But what do they see?

Functional consequences of abnormal visual system topography in ephrin-A⁻/⁻ mice

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The visual system

Topographic organisation
Normal

Ephrin-A2-/-
Some temporal axons incorrect

Ephrin-A5-/-
Some temporal and some nasal axons incorrect

Ephrin-A2/A5-/-
Few axons correct
Visually-evoked behaviour

• Placing response
• Visuomotor response
• Pupillary mobility
• Visual acuity

Visual pathways

• Retino-collicular projection
• Retino-pretectal projections
• Ipsilateral and contralateral projections
**Visuomotor response:**
Head tracking movements in response to moving stripes

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**Light conditions**

![Graph showing tracking movements in light conditions.]

**Spatial frequency**

- 0.03
- 0.13
- 0.26
- 0.52

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**Dark conditions**

![Graph showing tracking movements in dark conditions.]

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**Lack of sensitivity to light?**
Pupillary mobility, light dark avoidance tests

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**Reduced visual acuity?**
Visual acuity
Forced choice learning task
Visually-evoked behaviour

Normal:
• Placing response
• Pupillary mobility (pretectal, non-topographic)
• Visual acuity (geniculocortical)

Abnormal:
• Visuomotor response
  (pretectal, superior colliculus, binocular, but also tecto-olivary, cerebellar, neck muscles…)

Normal EphA
Ephrin-A2-/-: Some temporal axons incorrect
Ephrin-A5-/-: Some temporal and some nasal axons incorrect
Ephrin-A2/A5-/-: Few axons correct
Electrophysiological mapping

- Supernumerary non-topographic projections can evoke a collicular response
- The “strongest” RF is not necessarily the most topographically appropriate
- Similar amount of functional disorder in ephrin-A2/- and ephrin-A2/A5/- mice
Quantification of disorder

• Calculated the predicted location of RF based on the electrode recording location
• Disorder value represents the distance between predicted and actual RF location

![Graphs showing disorder value and receptive field size for different groups]
Non-correlation between visually evoked behaviour and functional retinocollicular topography:

Behaviour:  
WT > ephrin-A2-/- > ephrin-A2/A5-/-

Functional topography:  
WT > ephrin-A2-/- = ephrin-A2/A5-/-
Binocular input

Less than 10% of RGCs, project to rostral 1/3rd of the SC
Binocular input

Monocular field

A
B
C

Contralateral eye

1
2
3
4
5
6

Ipsilateral eye

D
E
F

6
5
4
3
2
1

Binocular field

Superior colliculus

F
E
D
C
B
A

1
2
3
4
5
6
Intact visual system

Monocular field

Binocular field

A B C

D E F

Contralateral eye

Ipsilateral eye

1 2 3

4 5 6

Superior colliculus

Monocular enucleation

Monocular field

Binocular field

A B C

D E F

Ipsilateral eye

Superior colliculus

Intact visual system
Relationship between contralateral and ipsilateral input
Visuomotor response
Monocular occlusion (left eye)

Light conditions, 0.32 cpd
Comparing anatomical and functional topography: Limits of activity dependent refinement?

Integration of binocular input: role for ephrin-A5?

Other projections to the SC?
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