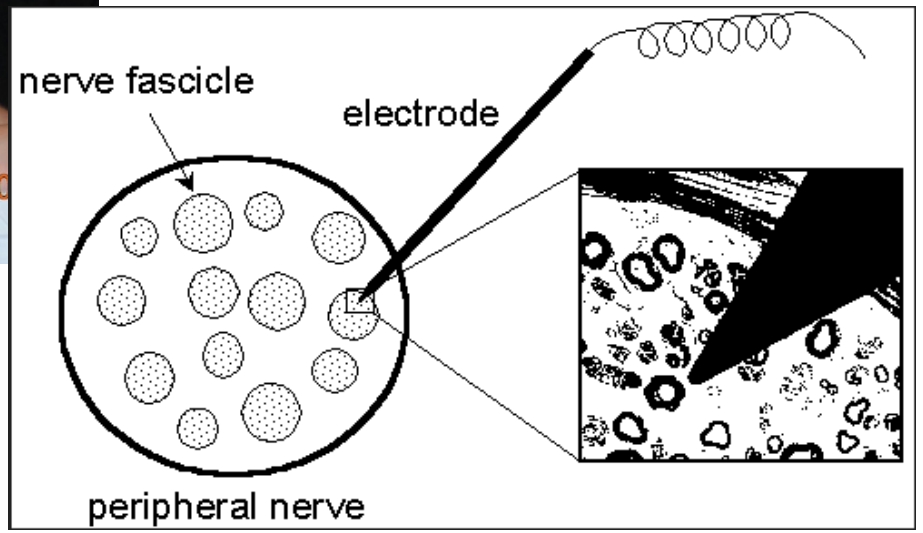
Finns C-nerver för beröring hos människa?

Mikroneurografi



Tjuvlyssna på nerver

Tunna (0,2 mm)
elektroder



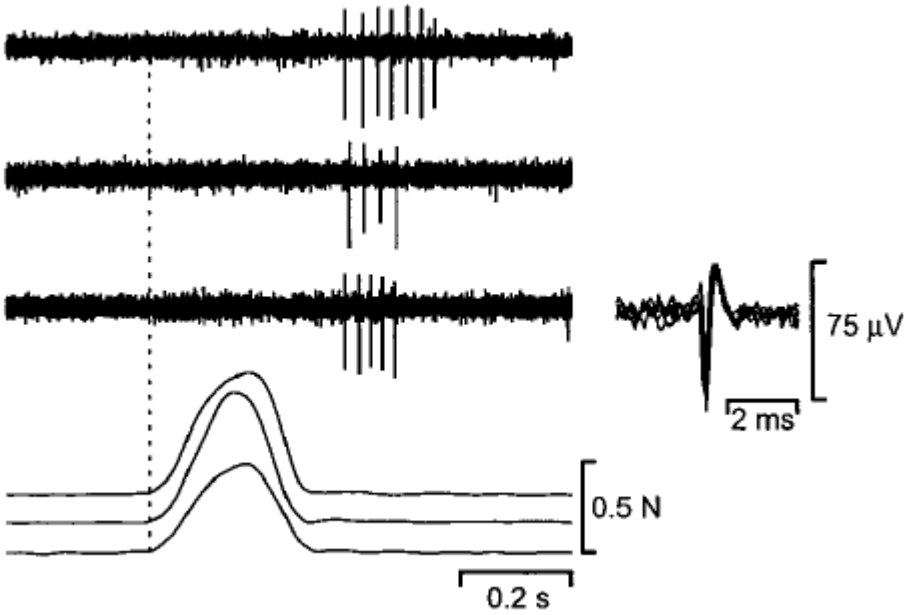
Snabba beröringsnerver

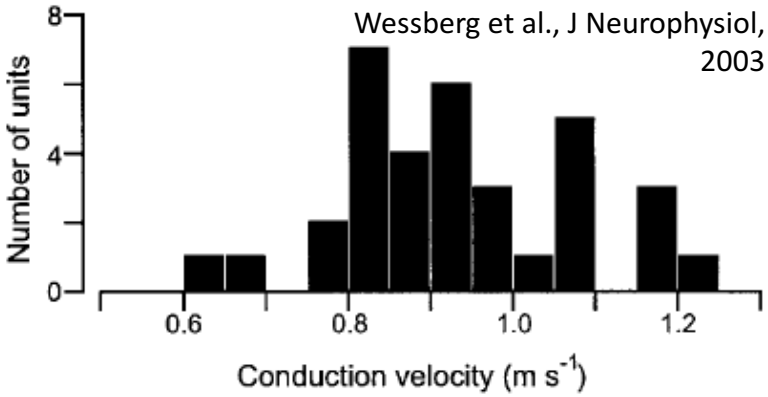
Aβ-nerver

Långsamma beröringsnerver

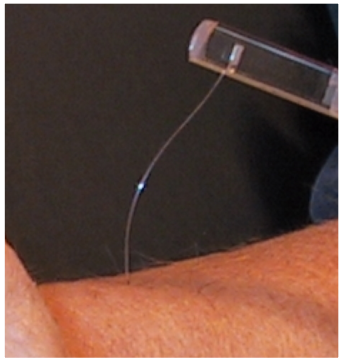
C-taktila (CT) nerver

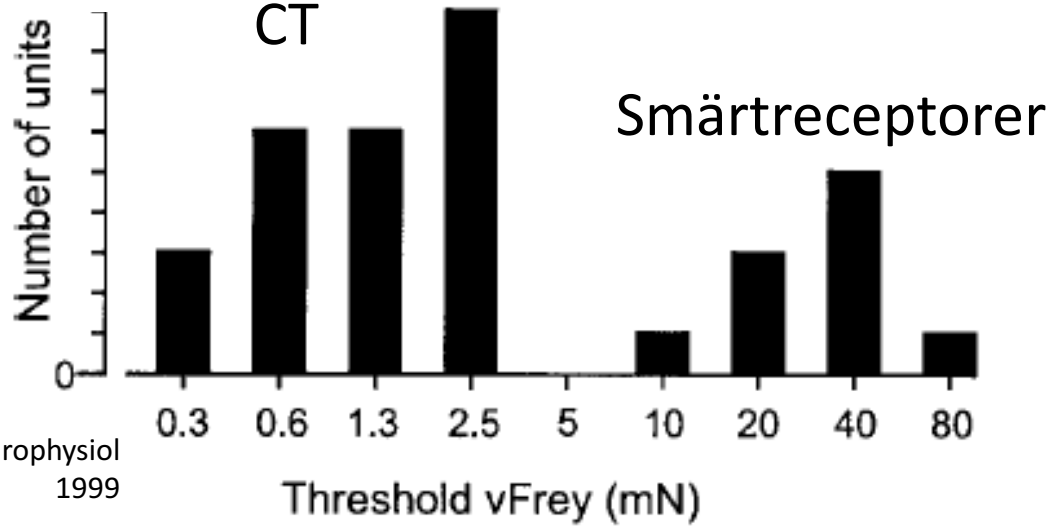
Fysiologisk karaktärisering





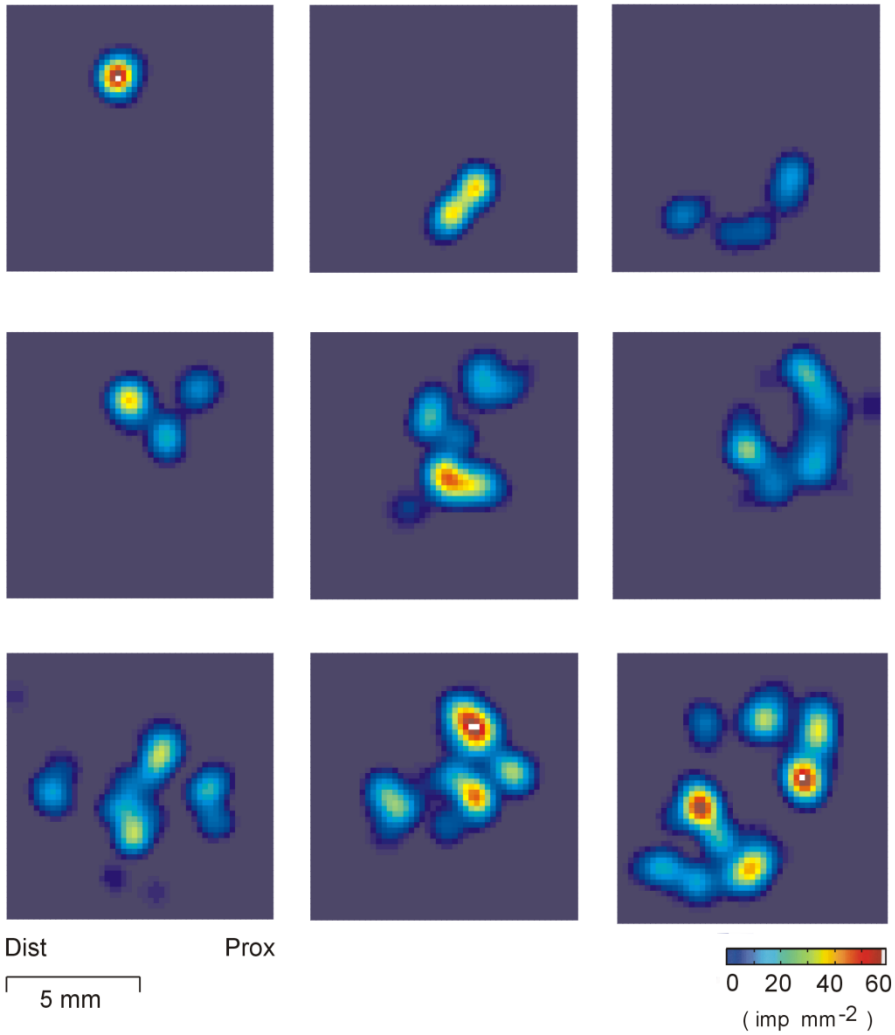
Wessberg et al., J Neurophysiol, 2003





Vallbo, et al, J Neurophysiol 1999

Anatomi



- Nio olika CT-nerver
- 1- 8 “hot spots”

Wessberg et al, J Neurophysiol, 2003

Egenskaper hos C-nerver för beröring

- Långsam ledningshastighet (1 m/s)
- Reagerar på lätt tryck och framför allt på långsamma strykningar
- Nervändslut inom ett område upp till 1 cm^2
- Finns ej i handflatans hud
- Funktion?

Problemet

- C-nerver för beröring aktiveras alltid parallellt med A-nerver. Svårt att veta vilken nerv som bidrar med vad.

En öppning

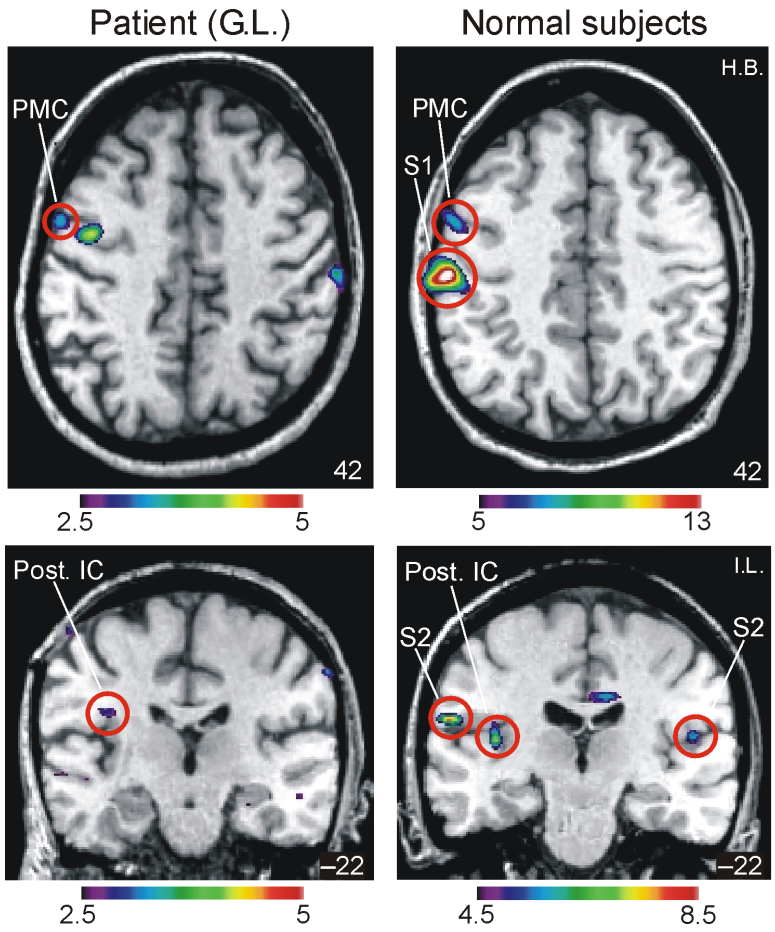
- En patient med selektiv förlust av A-nerver (extremt ovanligt)
- C-nerver intakta
- G.L. 54 år gammal. Nervinflammation vid 30 års ålder som drabbade hela kroppen nedanför näsan
- Innan undersökning – ingen beröringskänsel utom på pannan

G.L. kunde detektera borststrykning på handryggen och underarmen men inte på handflatan

G.L. beskrev borststrykningen som svag men behaglig

Till vilka områden i hjärnan projicerar C-nerver för beröring?

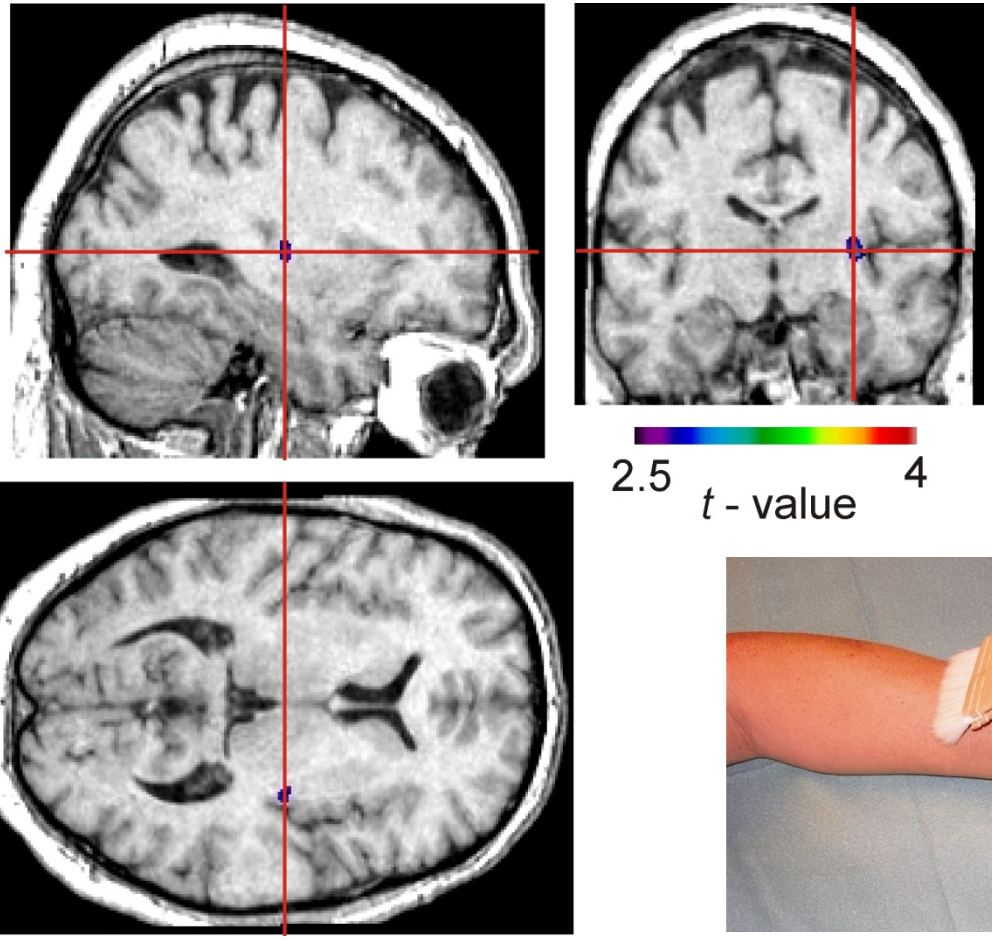
Borststrykning hos G.L. aktiverar insula men inte känselhjärnbark

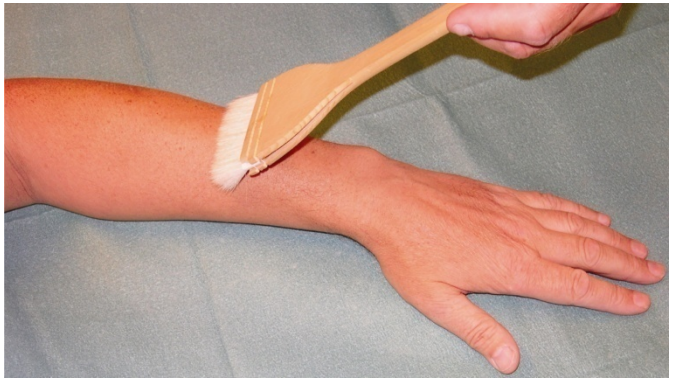


Olausson et al., Nature Neurosci, 2002

Borststrykning hos I.W. aktiverar insula

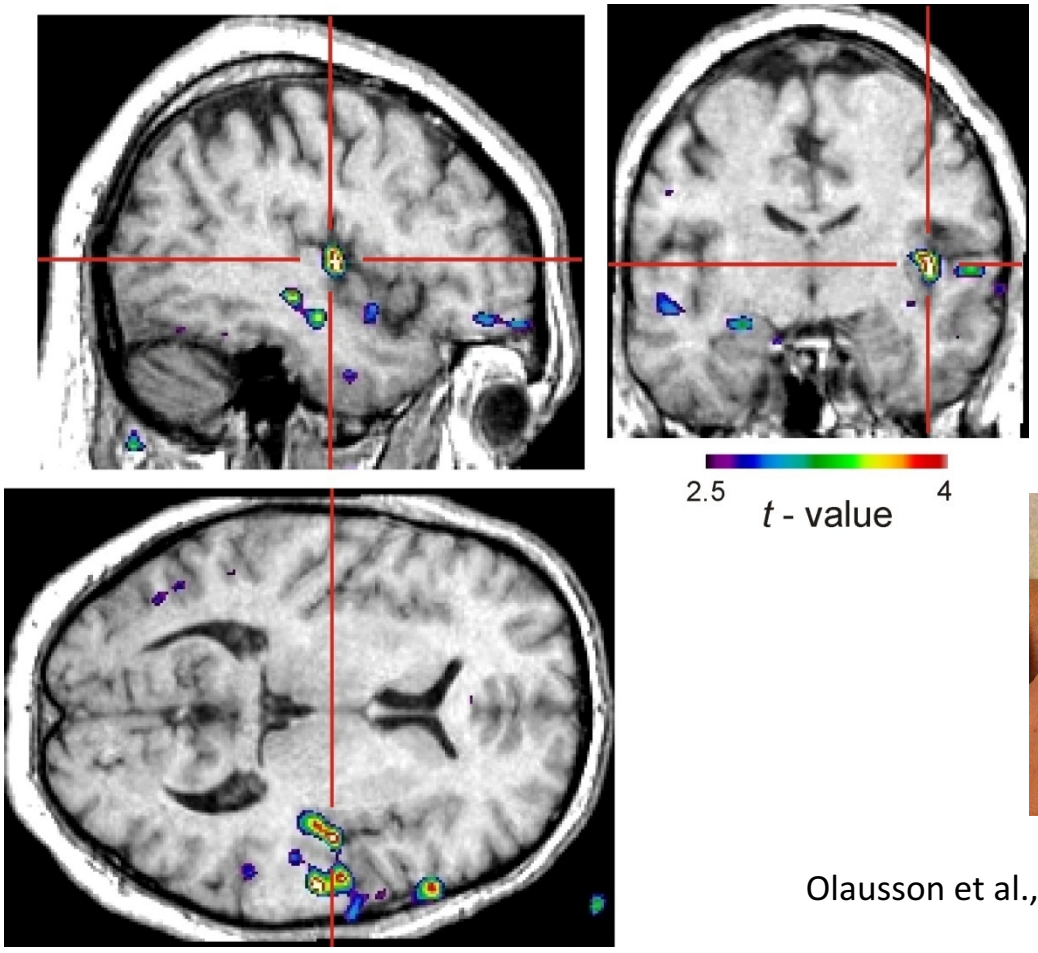
Patient (I.W.)





Mänsklig beröring mer effektiv

Patient (I.W.)



Olausson et al., Neurosci Lett, 2008

Insula

område för upprätthållande av välbefinnande

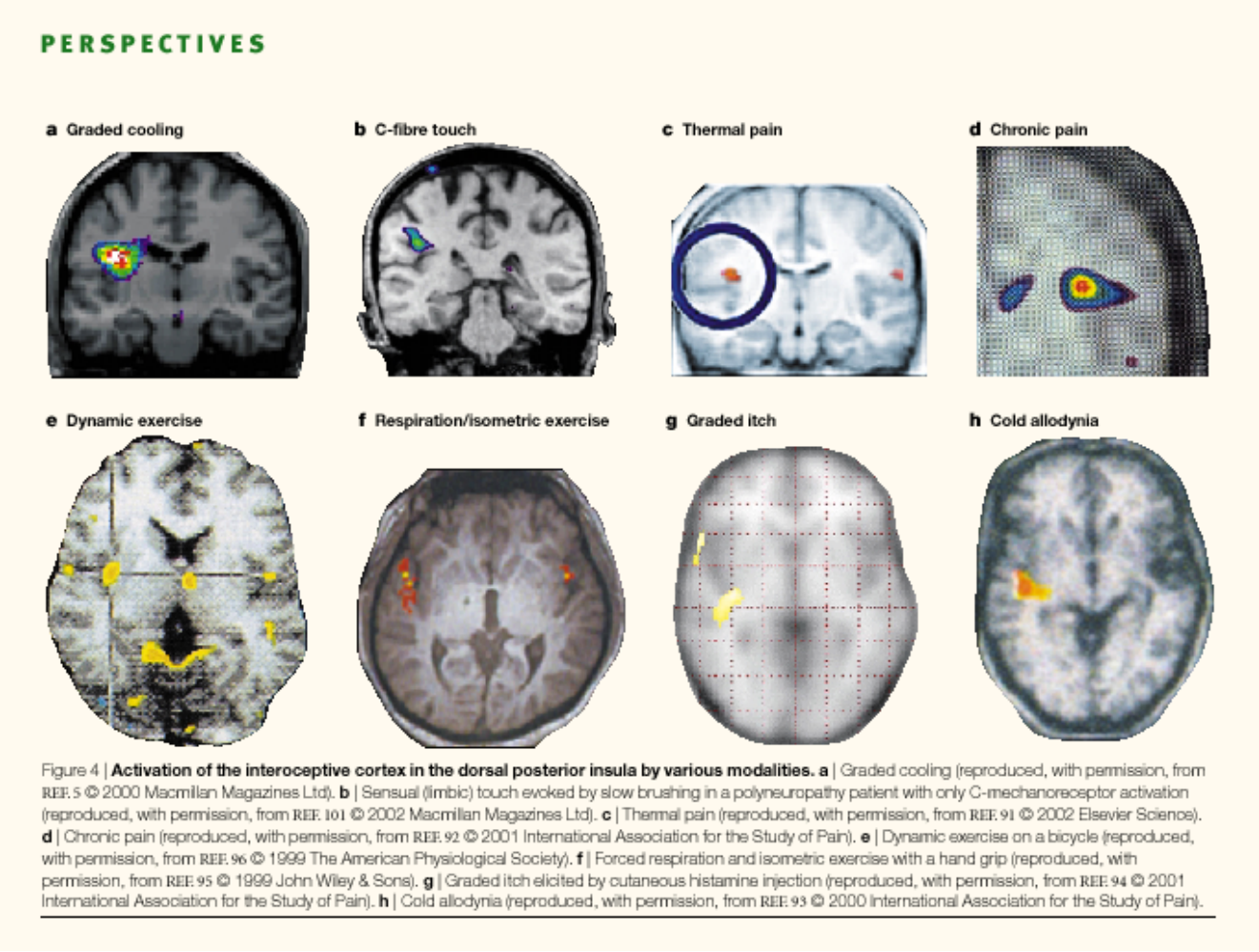


Figure 4 | **Activation of the interoceptive cortex in the dorsal posterior insula by various modalities. a** | Graded cooling (reproduced, with permission, from REF. 5 © 2000 Macmillan Magazines Ltd). **b** | Sensual (limbic) touch evoked by slow brushing in a polyneuropathy patient with only C-mechanoreceptor activation (reproduced, with permission, from REF. 101 © 2002 Macmillan Magazines Ltd). **c** | Thermal pain (reproduced, with permission, from REF. 91 © 2002 Elsevier Science). **d** | Chronic pain (reproduced, with permission, from REF. 92 © 2001 International Association for the Study of Pain). **e** | Dynamic exercise on a bicycle (reproduced, with permission, from REF. 96 © 1999 The American Physiological Society). **f** | Forced respiration and isometric exercise with a hand grip (reproduced, with permission, from REF. 95 © 1999 John Wiley & Sons). **g** | Graded itch elicited by cutaneous histamine injection (reproduced, with permission, from REF. 94 © 2001 International Association for the Study of Pain). **h** | Cold allodynia (reproduced, with permission, from REF. 93 © 2000 International Association for the Study of Pain).

Craig, A.D. Nature Rev Neurosci, 2002

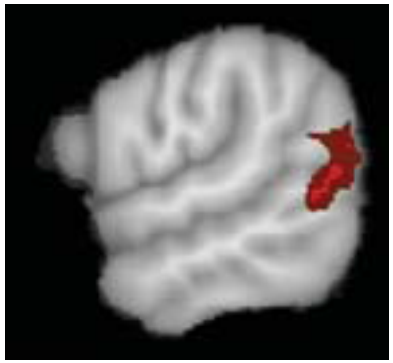
Efter insula

• Human Brain Mapping 00:000–000 (2011)

Brain Mechanisms for Processing Affective Touch

Ilanit Gordon, Avery C. Voos, Randi H. Bennett, Danielle Z. Bolling, Kevin A. Pelphrey, and Martha D. Kaiser*

Yale Child Study Center, Yale University School of Medicine



EJN EUROPEAN JOURNAL OF NEUROSCIENCE

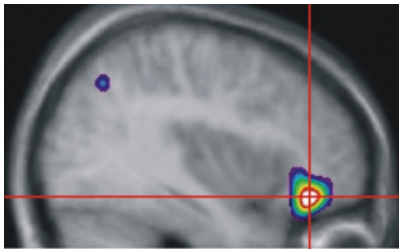
European Journal of Neuroscience, Vol. 35, pp. 1782–1788, 2012 doi:10.1111/j.1460-9568.2012.08092.x

BEHAVIORAL NEUROSCIENCE

Touching and feeling: differences in pleasant touch processing between glabrous and hairy skin in humans

F. McGlone,[1] H. Olausson,[2] J. A. Boyle,[3] M. Jones-Gotman,[3] C. Dancer,[4] S. Guest[5] and G. Essick[5]

[1]School of Natural Sciences & Psychology, Liverpool John Moores University, Liverpool, UK
[2]Department of Clinical Neurophysiology, Sahlgrenska University Hospital, Göteborg, Sweden
[3]Montreal Neurological Institute, McGill University, Montreal, Canada
[4]DancerDesign, St Helens, UK
[5]Department of Prosthodontics and Center for Neurosensory Disorders, School of Dentistry, University of North Carolina, Chapel Hill, NC, USA



NeuroImage 59 (2012) 3427–3432

Contents lists available at SciVerse ScienceDirect

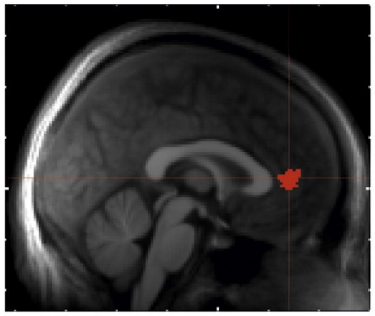
NeuroImage

journal homepage: www.elsevier.com/locate/ynimg

Pleasant human touch is represented in pregenual anterior cingulate cortex

Lenita Lindgren [a,b,*], Göran Westling [c], Christine Brulin [a], Stefan Lehtipalo [b], Micael Andersson [c], Lars Nyberg [c,d]

[a] Department of Nursing, Umeå University, Sweden
[b] Department of Surgical and Perioperative Science, Anesthesiology and Intensive Care, Umeå University Hospital, Sweden
[c] Radiation Sciences and Integrative Medical Biology, Umeå University Hospital, Umeå, Sweden
[d] Umeå Center for Functional Brain Imaging (UFBI), Sweden



Sagittal slice at 0mm

- posterior superior temporal sulcus
- mid-anterior orbitofrontal cortex
- pregenual anterior cingulate cortex

Patienter med selektiv förlust av C-nerver

- Vittangisjukan (hereditär sensorisk och autonom neuropati typ V)
- Uttalad förlust av C-nerver
- A-nerver intakta
- Nedsatt känsel för smärta och temperatur
- Frakturer utan smärta
- Ledmissbildningar

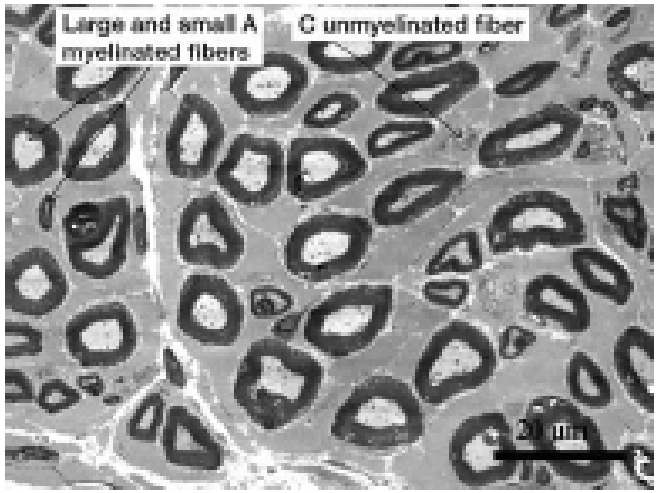
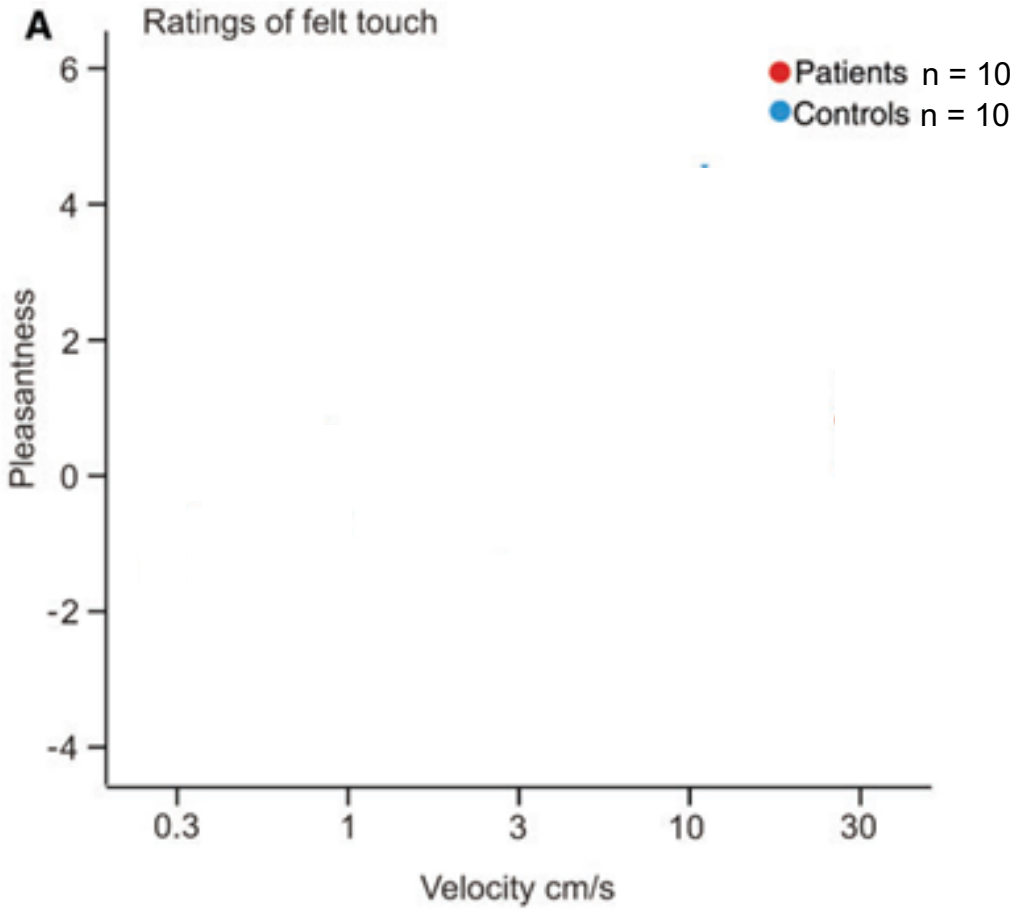
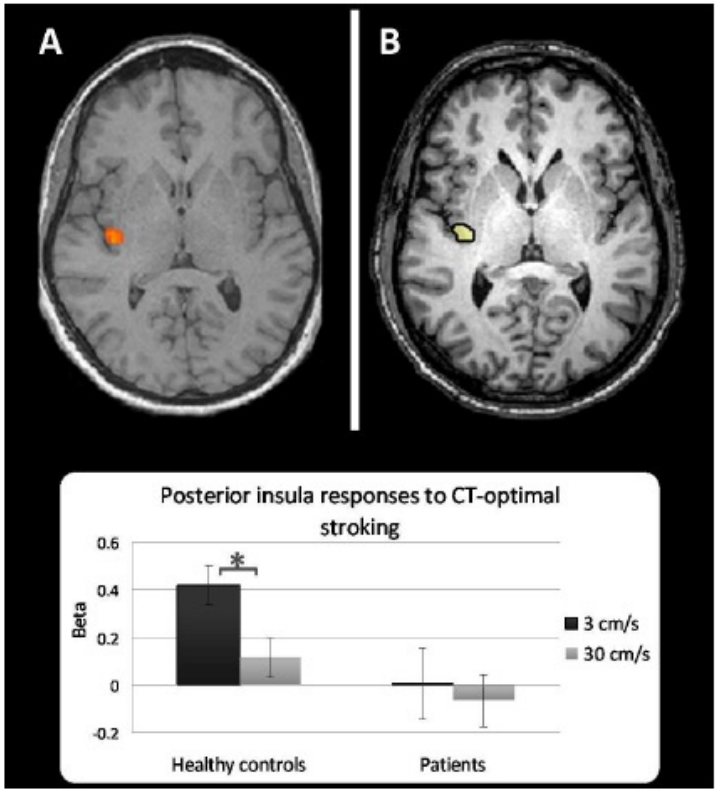


Figure 7. Electron microscopy from the sural nerve (case 1) showing severe reduction in number of C fibers.

Minde, Thesis, 2006

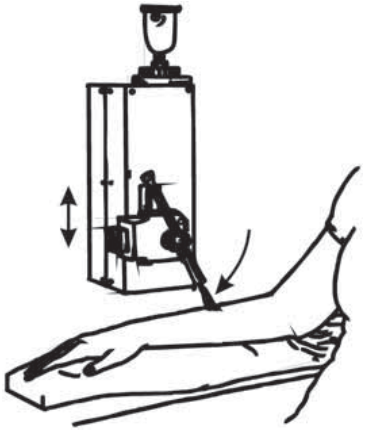
Patienter med selektiv förlust av C-nerver

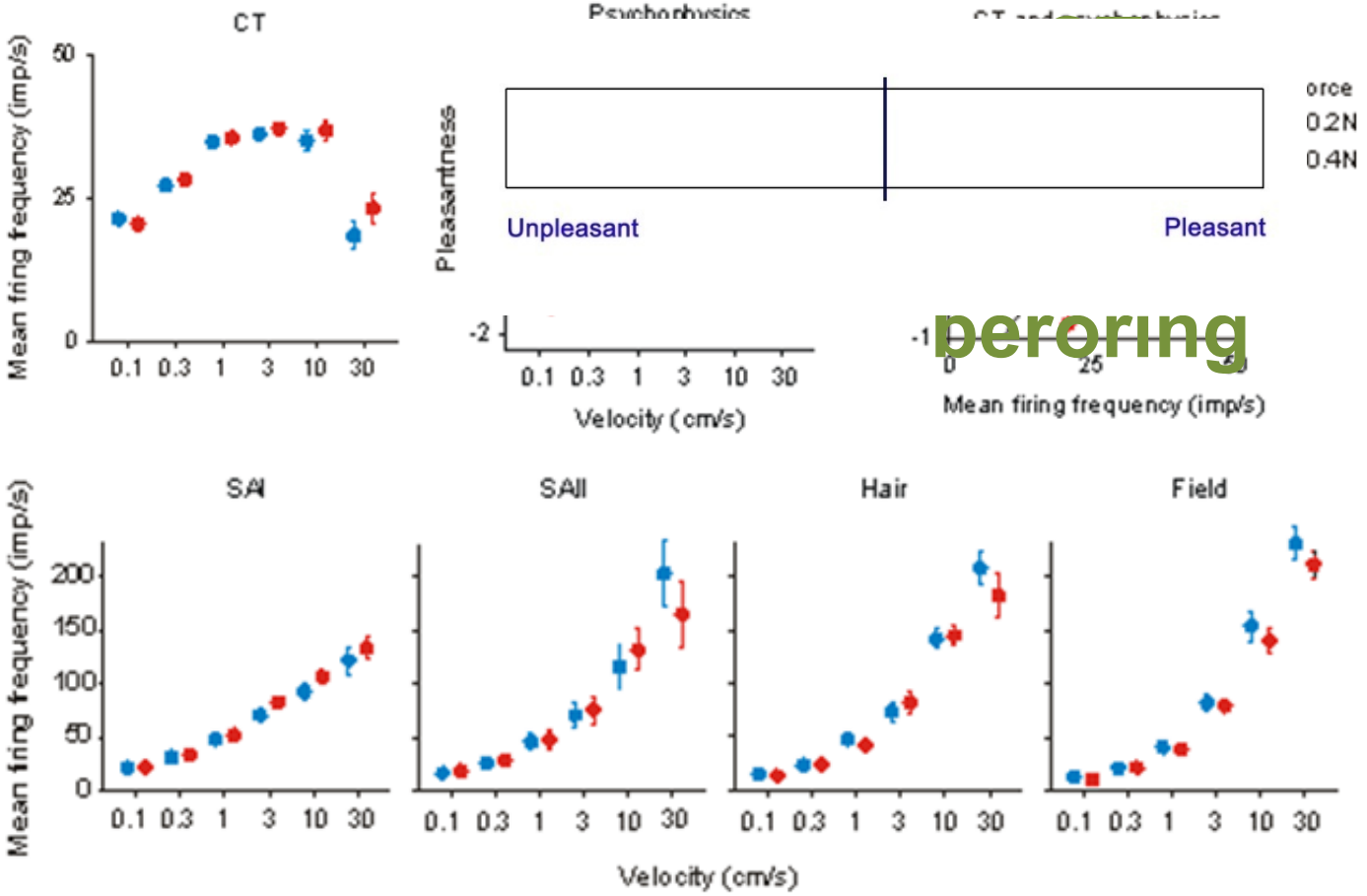




Morrison et al, Brain, 2011

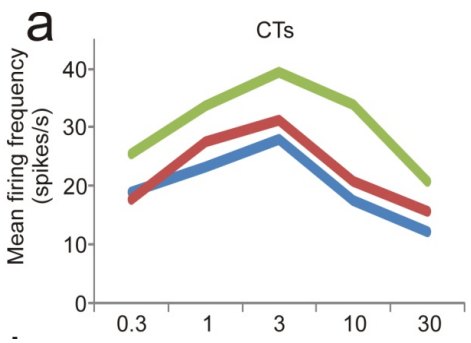
Tillbaka till mikroneurografi

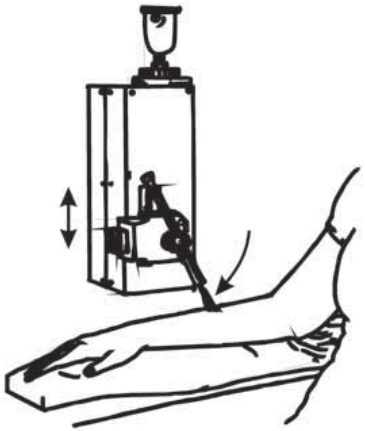




Löken, et al., Nat Neurosci, 2009

Temperatureffekter





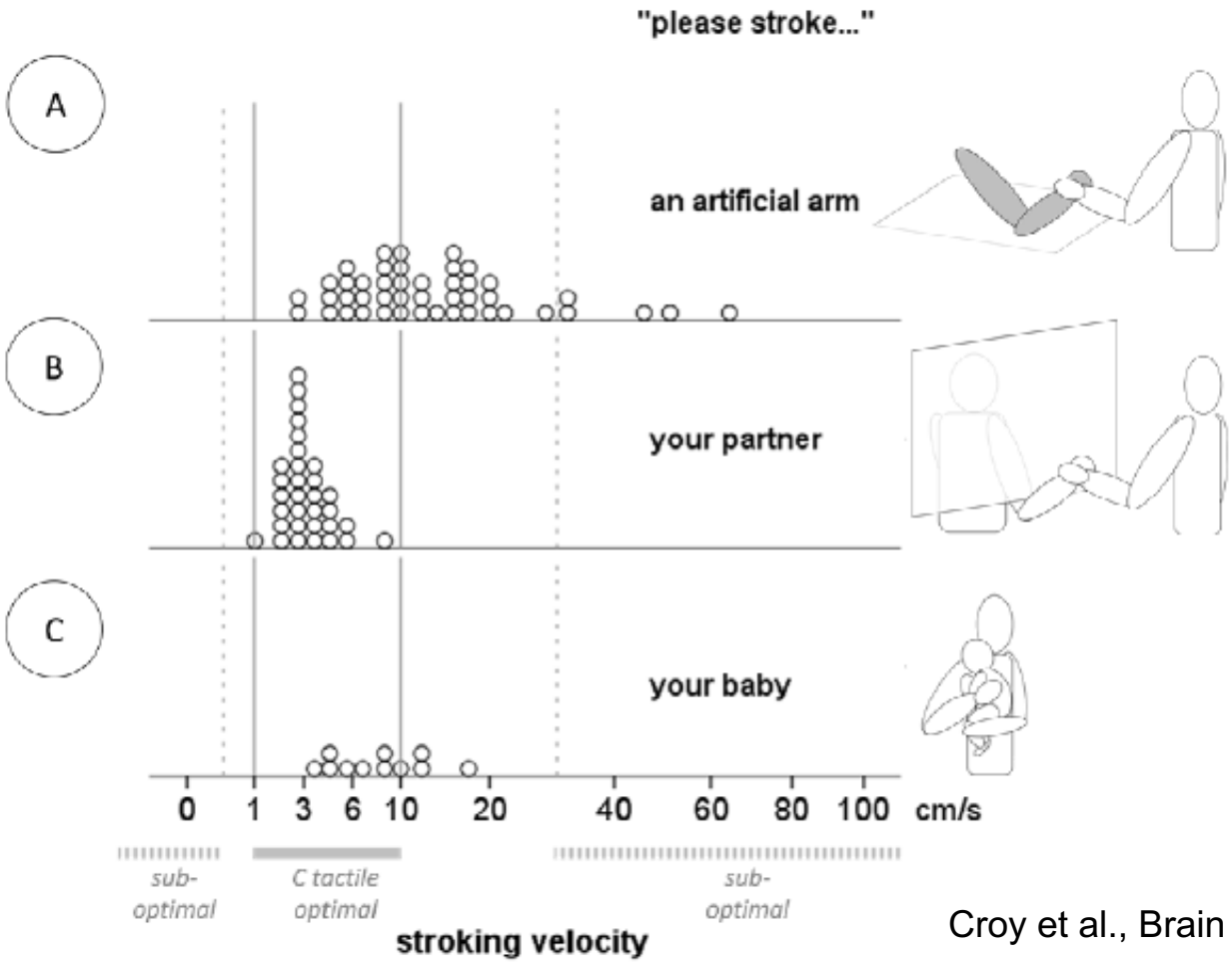
- Hastighet 1-10 cm/s
- Temperatur 32 grader C

- CT-systemet är inställt på att svara på mänsklig beröring

Cool Neutral Warm

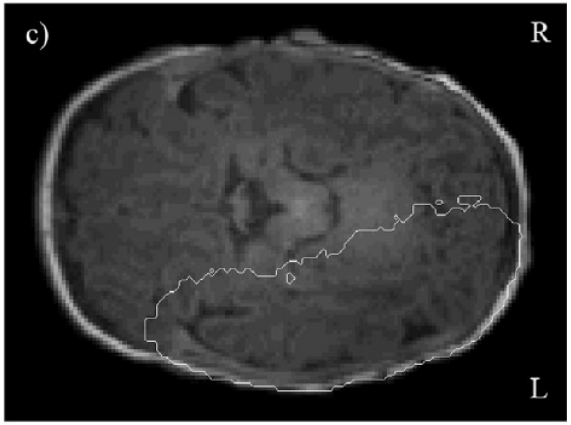
Ackerley et al, J Neurosci, 2014

Hastighet för hudstrykningar



Croy et al., Brain Res Bull, 2015

Långsam och snabb borststrykning på två månaders barn

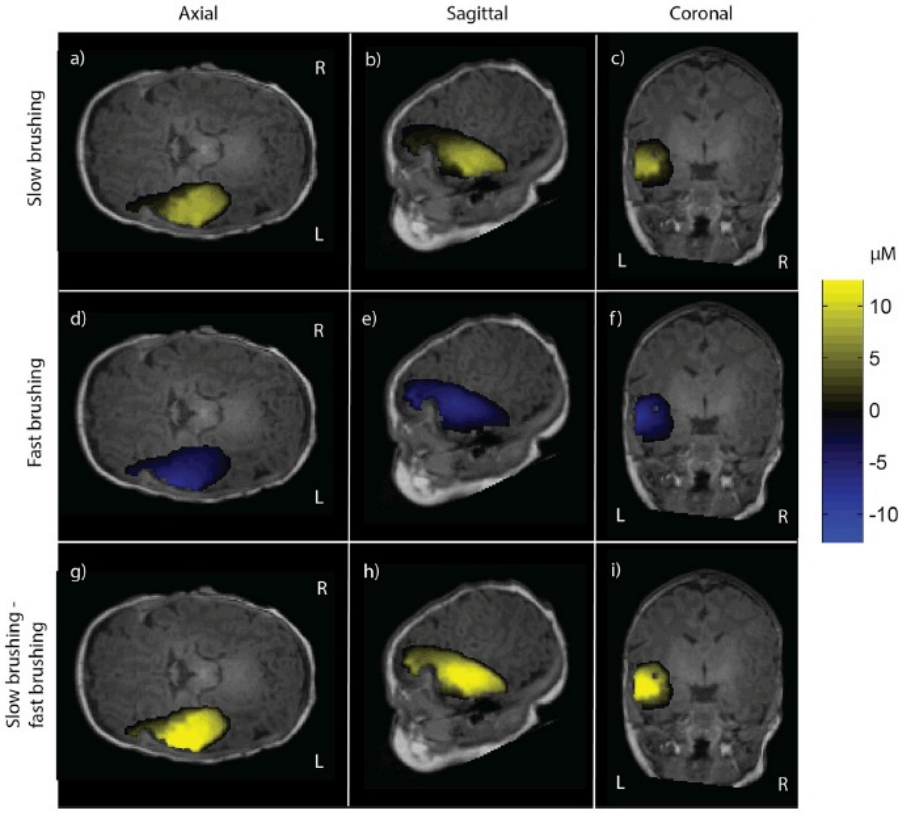


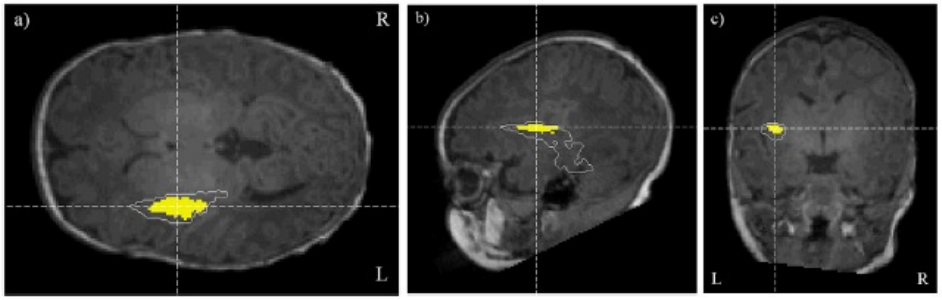
N = 16

3 cm/s
20 cm/s

Jönsson et al, Neuroimage, 2018

Olika svar på långsam och snabb borststrykning





Två månaders barn kan skilja mellan långsam och snabb borststrykning

Beröring över livscykeln

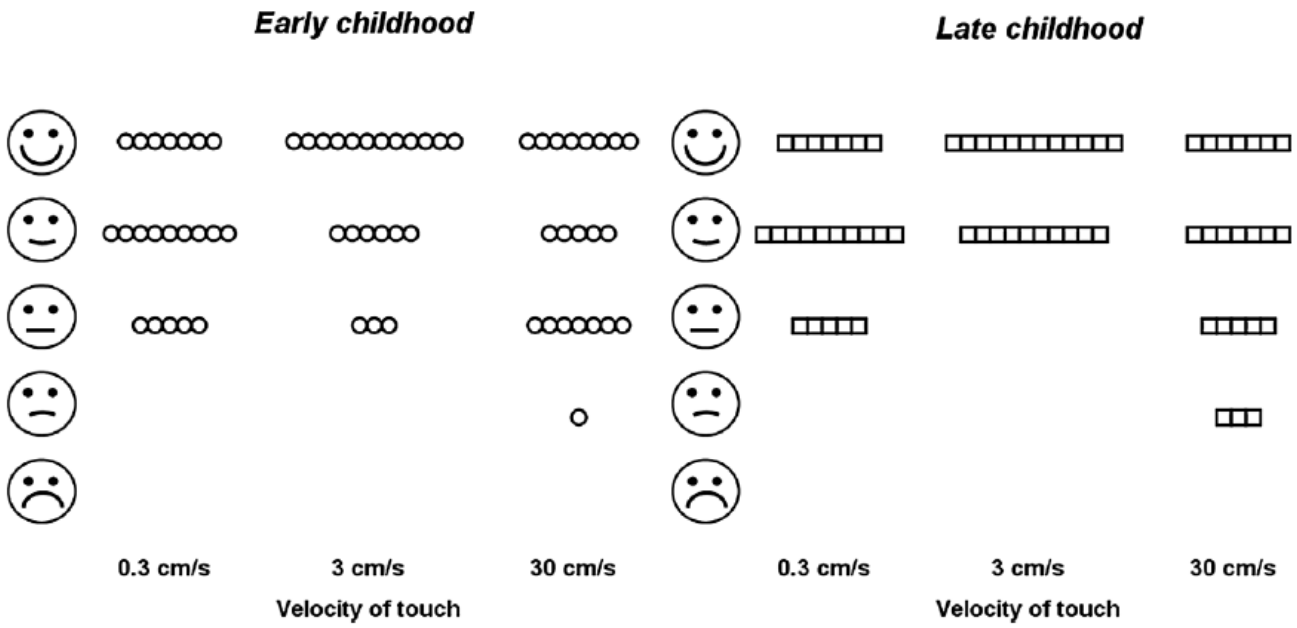
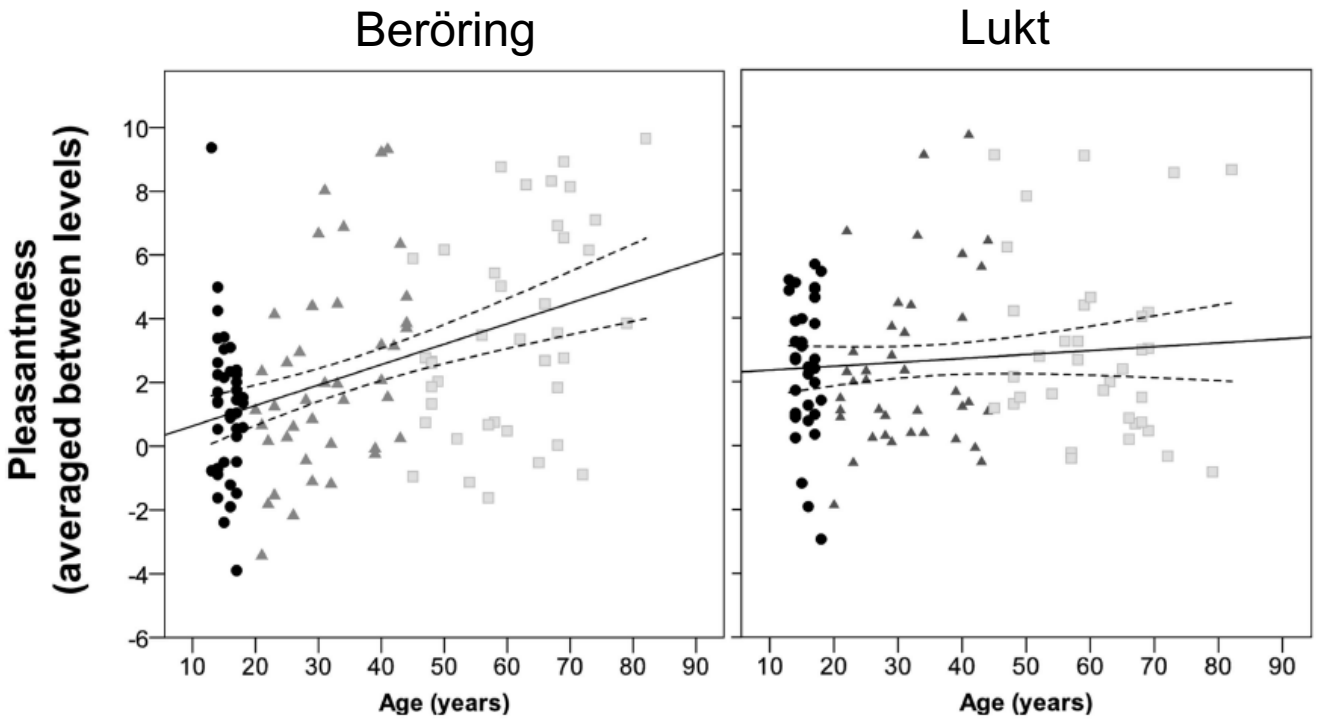


Fig. 1. Pleasantness ratings following soft stroking on the forearm with the C-tactile suboptimal stroking velocity of 0.3 and 30 cm/s and the optimal stroking velocity of 3 cm/s for early and late childhood. The highest density of positive ratings is observed for the 3 cm/s velocity of touch. Ratings were done by young (5–8 years, N = 21) and older (9–12 years, N = 22) children. Each circle represents the median rating of a single child. Children in both age groups significantly preferred the C-tactile optimal over the suboptimal velocities.

Croy et al, Developmental Cog Neurosci, 2017

Beröring över livscykeln



Beröring uppfattas som mer behaglig hos äldre

Sehlstedt et al., Psych Aging, 2016

Psykofarmakologiska mekanismer

Neuroscience and Biobehavioral Reviews 34 (2010) 260–268

Contents lists available at ScienceDirect

Neuroscience and Biobehavioral Reviews

journal homepage: www.elsevier.com/locate/neubiorev

Review

The social role of touch in humans and primates: Behavioural function and neurobiological mechanisms

R.I.M. Dunbar *

British Academy Centenary Research Project, Institute of Cognitive & Evolutionary Anthropology, University of Oxford, 64 Banbury Road, Oxford OX2 6PN, United Kingdom

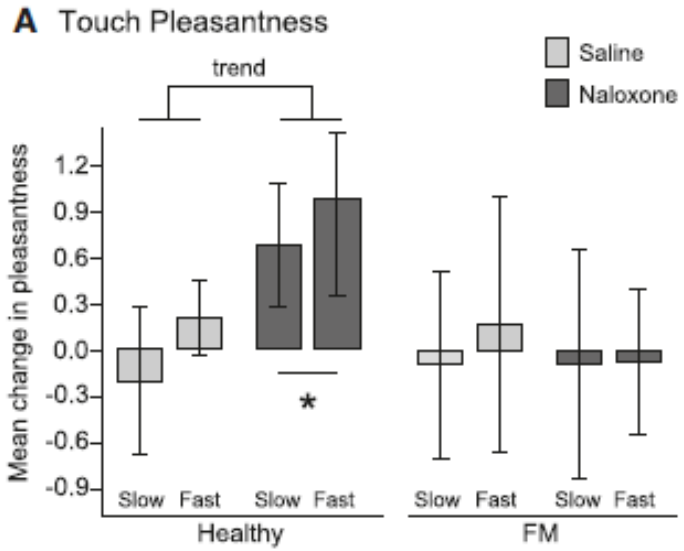
ARTICLE INFO

Keywords:
Touch
Social grooming
Endorphins
Oxytocin
Social bonding
Primates

ABSTRACT

Grooming is a widespread activity throughout the animal kingdom, but in primates (including humans) social grooming, or allo-grooming (the grooming of others), plays a particularly important role in social bonding which, in turn, has a major impact on an individual's lifetime reproductive fitness. New evidence from comparative brain analyses suggests that primates have social relationships of a qualitatively different kind to those found in other animal species, and I suggest that, in primates, social grooming has acquired a new function of supporting these. I review the evidence for a neuropeptide basis for social bonding, and draw attention to the fact that the neuroendrocrine pathways involved are quite unresolved. Despite recent claims for the central importance of oxytocin, there is equally good, but invariably ignored, evidence for a role for endorphins. I suggest that these two neuropeptide families may play different roles in the processes of social bonding in primates and non-primates, and that more experimental work will be needed to tease them apart.

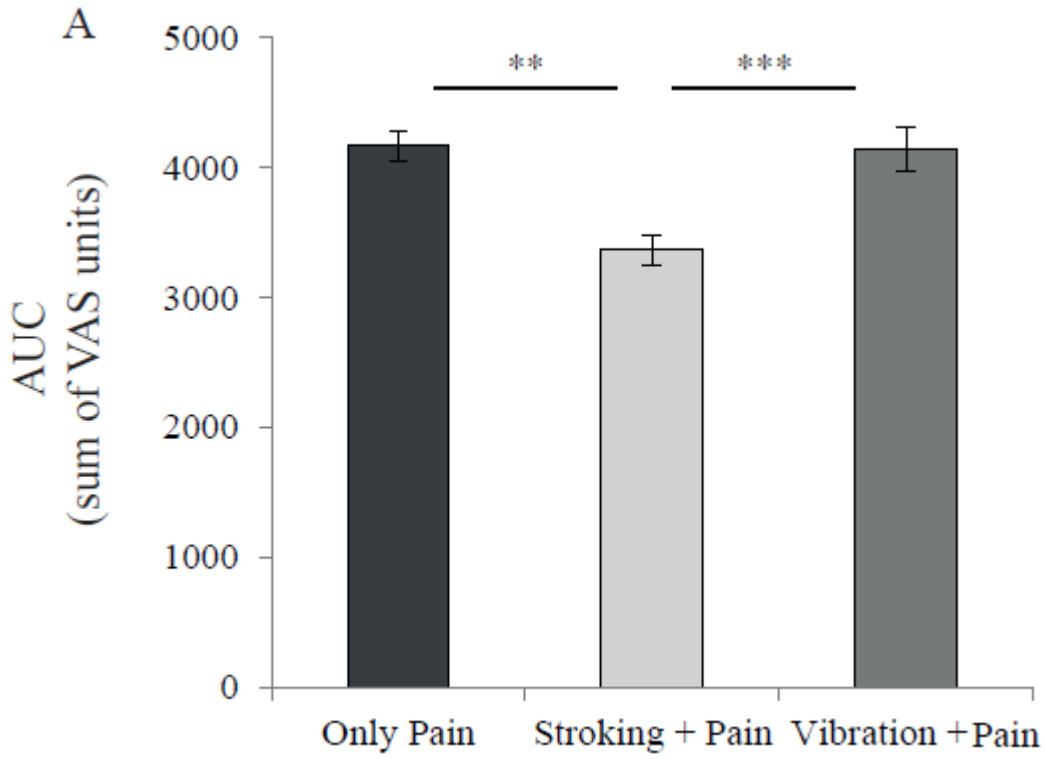
Naloxon gör att beröring upplevs behagligare hos friska och svagare vid fibromyalgi



Case et al., eNEURO 2016

Behaglig beröring och smärta

Endast värmesmärta
Värmesmärta och långsam borststrykning
Värmesmärta och vibration (50 Hz)

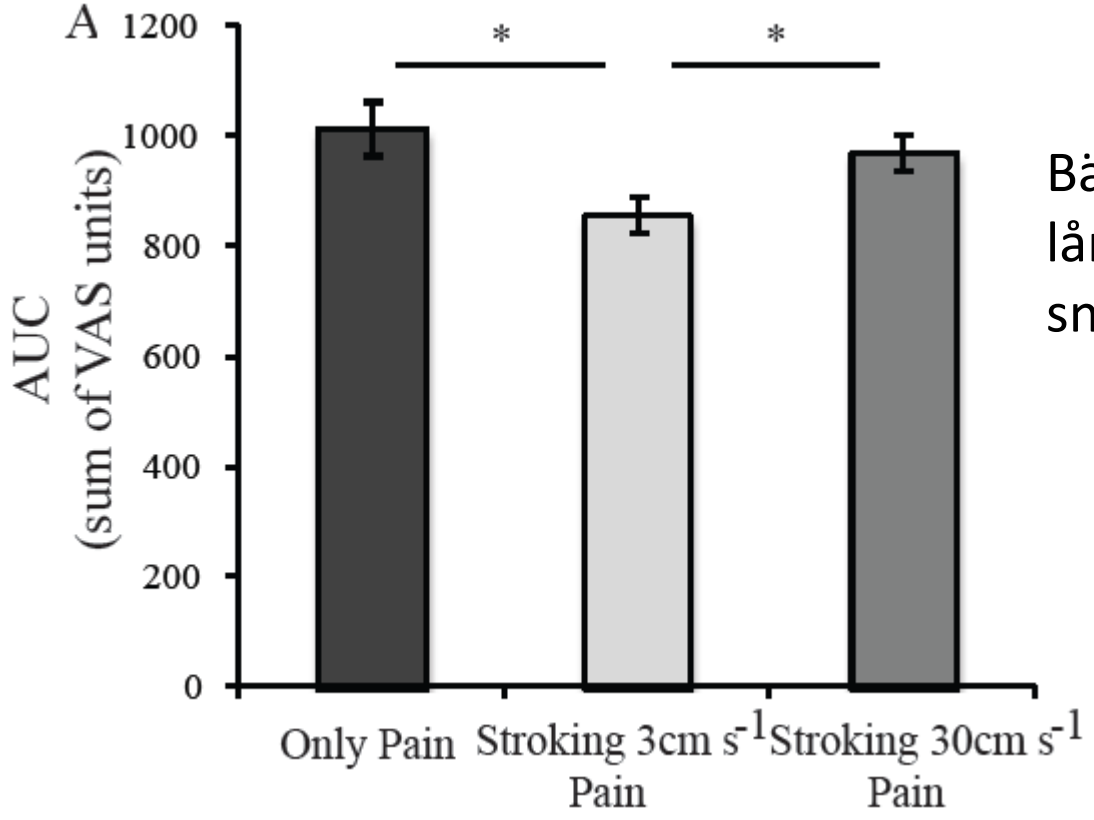


- Smärtlindring av långsam borststrykning
- Kan vara till följd av distraktion

Liljencrantz et al, Eur J Pain, 2017

Behaglig beröring och smärta

Endast värmesmärta
Långsam strykning (3cm/s) följt av värmesmärta
Snabb strykning (30cm/s) följt av värmesmärta

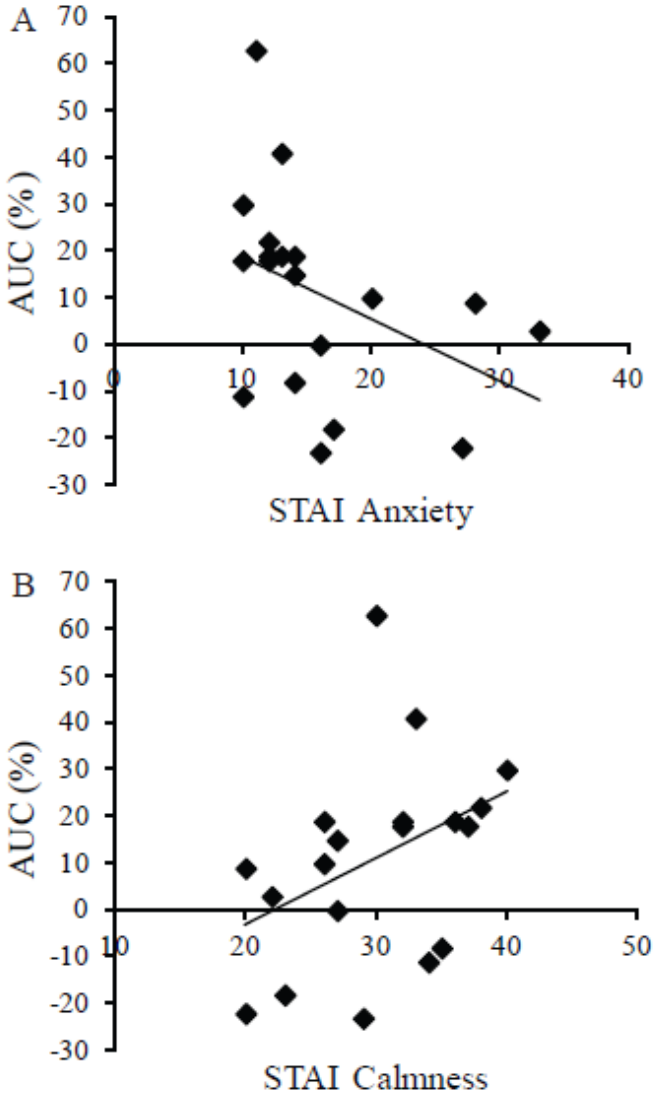


Bättre smärtlindring för långsam (10%) jämfört med snabb (1%) borststrykning

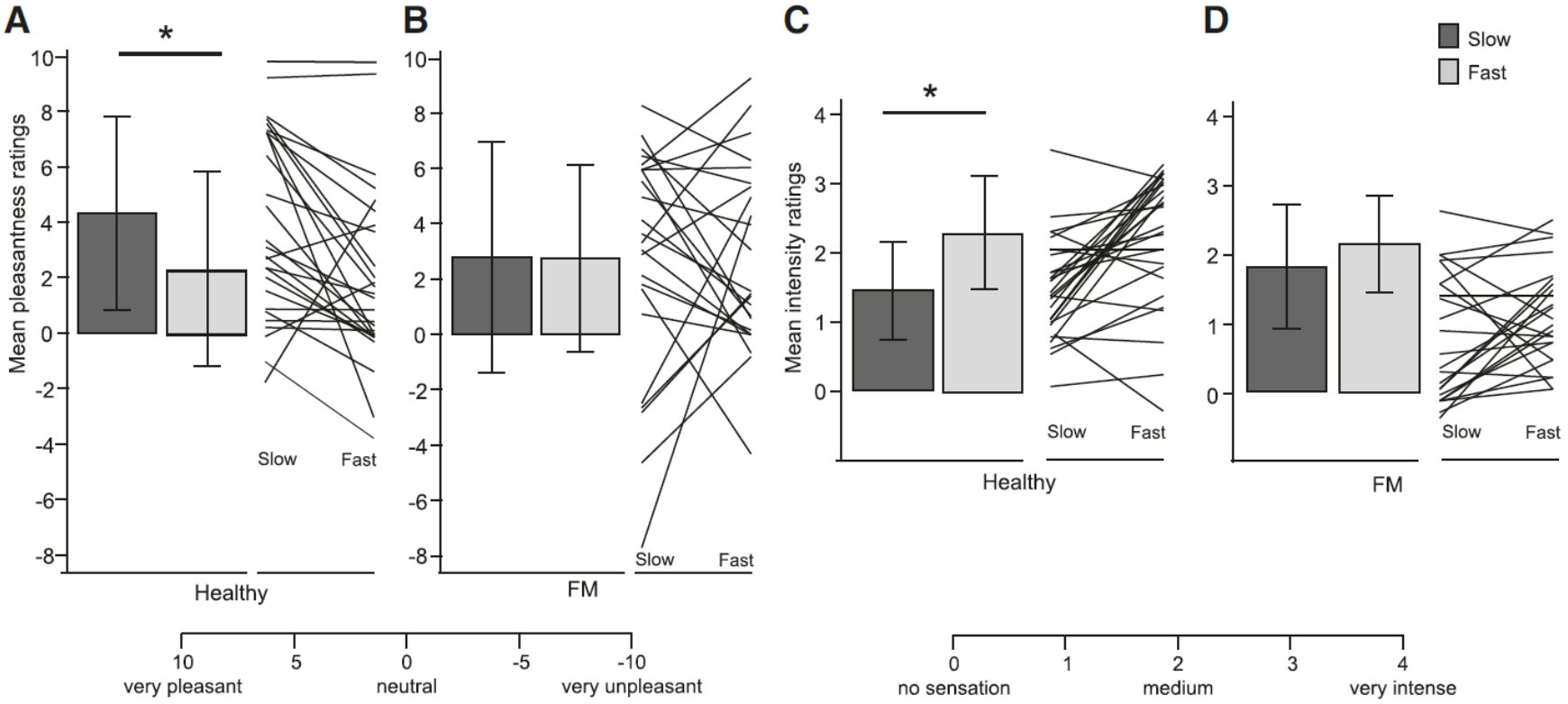
Behaglig beröring och smärtlindring

Skattningsformulär

Individuella skillnader i smärtlindring korrelerar med hur orolig och lugn man känner sig



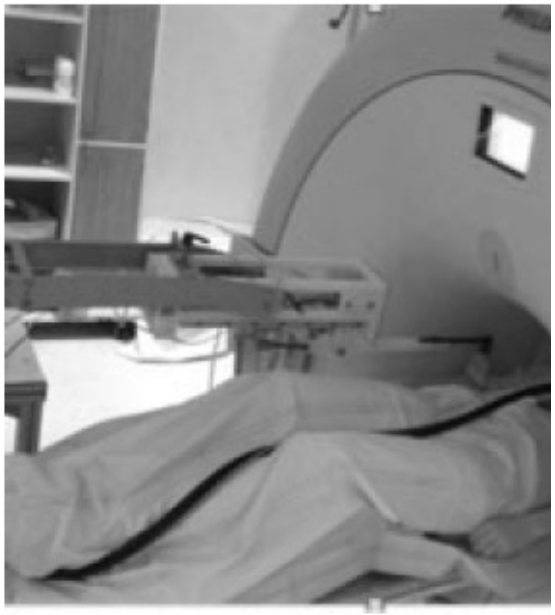
Hur påverkar kronisk smärta hudberöring?



Små skillnader mellan långsam och snabb borststrykning vid fibromyalgi

Case et al., eNEURO 2016

Hudberöring vid anorexia nervosa



Characteristic	Healthy controls (HC, n=25)		Anorexia nervosa (AN, n=25)		p
	Mean	SD	Mean	SD	
Age	21.2	2.1	20.3	2.2	n.s.
Age of onset	-	-	16.3	2.7	-
Duration of illness			4.1	3.5	
Years of education	13.7	1.4	12.2	1.5	n.s.
Body mass index (BMI)	21.1	2.3	16.3	1	<0.001
Depression score (BDI)	7.0	7.5	27.2	13.2	<0.001
Skin stroking pleasantness rating	1.5	1.6	0.4	1.7	0.03

Table 1 *Demographic, clinical and behavioral data for healthy controls and women diagnosed with AN.*

Davidovic et al, submitted

Svagare aktivering av nucleus caudatus hos anorexia nervosa

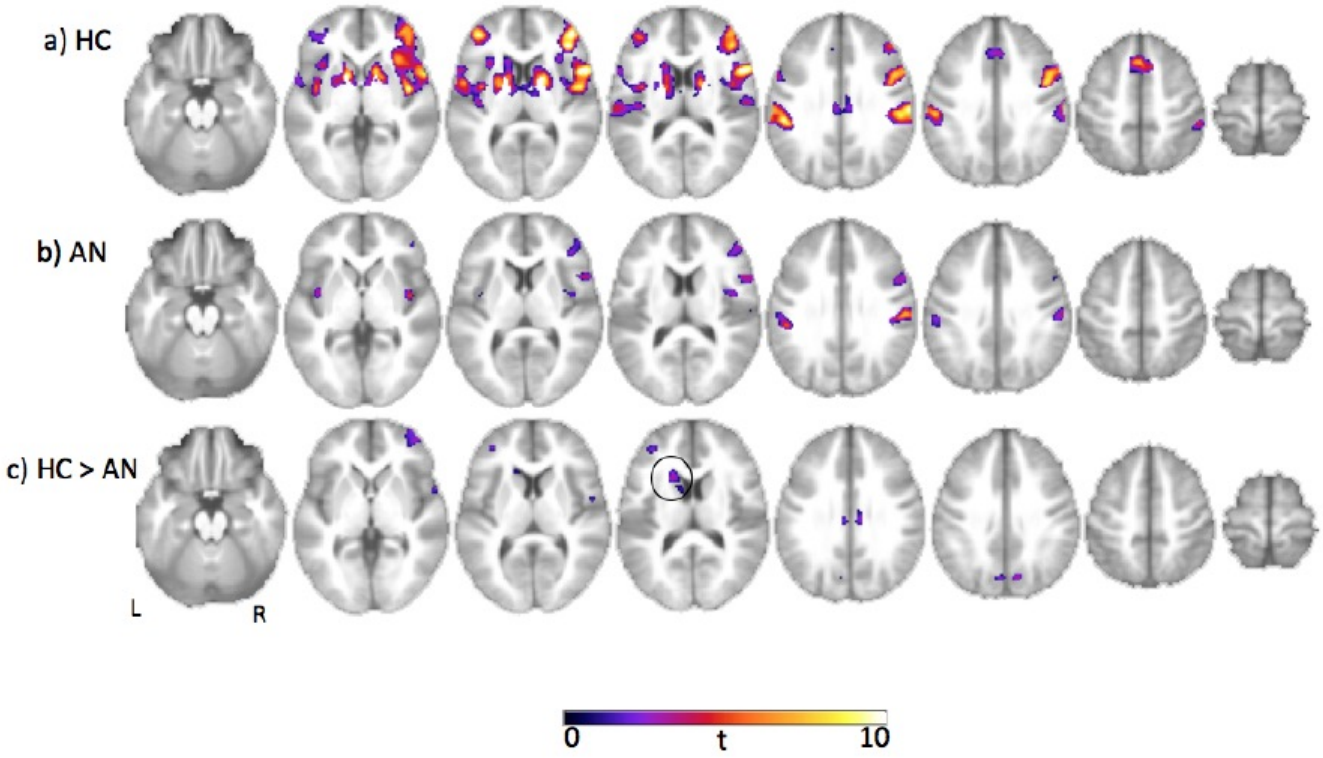
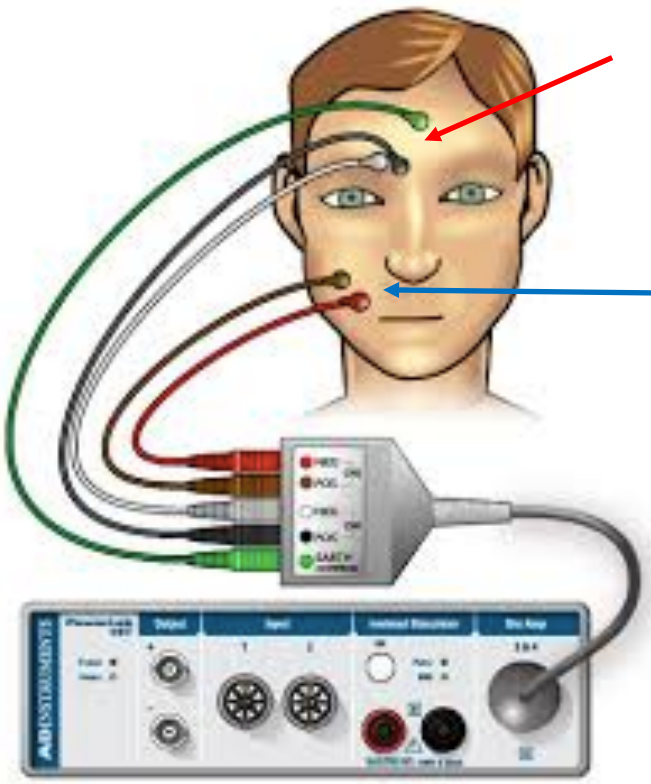


Figure 4 *Whole brain results for the contrast 'brush move'>'brush rest' for healthy controls (HC), anorexia nervosa patients (AN), and contrast between the two groups. All three maps are thresholded at p<0.001 and cluster size 37. Images are presented at z: -20, -6, 0, 8, 14, 30, 36, 52, 68. In circle: left caudate nucleus (caput).*

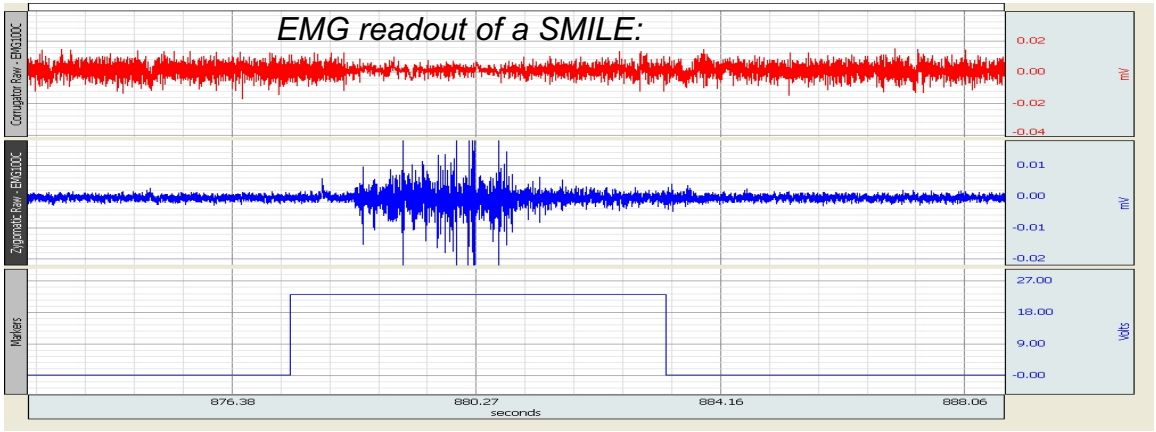
Davidovic et al, submitted

Ansikts-EMG och hudberöring

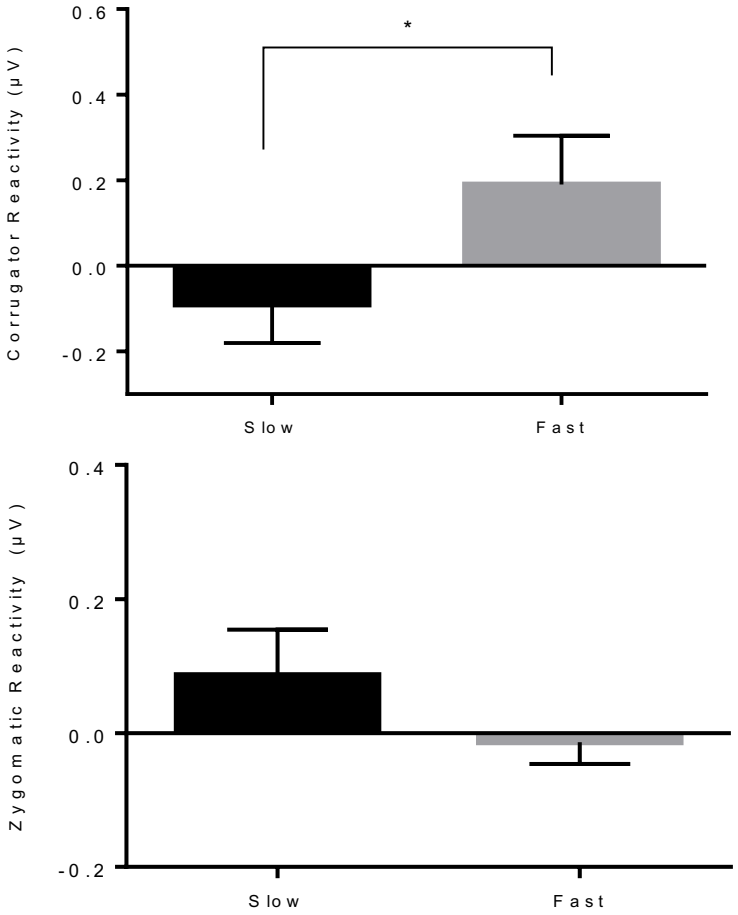


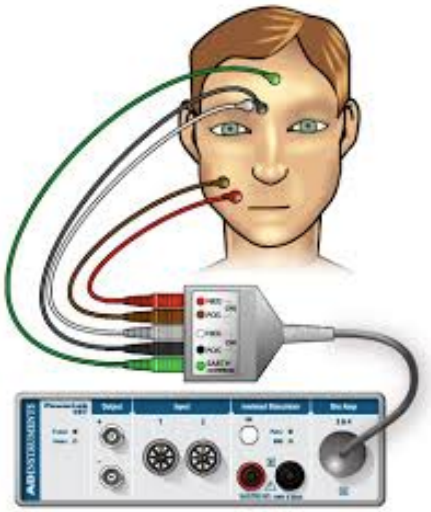
Corrugator
activates when frowning

Zygomatic
activates when smiling



Ansikts-EMG och hudberöring



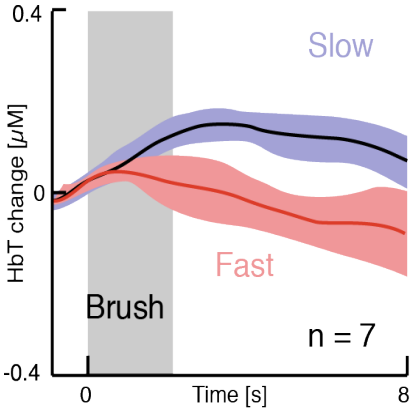


Mayo et al., manuscript

Tack till

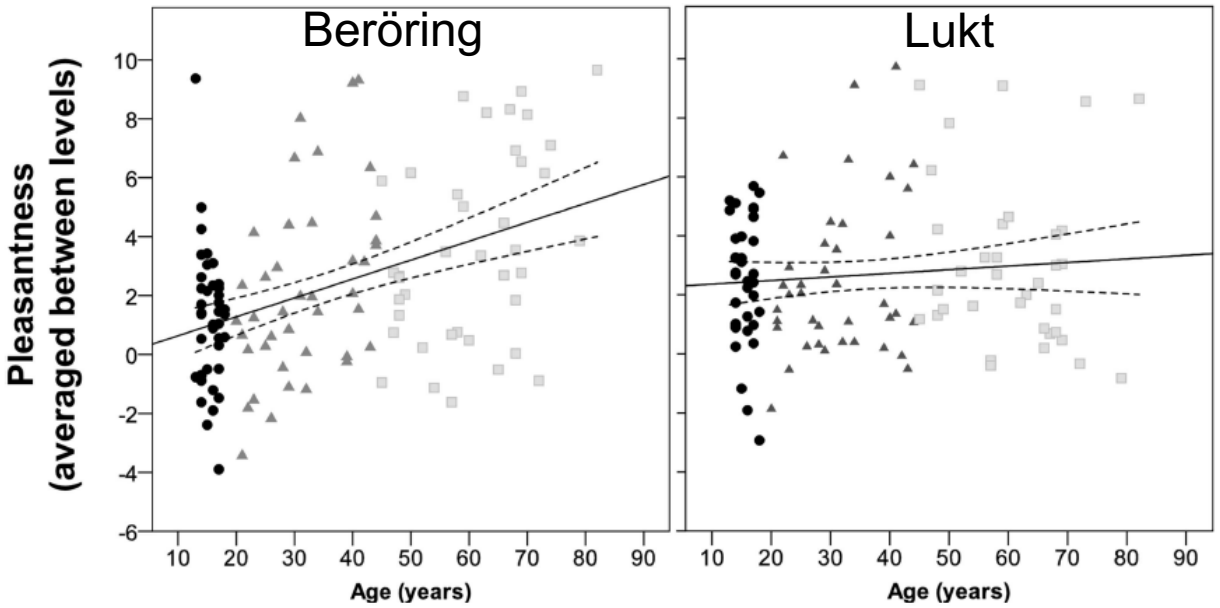
- Catherine Bushnell, National Institutes of Health, USA
- Ilona Croy, Dresden Technical Univ
- Francis McGlone, Liverpool John Moores Univ
- Hasse Karlsson, Åbo universitet
- Medarbetare vid Göteborgs och Linköpings universitet
- Bidrag från Vetenskapsrådet, MMW, Västra Götalandsregionen och Region Östergötland

CT-beröring över livscykeln



CT utvecklas
innan ”vanlig beröring”?

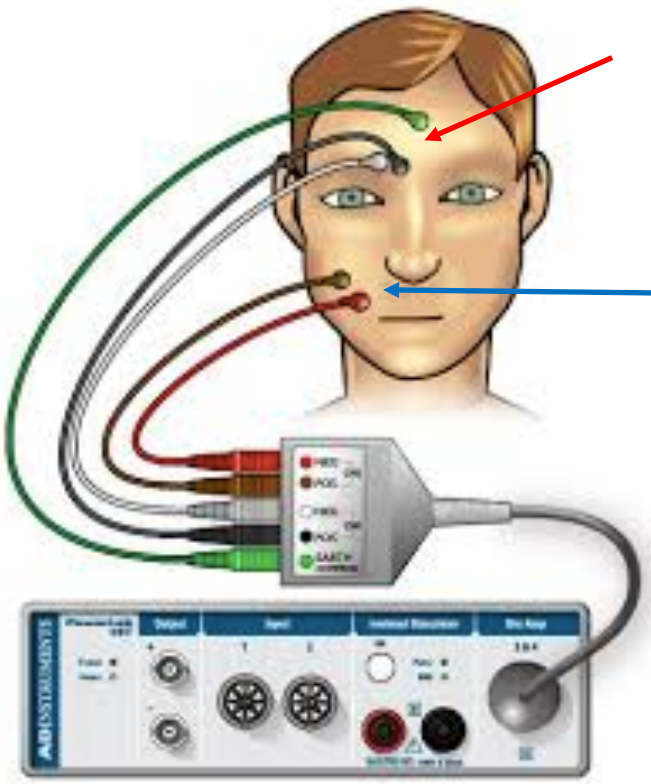
Jönsson et al., submitted



Beröring
behagligare
med åldern

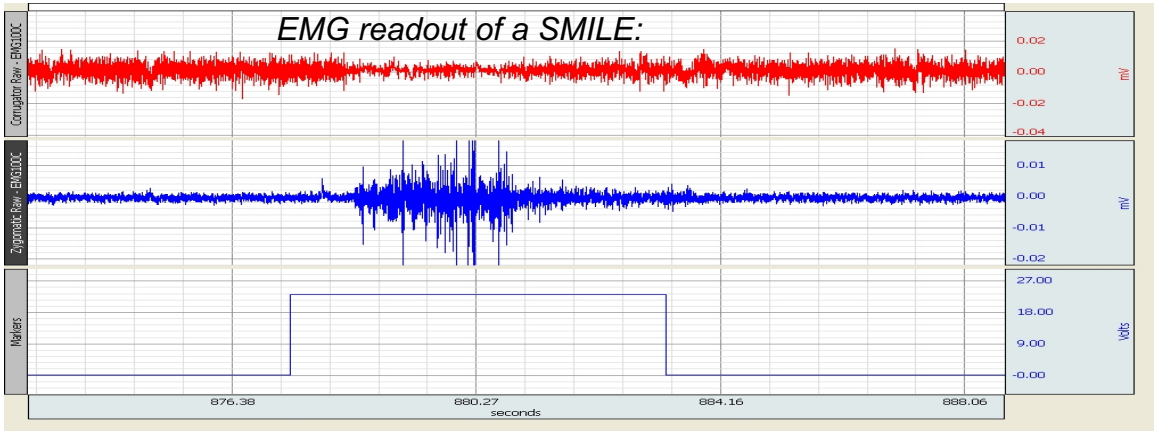
Sehlstedt et al.,
Psych Aging, 2016

Ansiktsmimik och välbehag (pågående)

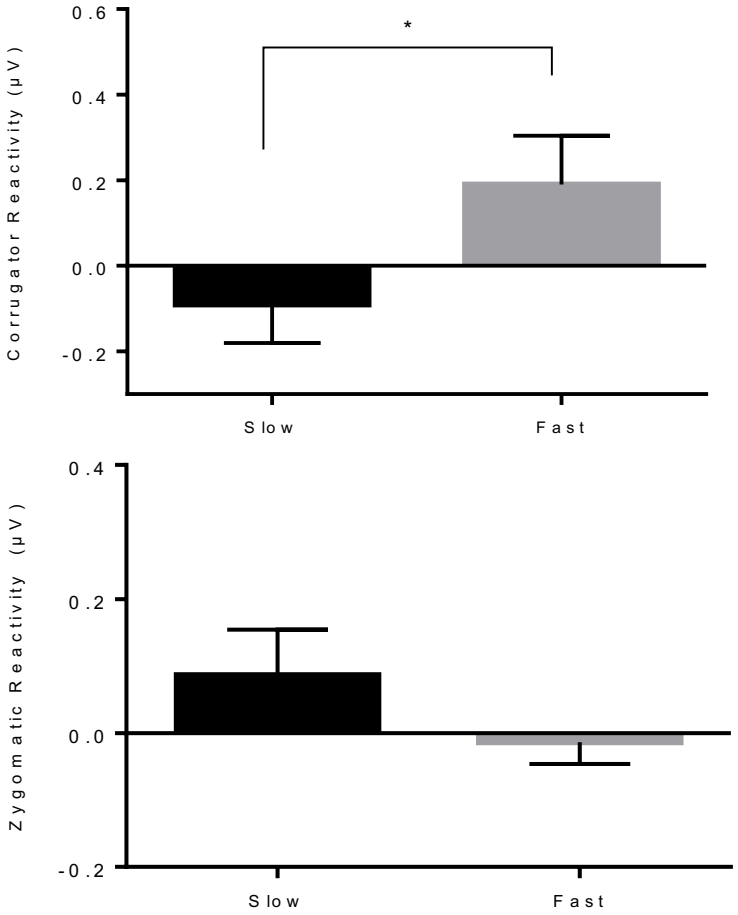


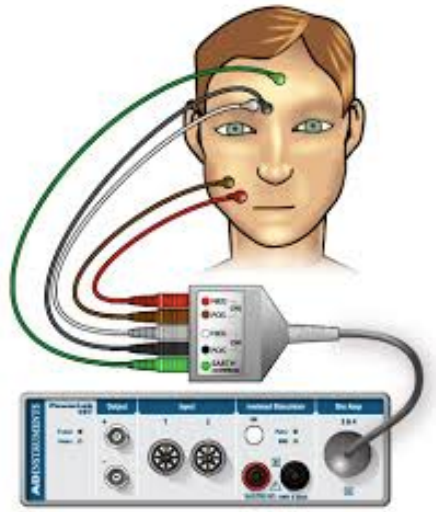
Corrugator
activates when frowning

Zygomatic
activates when smiling



Ansiktsmimik vid hudstimulering (pågående)

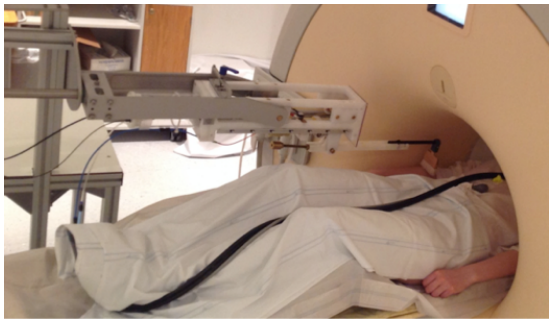




Mayo et al., manuskript

CT-beröring vid självsvält (pågående)

Beröring är viktig för kroppsuppfattning



Davidovic et al, manuskript

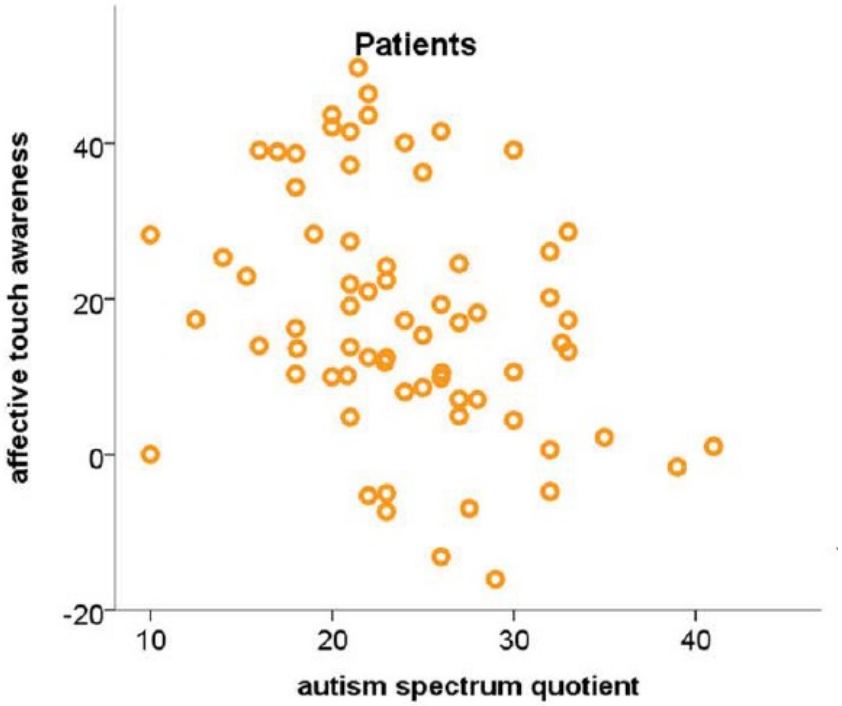
Anorexia nervosa (n = 23)

Mindre aktivering av insula

Sjukdomsmekanism?

”Top-down”-faktorer (pågående)

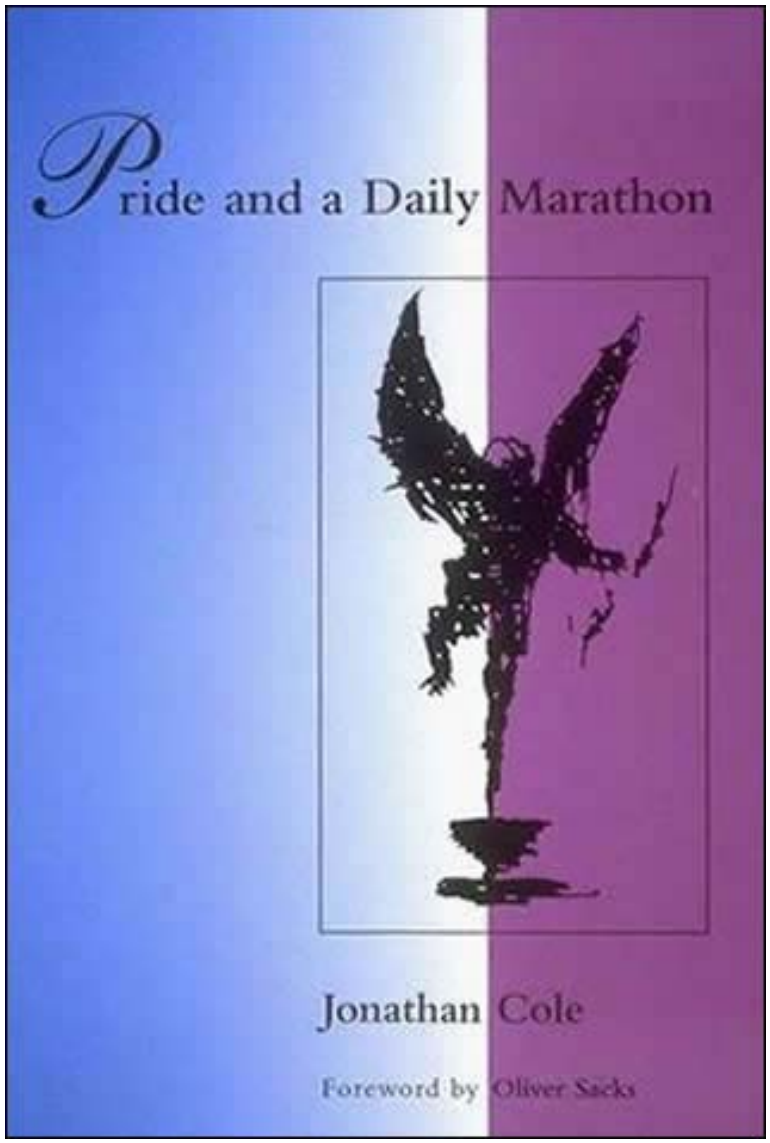
- Vem som berör (föremål, själv, vän, främling)
  - fMRI
  - ansiktsEMG
- Friska och autism



Croy et al., Psych Res, 2016

Våra sinnen

- Syn
- Hörsel
- Lukt
- Smak
- Känsel



"At the age of 19, Ian Waterman was suddenly struck down at work by a rare neurological illness that deprived him of all sensation below the neck. He fell on the floor in a heap, unable to stand or control his limbs,…"

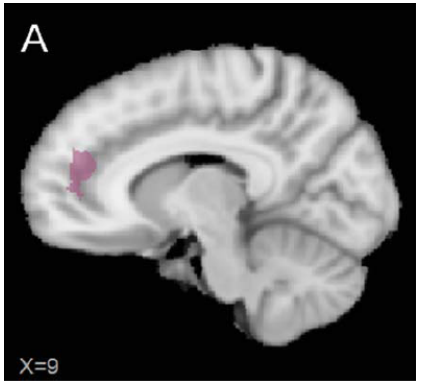
Efter insula

• Human Brain Mapping 00:000–000 (2011)

Brain Mechanisms for Processing Affective Touch

Ilanit Gordon, Avery C. Voos, Randi H. Bennett, Danielle Z. Bolling, Kevin A. Pelphrey, and Martha D. Kaiser*

Yale Child Study Center, Yale University School of Medicine



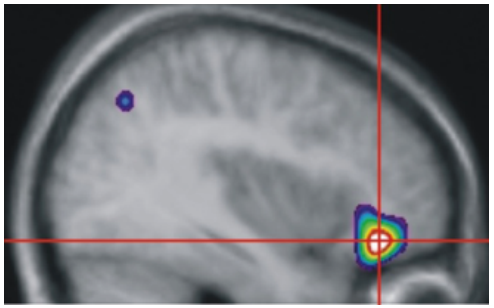
EJN fens EUROPEAN JOURNAL OF NEUROSCIENCE

European Journal of Neuroscience, Vol. 35, pp. 1782–1788, 2012 doi:10.1111/j.1460-9568.2012.08092.x

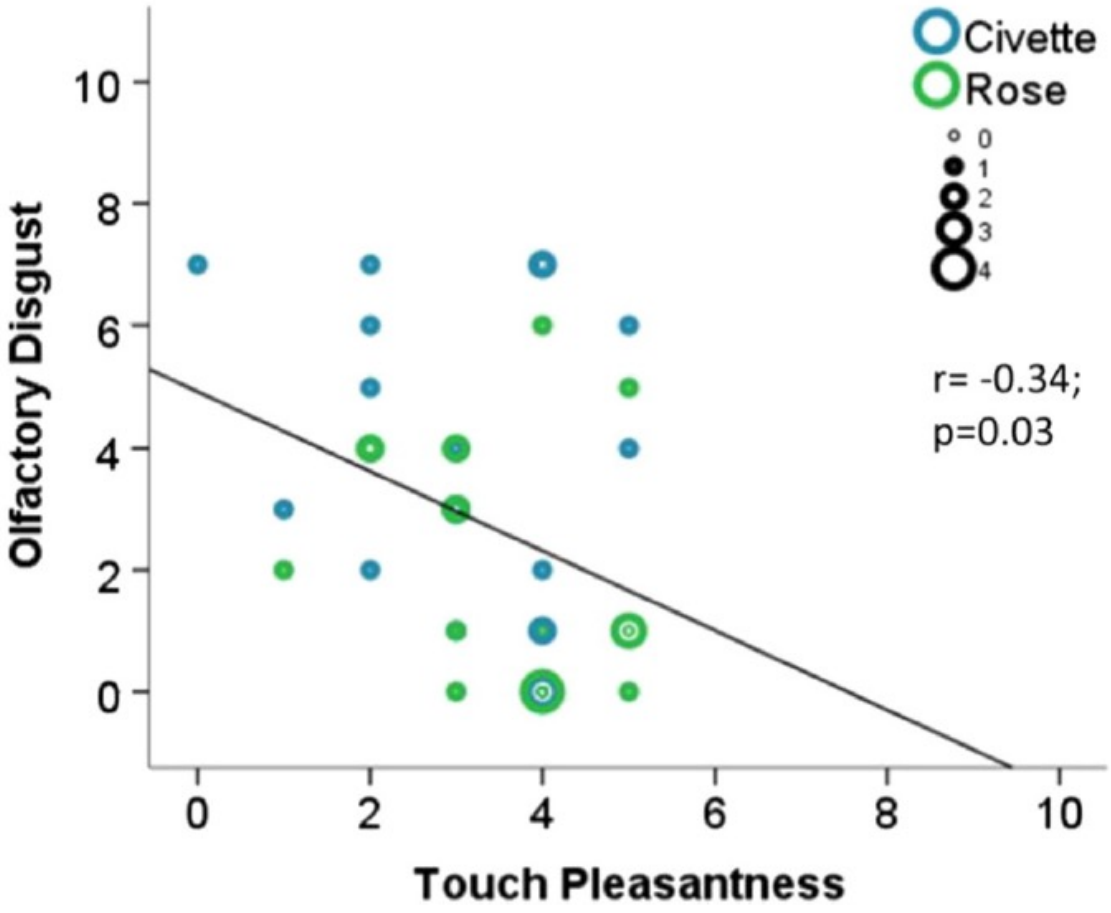
BEHAVIORAL NEUROSCIENCE

Touching and feeling: differences in pleasant touch processing between glabrous and hairy skin in humans

F. McGlone,[1] H. Olausson,[2] J. A. Boyle,[3] M. Jones-Gotman,[3] C. Dancer,[4] S. Guest[5] and G. Essick[5]
[1]School of Natural Sciences & Psychology, Liverpool John Moores University, Liverpool, UK
[2]Department of Clinical Neurophysiology, Sahlgrenska University Hospital, Göteborg, Sweden
[3]Montreal Neurological Institute, McGill University, Montreal, Canada
[4]DancerDesign, St Helens, UK
[5]Department of Prosthodontics and Center for Neurosensory Disorders, School of Dentistry, University of North Carolina, Chapel Hill, NC, USA

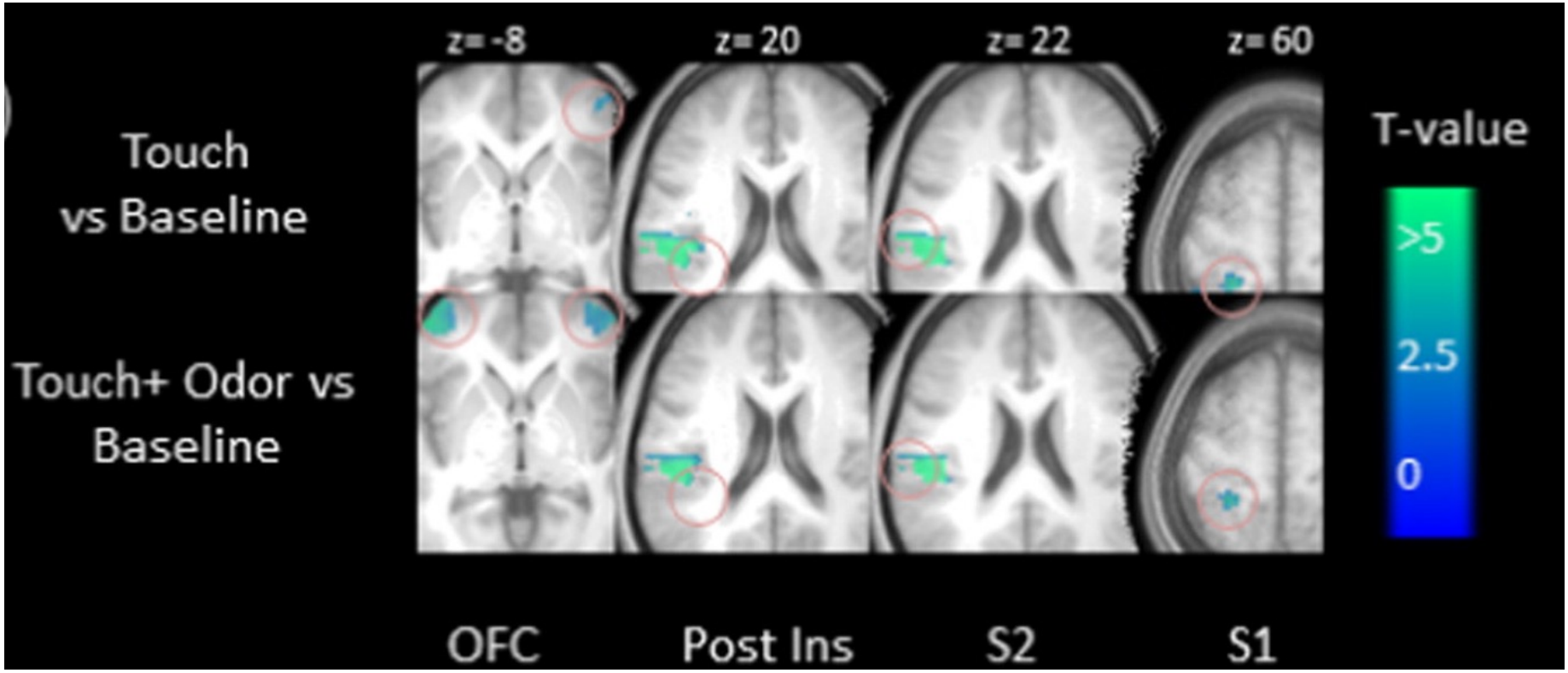


Beröring och lukt



Croy et al., Neuroimage 2016

Beröring och lukt



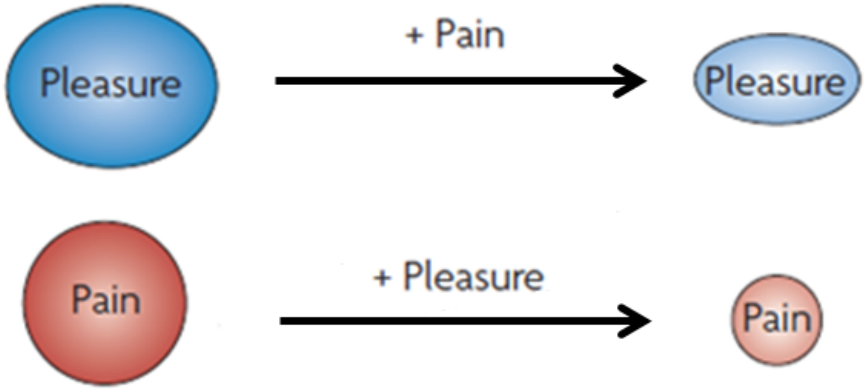
Croy et al., Neuroimage 2016

Obehaglig beröring förskjuter bearbetning från insula till känselhjärnbark

Affective touch and pain interaction

"Nature has placed mankind under the governance of two sovereign masters, pain and pleasure."

-Jeremy Bentham



Leknes & Tracey, Nature Rev Neuosci. 2008

Does CT targeted touch reduce pain in humans?

Three animal studies support a role for CTs in pain modulation:

- C-LTMR targeted input may inhibit C-nociceptive messages in the dorsal horn

  Lu & Perl, J.Neurosci, 2003

- Pharmacogenetic activation of C-LTMRs promotes conditioned place preference indicating that activation is positively reinforcing/anxiolytic

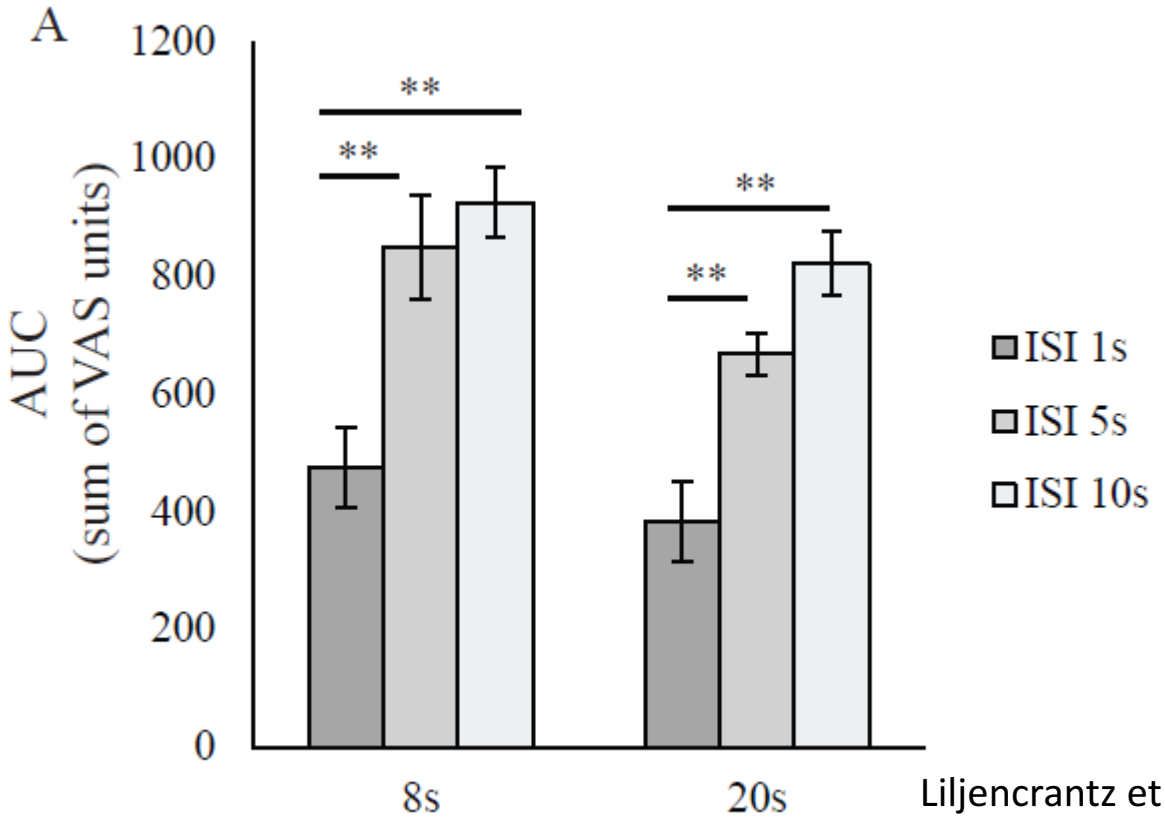
  Vrontou et al., Nature, 2013

- C-LTMRs, when activated, release TAFA4 with analgesic effects

  Delfini et al., Cell Rep, 2013

CTs and pain modulation

CT targeted touch (3cm/s) preceding pain by 1, 5 or 10s
CT targeted touch (3cm/s) with duration 8 or 20s



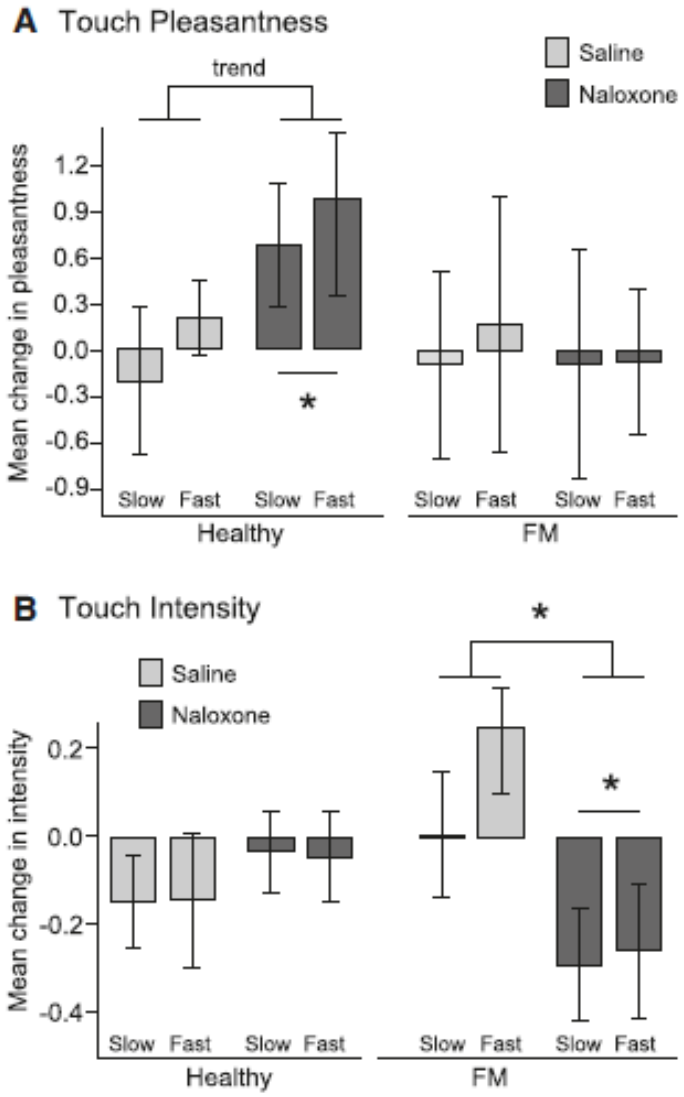
Greater pain reduction for shorter time between touch offset and heat onset

Liljencrantz et al, Eur J Pain, 2017

Conclusions: Affective touch and pain modulation

- The same painful heat stimulus is perceived as less painful when preceded by CT targeted touch
- Less pain reducing effect of CT targeted touch in subjects with high anxiety and low calmness ratings

Naloxone increases touch pleasantness in HC and reduces touch intensity in FM

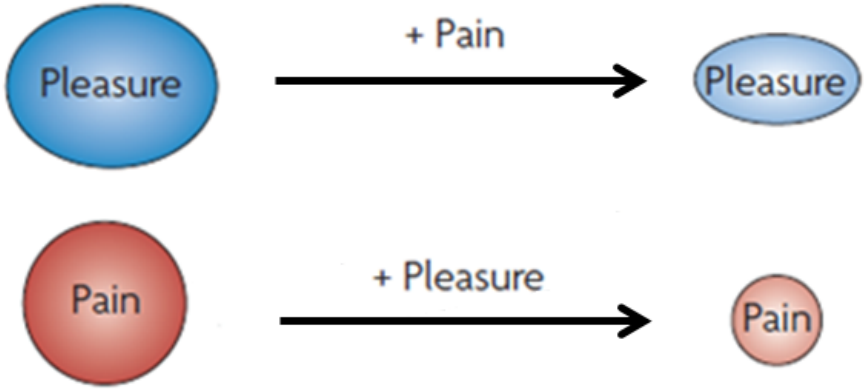


Case et al., eNEURO 2016

Affective touch and pain interaction

"Nature has placed mankind under the governance of two sovereign masters, pain and pleasure."

-Jeremy Bentham



Leknes & Tracey, Nature Rev Neuosci. 2008

Does chronic pain influence affective touch perception?