MCDB 153

Neural Development

Target Selection
Lecture Set 5

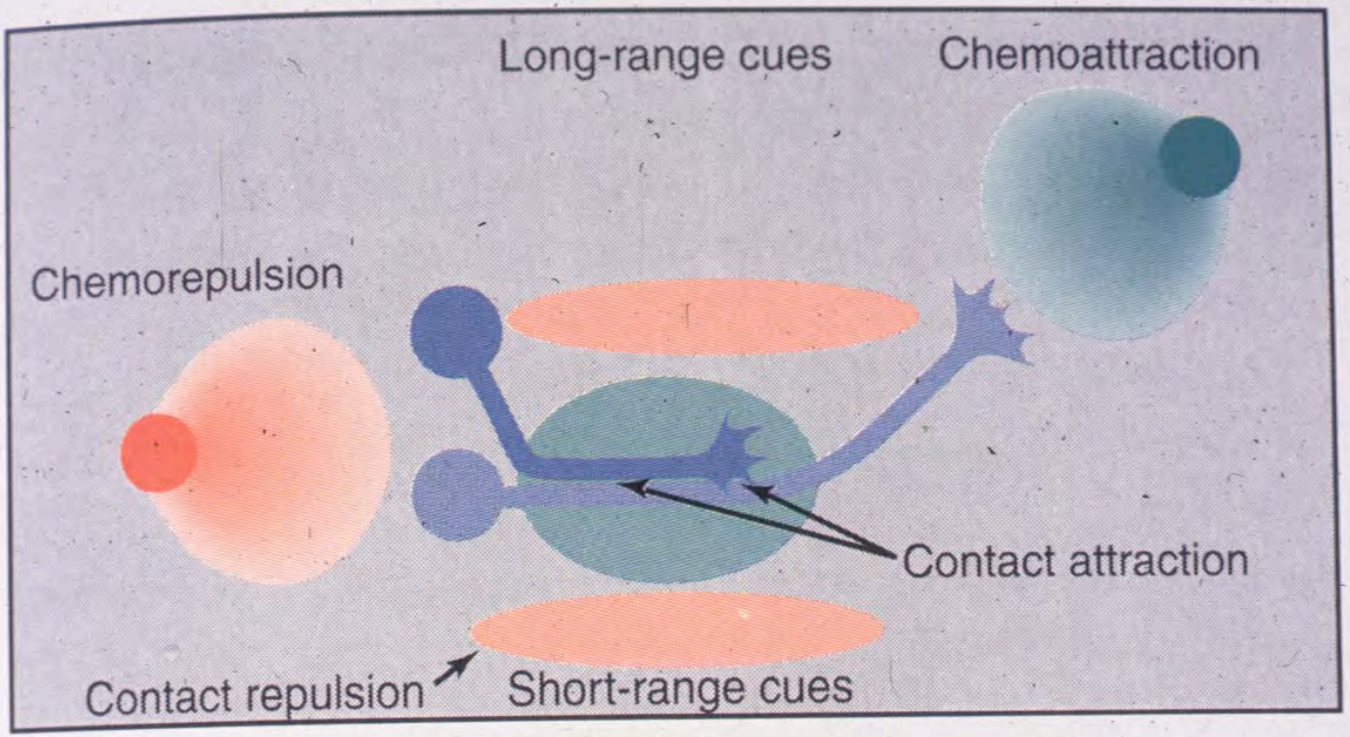
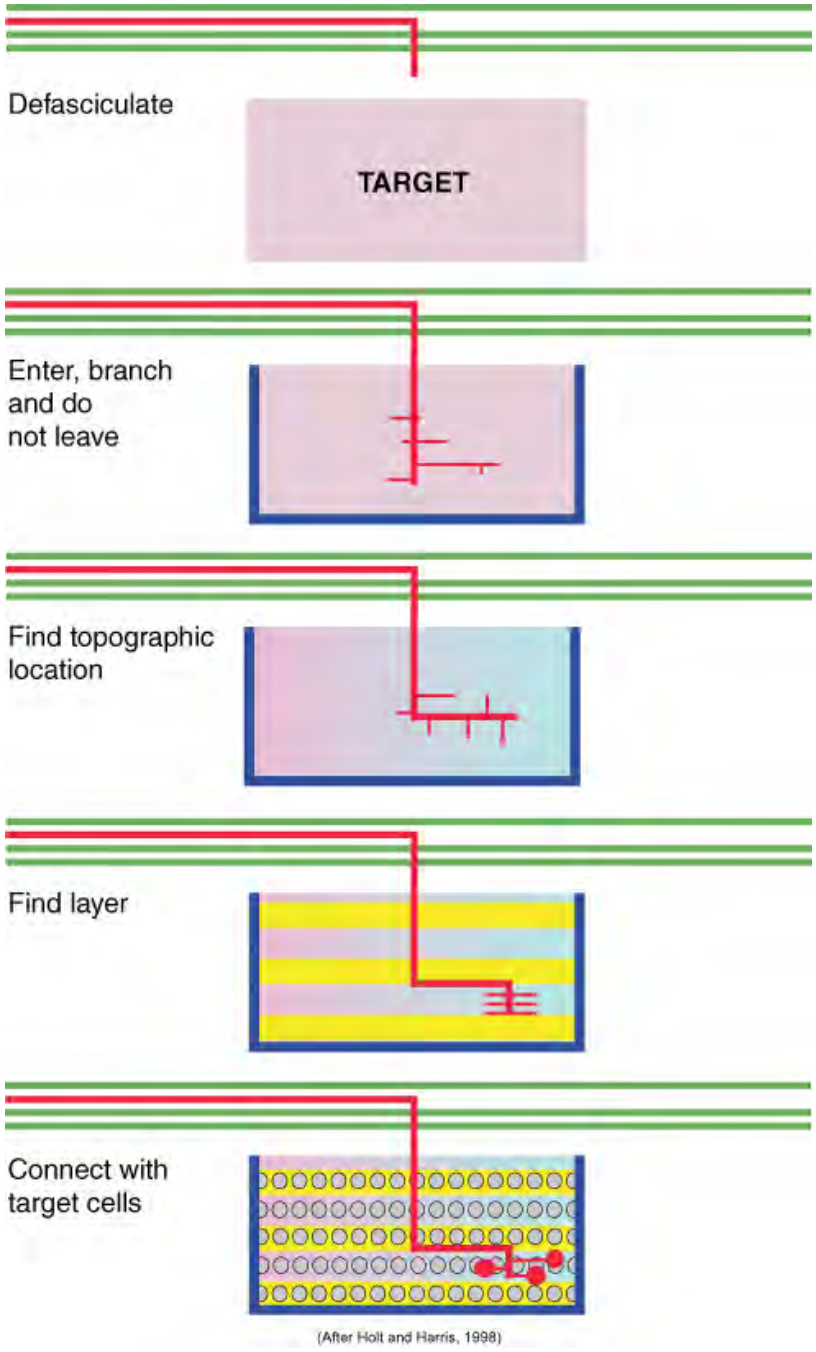
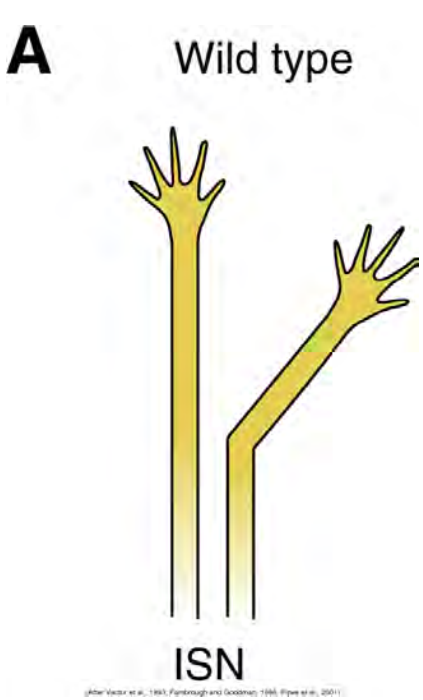
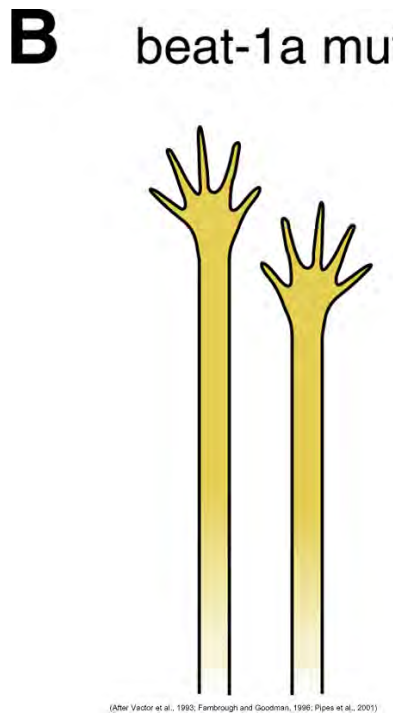
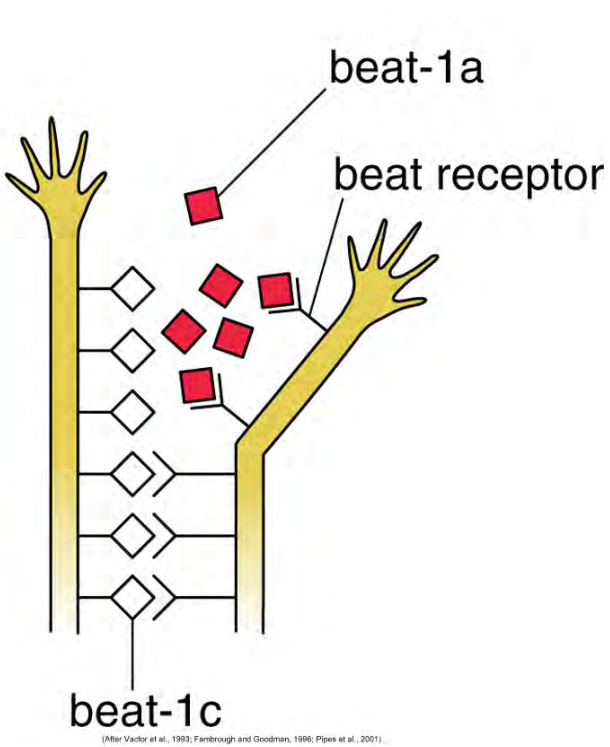


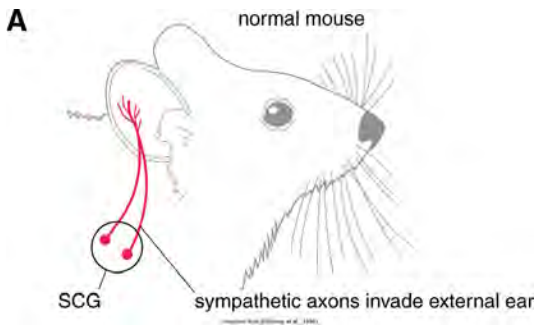
FIGURE 18.10 Axons are guided by the simultaneous and coordinate actions of four types of guidance mechanisms: contact attraction, chemoattraction, contact repulsion, and chemorepulsion. Individual growth cones might be "pushed" from behind by a chemorepellent, "pulled" from in front by a chemoattractant, and "hemmed in" by attractive and repulsive local cues (cell surface or extracellular matrix molecules). Push, pull, and hem: these forces act together to ensure accurate guidance. Adapted from Tessier-Lavigne and Goodman.[70]

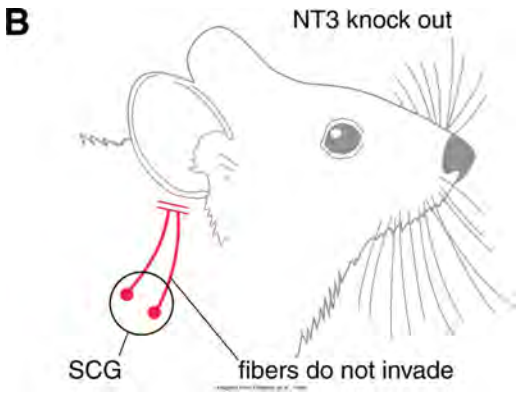

Defasciculate
TARGET
Enter, branch and do not leave
Find topographic location
Find layer
Connect with target cells
(After Holt and Harris, 1998)

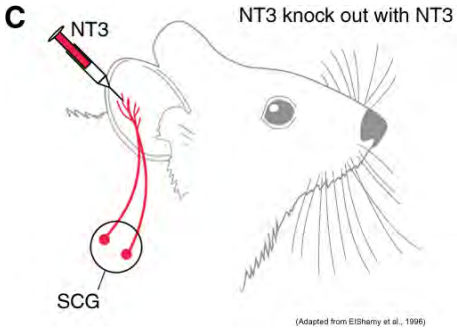

A
Wild type
ISN
(After Vactor et al., 1993; Fambrough and Goodman, 1996; Pipes et al., 2001)


B
beat-1a mutant
(After Vactor et al., 1993; Fambrough and Goodman, 1996; Pipes et al., 2001)

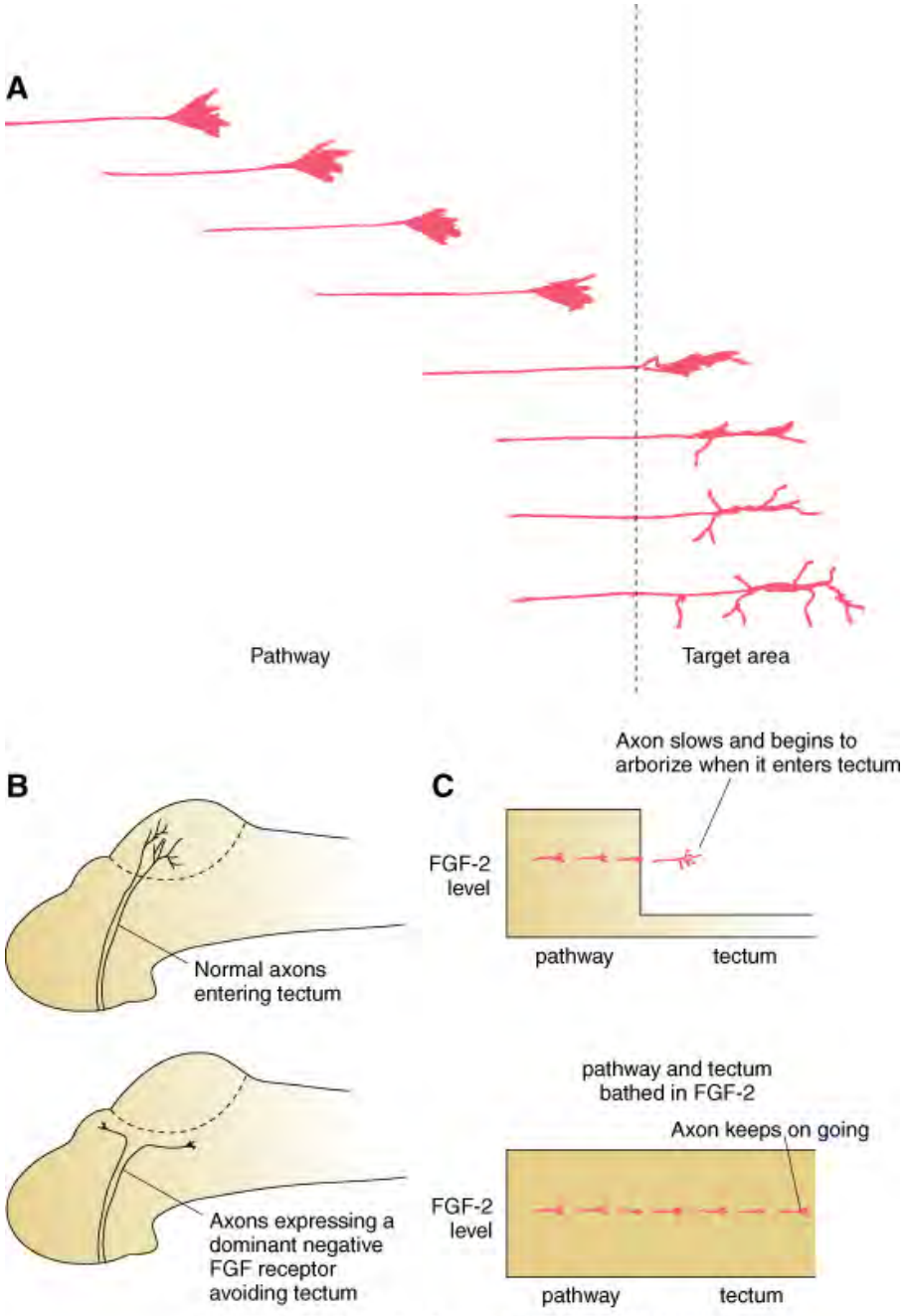

D
beat-1a
beat receptor
beat-1c
(After Vactor et al., 1993; Fambrough and Goodman, 1996; Pipes et al., 2001)



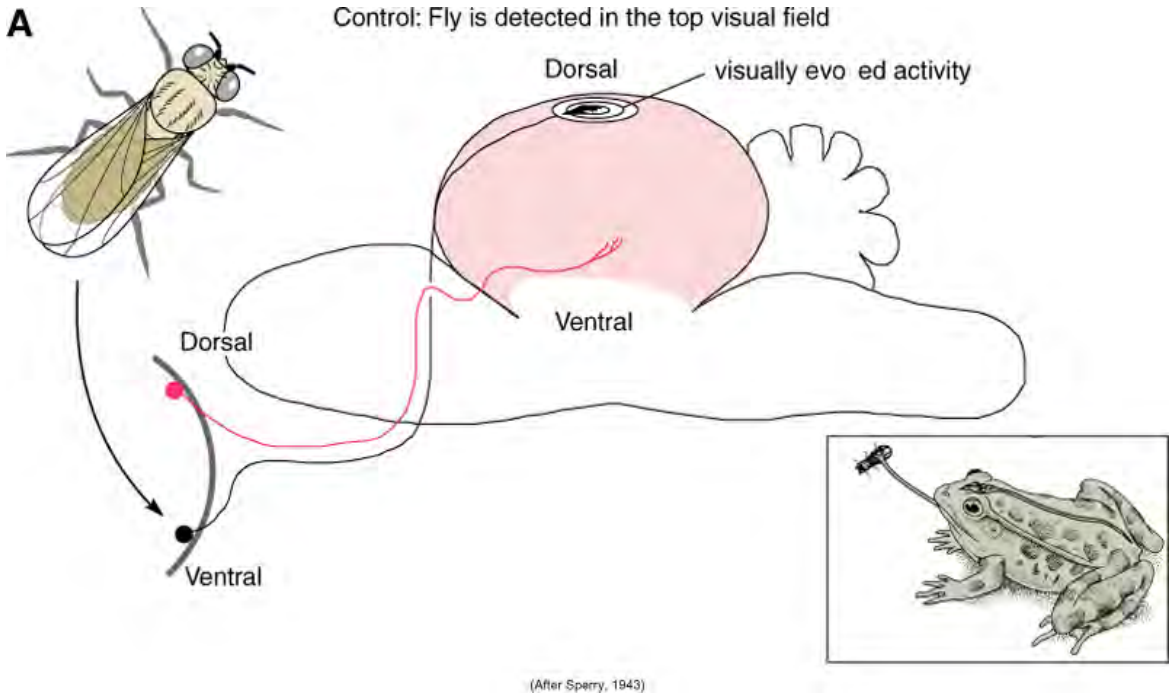




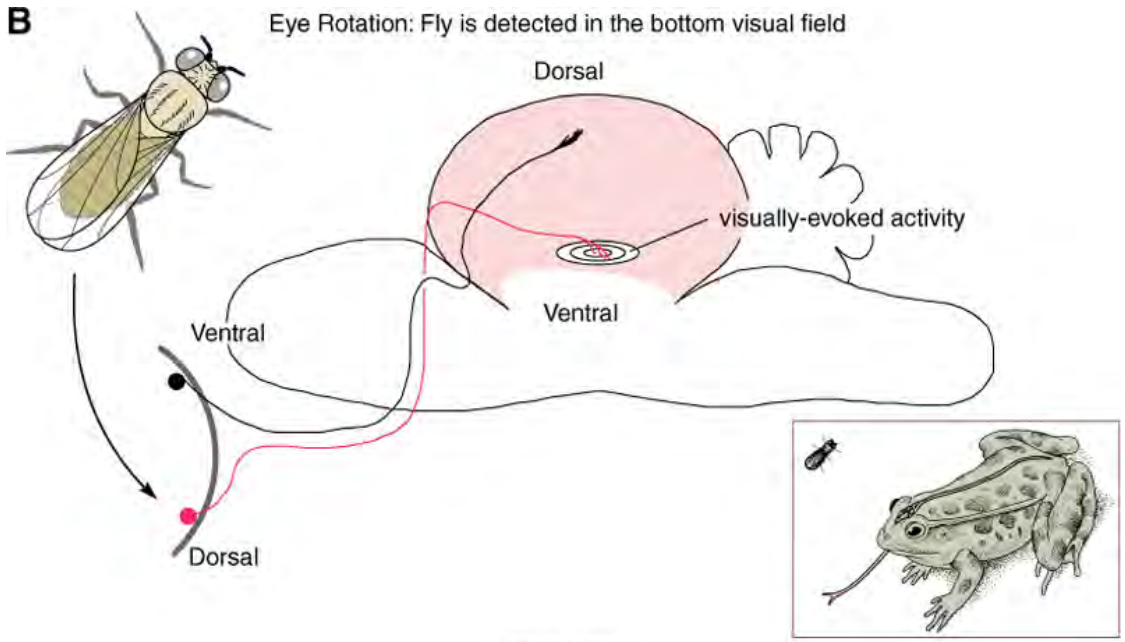
NT3 knock out with NT3 injection: Fibers invade again



(Adapted from Harris et al., 1987; McFarlane et al., 1995; McFarlane et al., 1996)

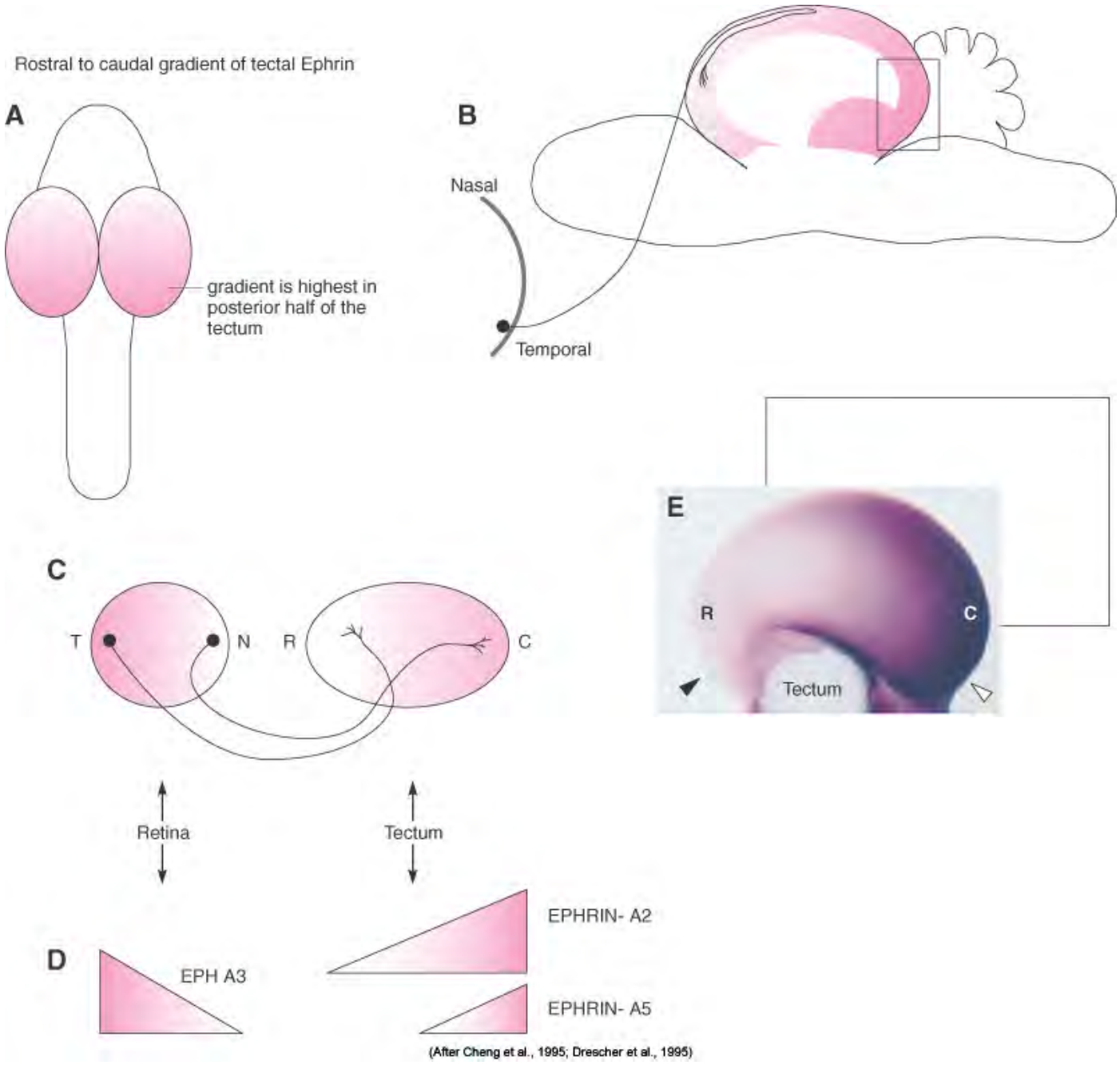


(After Sperry, 1943)

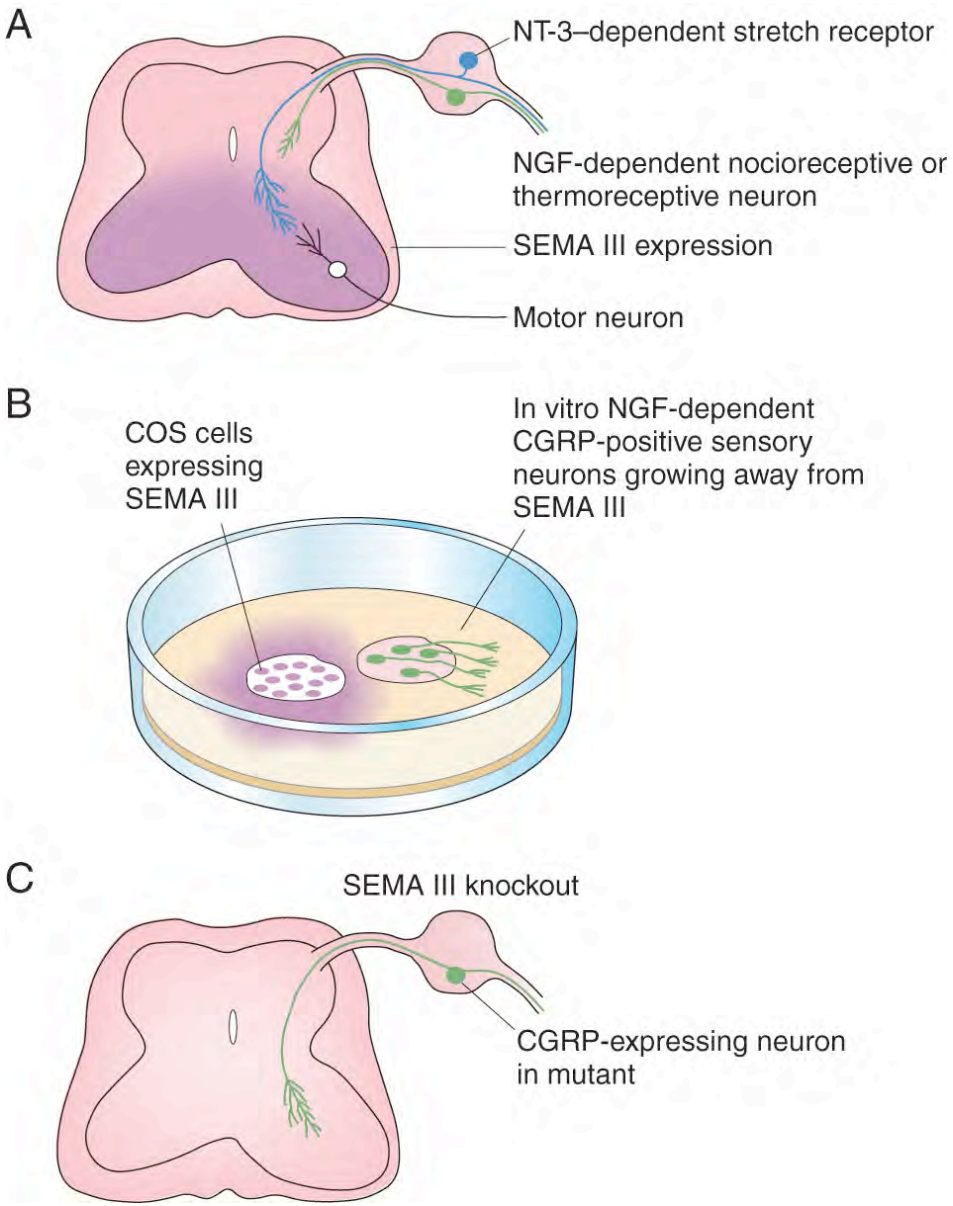


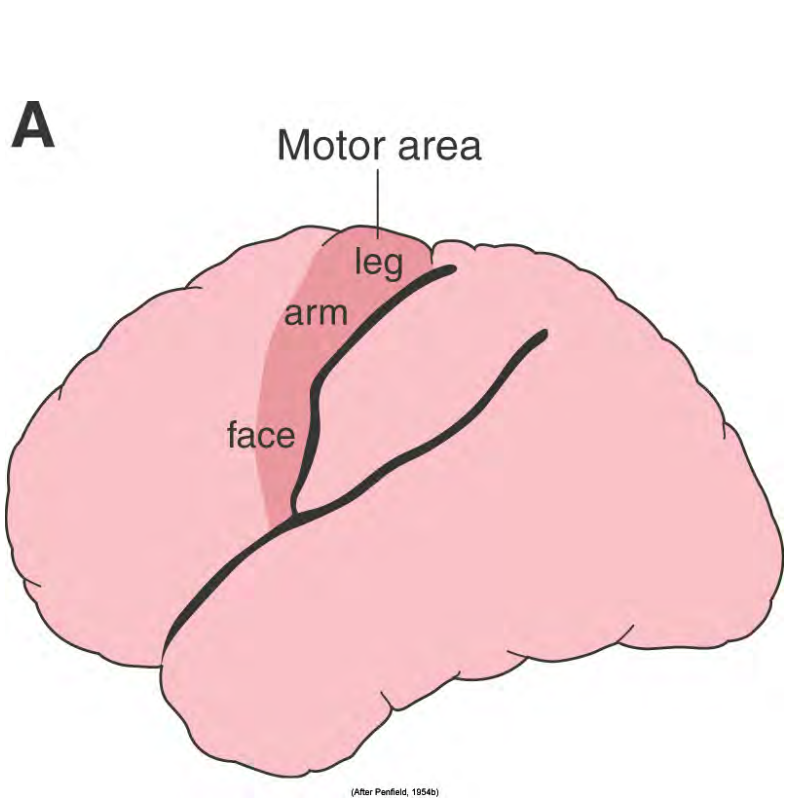
(After Sperry, 1943)

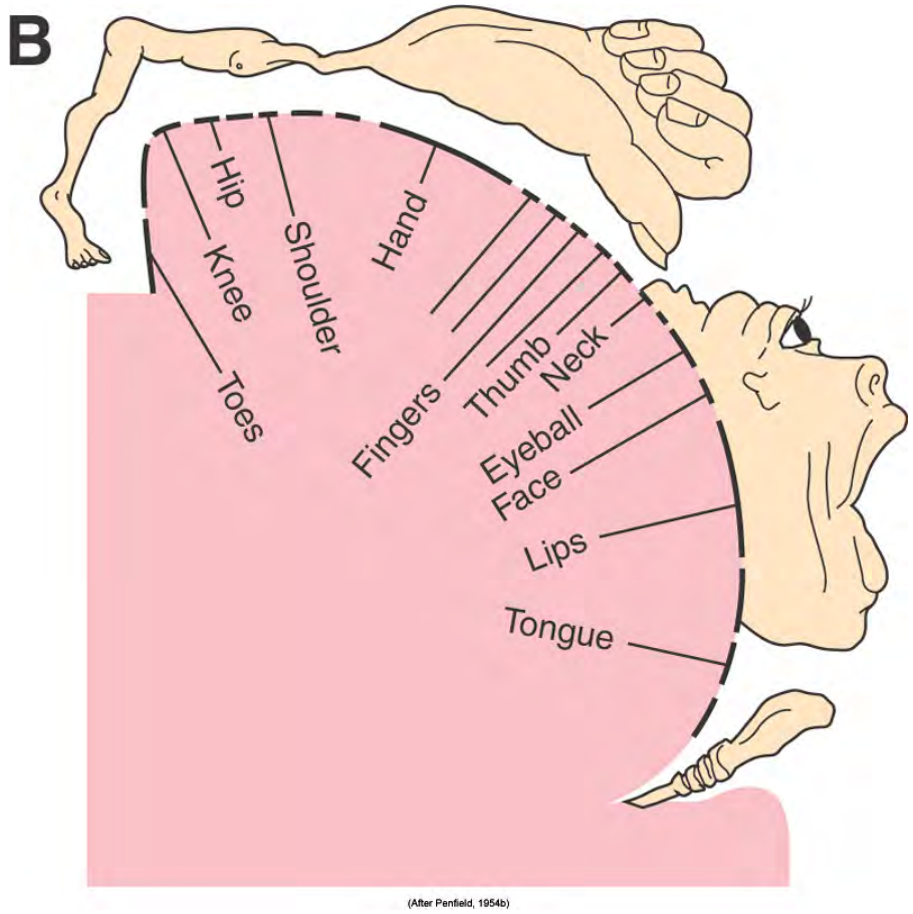
Sperry postulated the existence of two or more cytochemical gradients “that spread across and through each other with their axes roughly perpendicular”

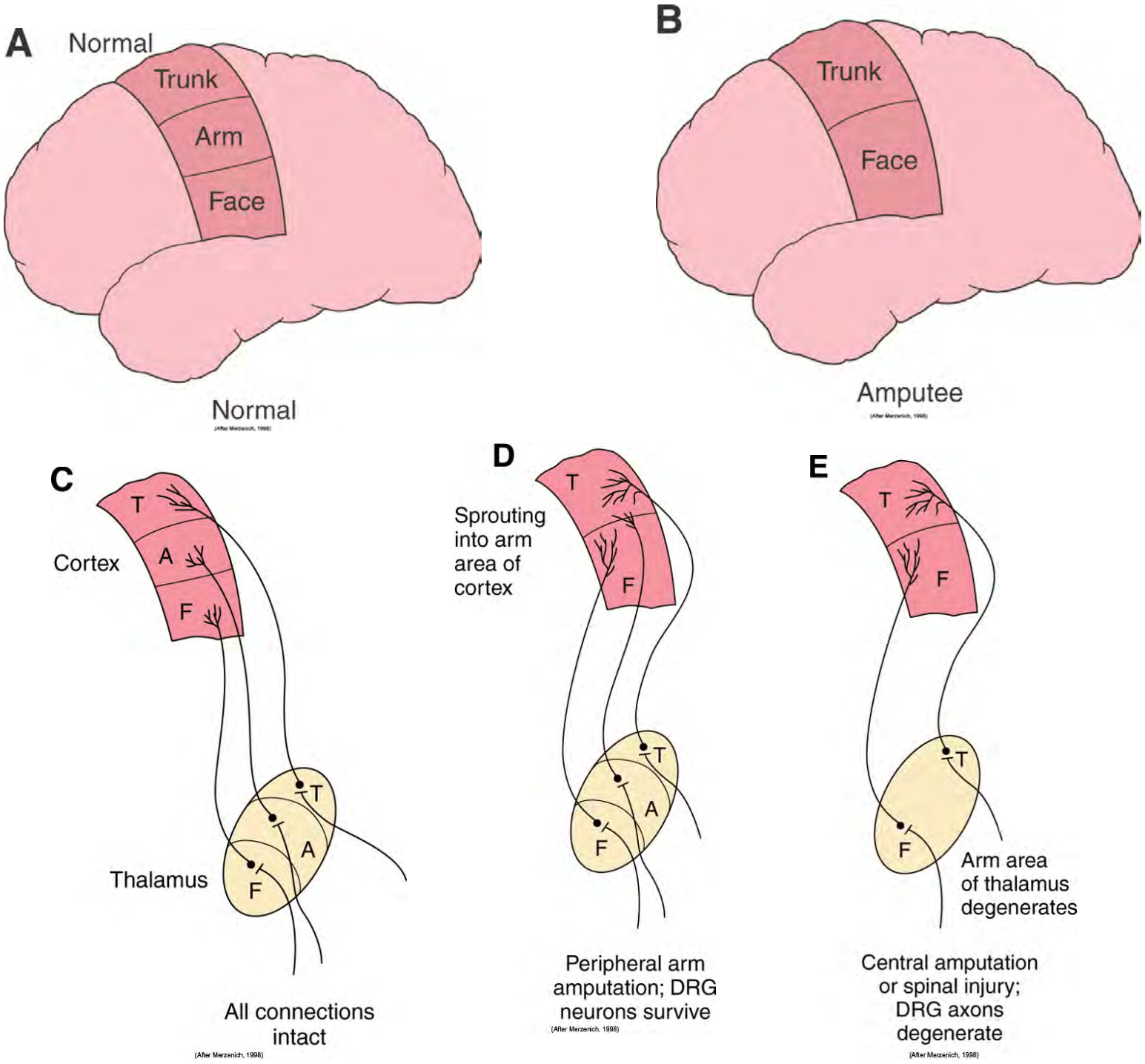


(After Cheng et al., 1995; Drescher et al., 1995)


A
NT-3–dependent stretch receptor
NGF-dependent nocioreceptive or thermoreceptive neuron
SEMA III expression
Motor neuron
B
COS cells expressing SEMA III
In vitro NGF-dependent CGRP-positive sensory neurons growing away from SEMA III
C
SEMA III knockout
CGRP-expressing neuron in mutant


A
Motor area
leg
arm
face
(After Penfield, 1954b)


B
Hip
Knee
Toes
Shoulder
Hand
Fingers
Thumb
Neck
Eyeball
Face
Lips
Tongue
(After Penfield, 1954b)


A
Normal
Trunk
Arm
Face
Normal
(After Merzenich, 1998)
B
Trunk
Face
Amputee
(After Merzenich, 1998)
C
Cortex
T
A
F
Thalamus
T
A
F
All connections intact
(After Merzenich, 1998)
D
Sprouting into arm area of cortex
T
F
T
A
F
Peripheral arm amputation; DRG neurons survive
(After Merzenich, 1998)
E
T
F
T
F
Arm area of thalamus degenerates
Central amputation or spinal injury; DRG axons degenerate
(After Merzenich, 1998)

Summary

1) Gradients and Cell Adhesion Molecules Guide Target Selection
2) Topographic Maps