Training Information-Integration Category Learning

Brian J. Spiering


SA Tourism - Unknown

Outline

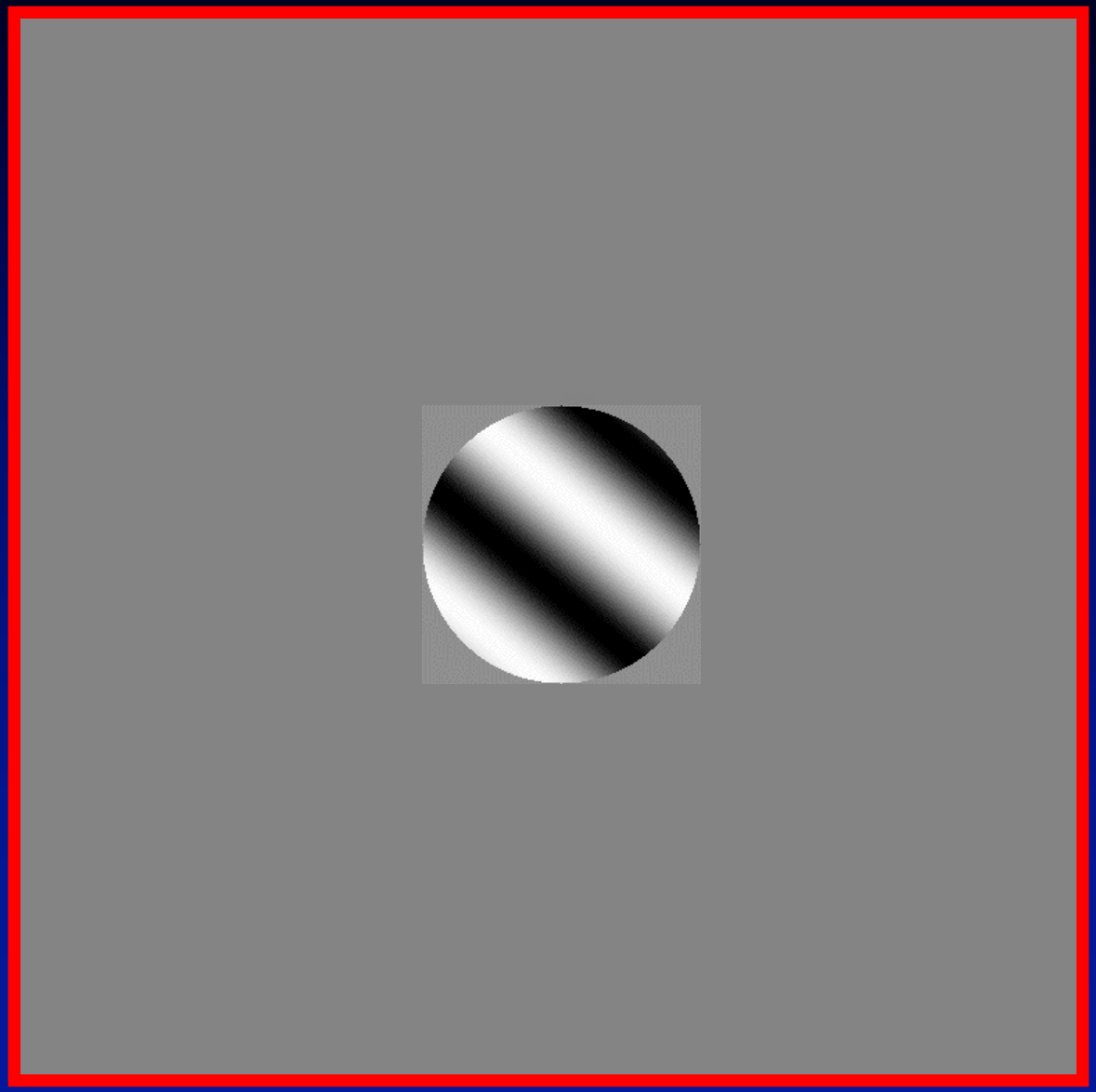
1) Category-learning tasks

2) COVIS Model

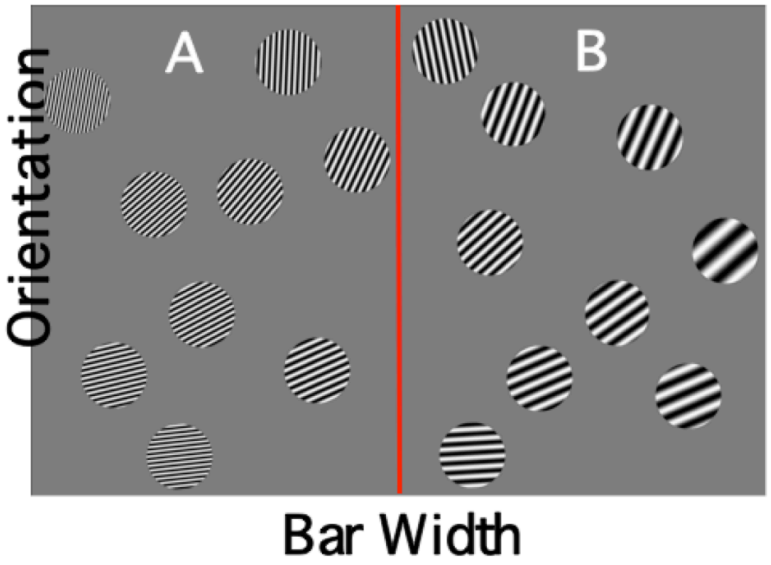
3) Behavioral tests of COVIS Model

4) Conclusions

Stimulus on a Single Category-Learning Trial



Rule-Based Category Learning

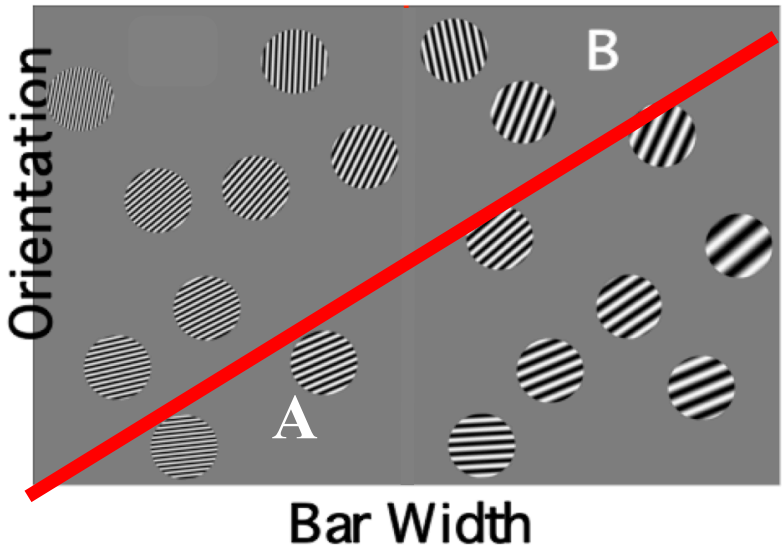


Categorization rule is easy to describe

Effective learning requires:

- no distractions
- active and effortful processing of feedback
- the nature and timing of feedback is not critical

Information-Integration Category Learning



Categorization rule is difficult to describe

Effective learning requires:

- consistent feedback immediately after response
- consistent mapping from category to response location
- no active feedback processing

A Real-Life Information-Integration Task?

Does this mammogram show a tumor?

A Real-Life Information-Integration Task?

Tumor!

The Two Category Learning Systems of COVIS

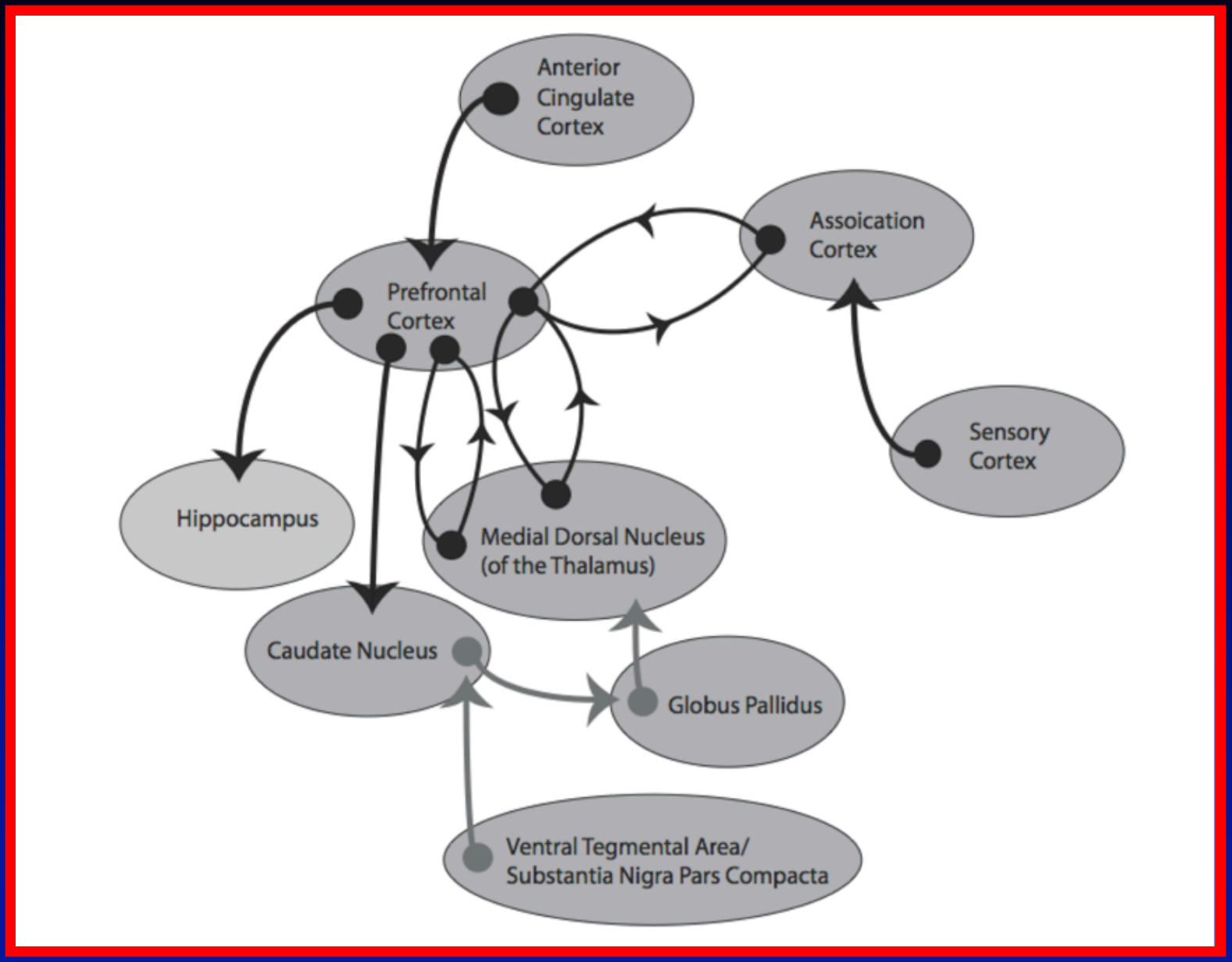
(Ashby, Alfonso-Reese, Turken, & Waldron, *Psychological Review*, 1998)

- Logical-reasoning system
  - quickly learns explicit rules
- Procedural-learning system
  - slowly learns almost any similarity-based rule
- Simultaneously active in all tasks (at least initially)

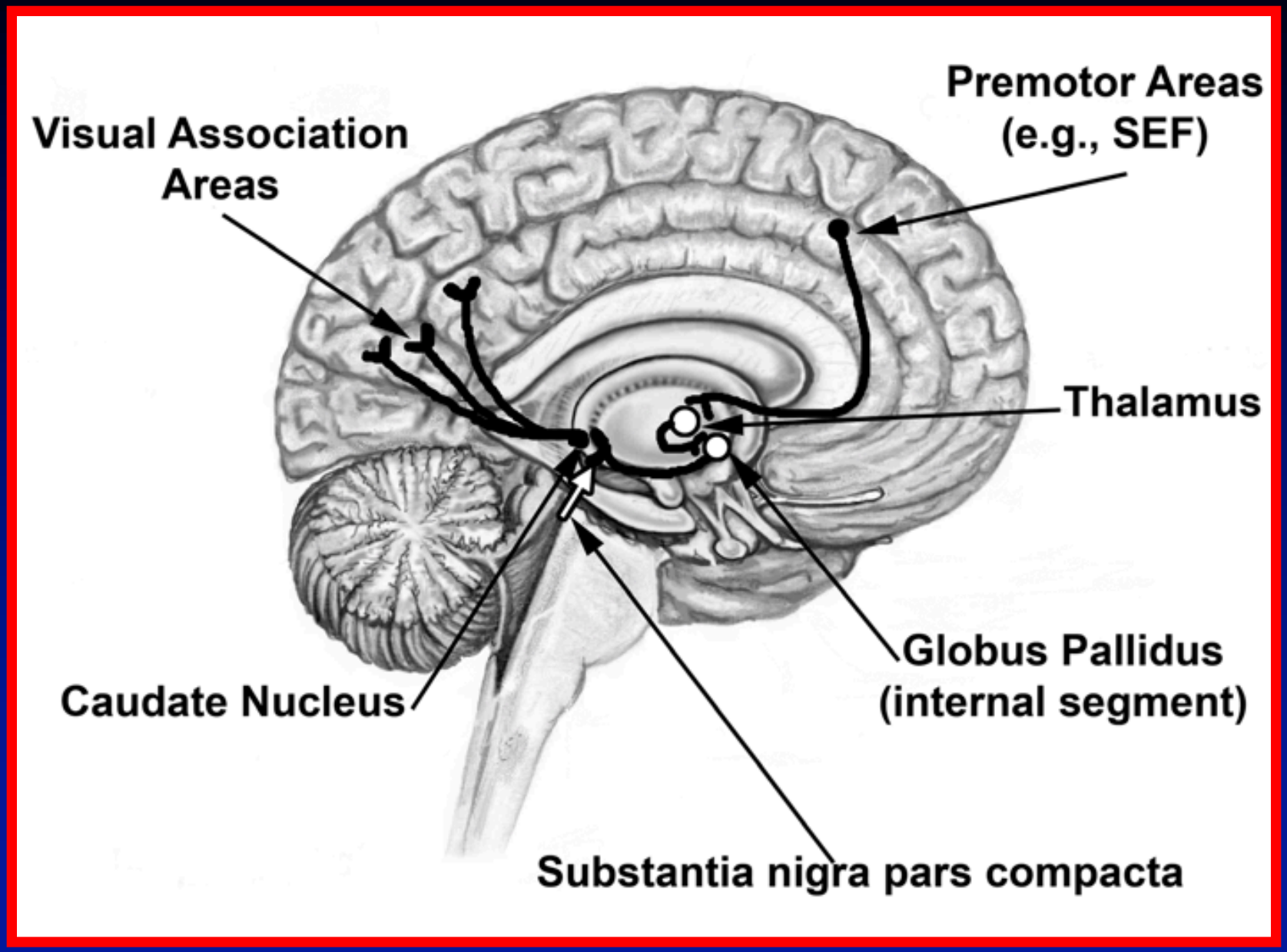
The COVIS Explicit System

- Logical reasoning system
- Uses working memory and executive attention
- Working memory & attentional switching component – FROST (Ashby, Ell, Valentin, & Casale, 2005, *J. of Cognitive Neuroscience*)

The COVIS Explicit System



The COVIS Procedural-Learning System



Evidence Supporting COVIS

Single-cell recording studies

Asaad, Rainer, & Miller, 2000; Hoshi, Shima, & Tanji, 1998; Merchant, Zainos, Hernadez, Salinas, & Romo, 1997; Romo, Merchant, Ruiz, Crespo, & Zainos, 1995; White & Wise, 1999

Animal lesion experiments

Eacott & Gaffan, 1991; Gaffan & Eacott, 1995; Gaffan & Harrison, 1987; McDonald & White, 1993, 1994; Packard, Hirsch, & White, 1989; Packard & McGaugh, 1992; Roberts & Wallis, 2000

Neuropsychological patient studies

Ashby, Noble, Filoteo, Waldron, & Ell, 2003; Brown & Marsden, 1988; Cools et al., 1984; Downes et al., 1989; Filoteo, Maddox, & Davis, 2001a, 2001b; Filoteo, Maddox, Ing, Zizak, & Song, in press; Filoteo, Maddox, Salmon, & Song, 2005; Janowsky, Shimamura, Kritchevsky, & Squire, 1989; Knowlton, Mangels, & Squire, 1996; Leng & Parkin, 1988; Snowden et al., 2001

Neuroimaging experiments

Konishi et al., 1999; Lombardi et al., 1999; Nomura et al., in press; Poldrack, et al., 2001; Rao et al., 1997; Rogers, Andrews, Grasby, Brooks, & Robbins, 2000; Seger & Cincotta, 2002; Volz et al., 1997

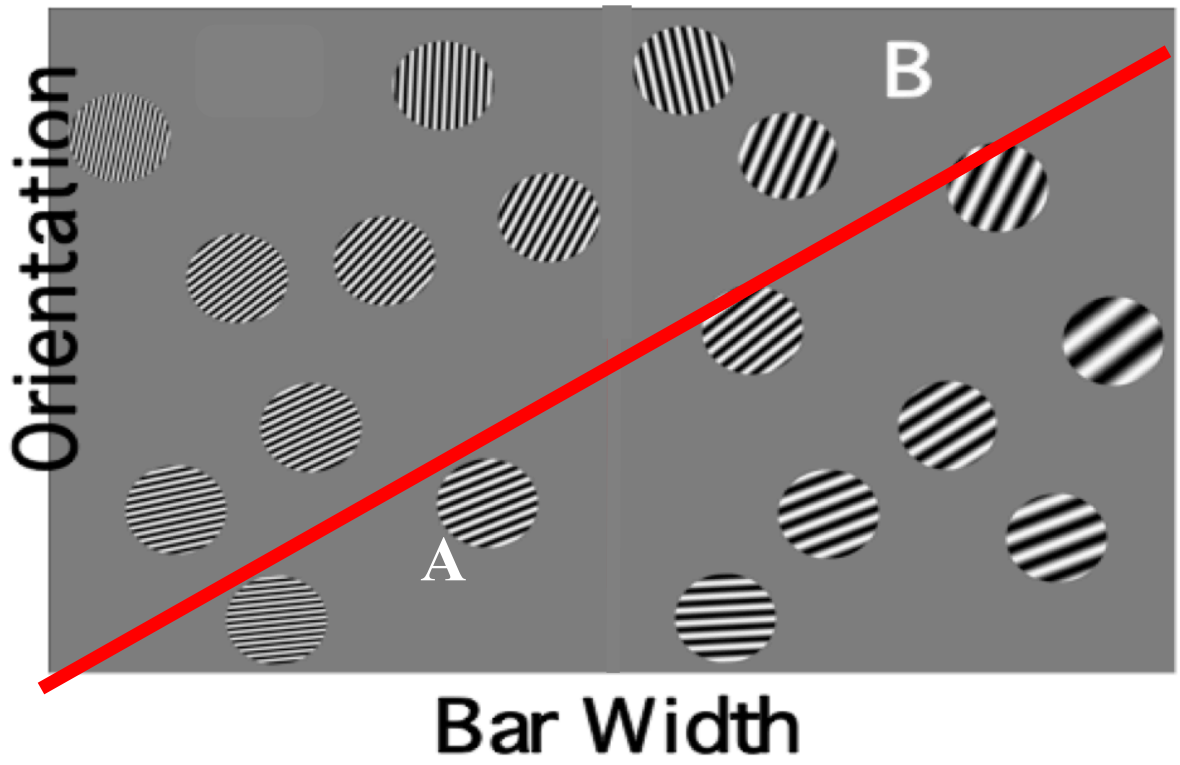
Traditional cognitive behavioral experiments

Ashby & Ell, 2002; Ashby, Ell, & Waldron, 2003; Ashby, Maddox, & Bohil, 2002; Ashby, Queller, & Berretty, 1999; Ashby, Waldron, Lee, & Berkman, 2001; Maddox, Ashby, & Bohil, 2003; Maddox, Ashby, Ing, & Pickering, 2004; Maddox, Bohil, & Ing, in press; Waldron & Ashby, 2001; Zeithamova & Maddox, in press

Spiering, B. J., & Ashby, F. G. (2008)

Response processes in information-integration category learning.

Neurobiology of Learning and Memory


Orientation
B
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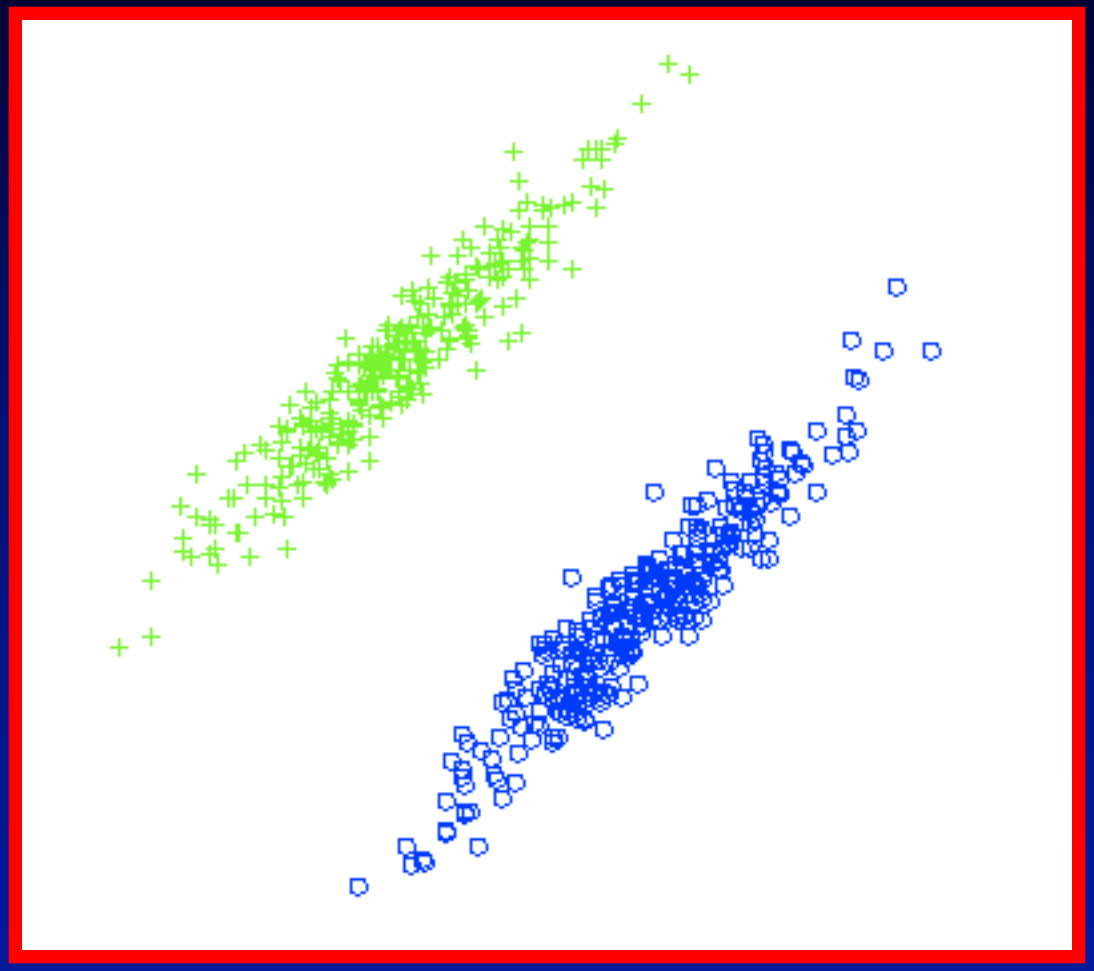
Bar Width

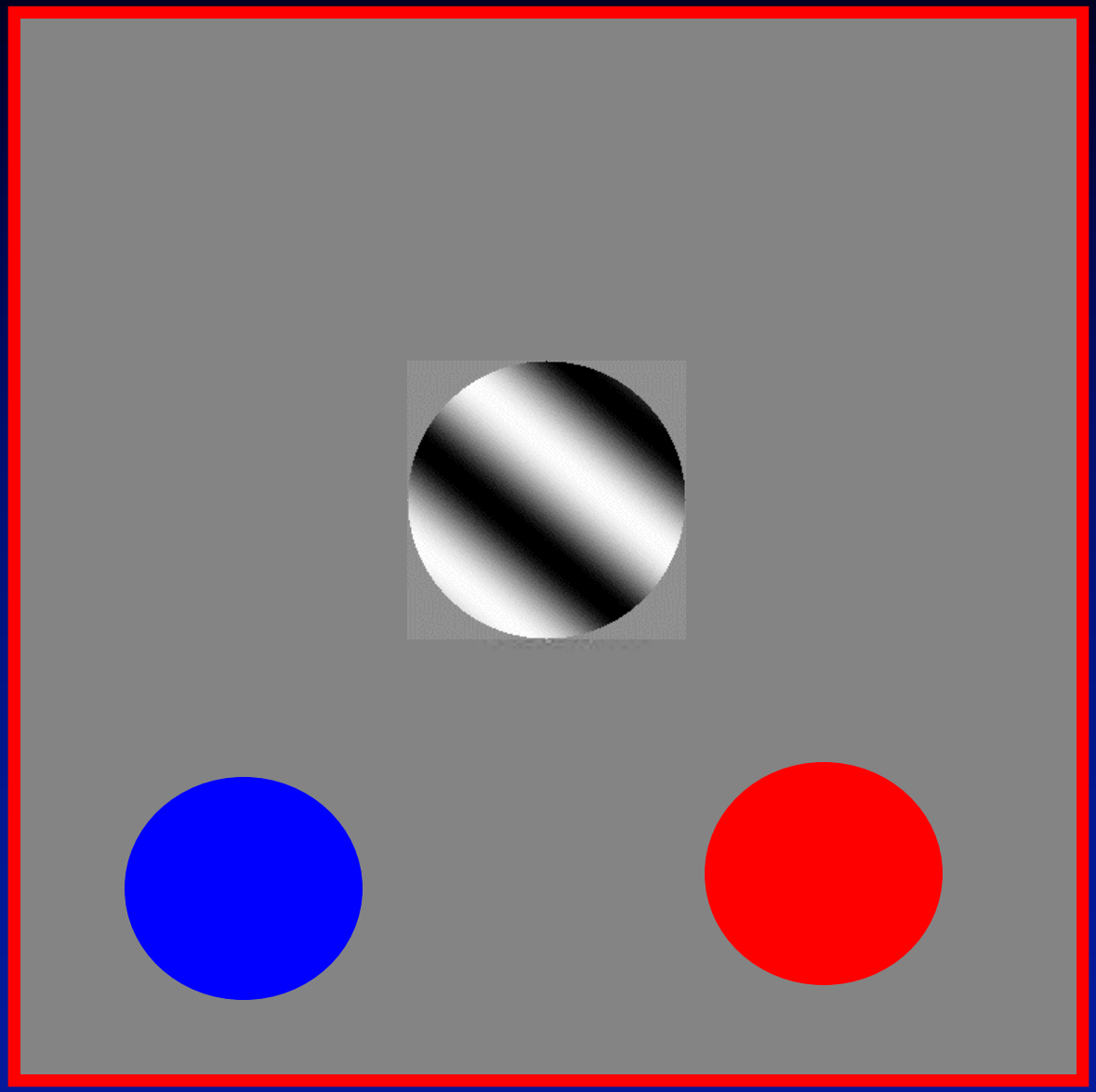
Are consistent responses required for II category learning?

- Ashby, Ell, & Waldron (2003)
- Maddox, Bohil, & Ing (2004)
- Olson & Gettner (1999)

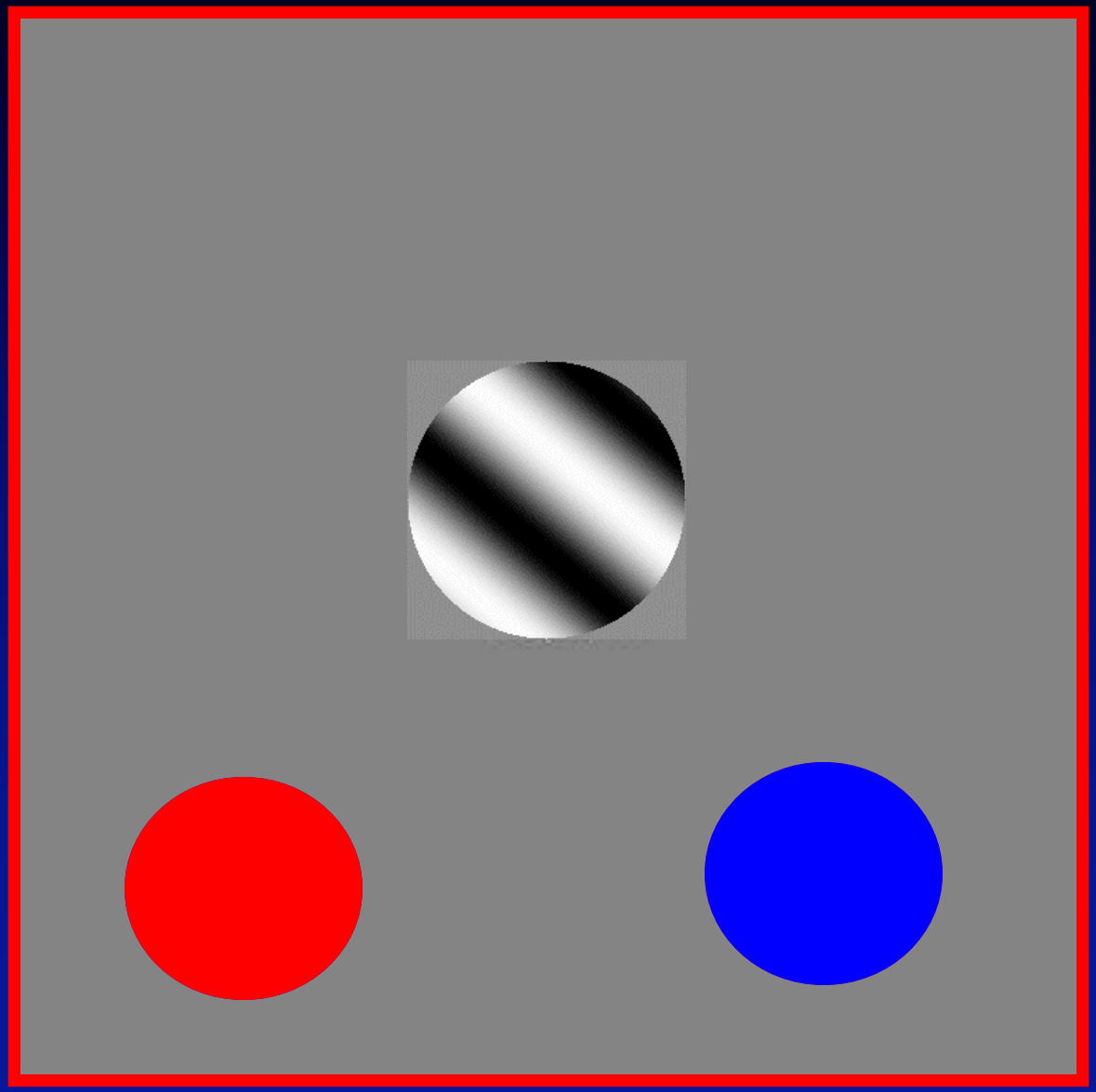
Stimuli



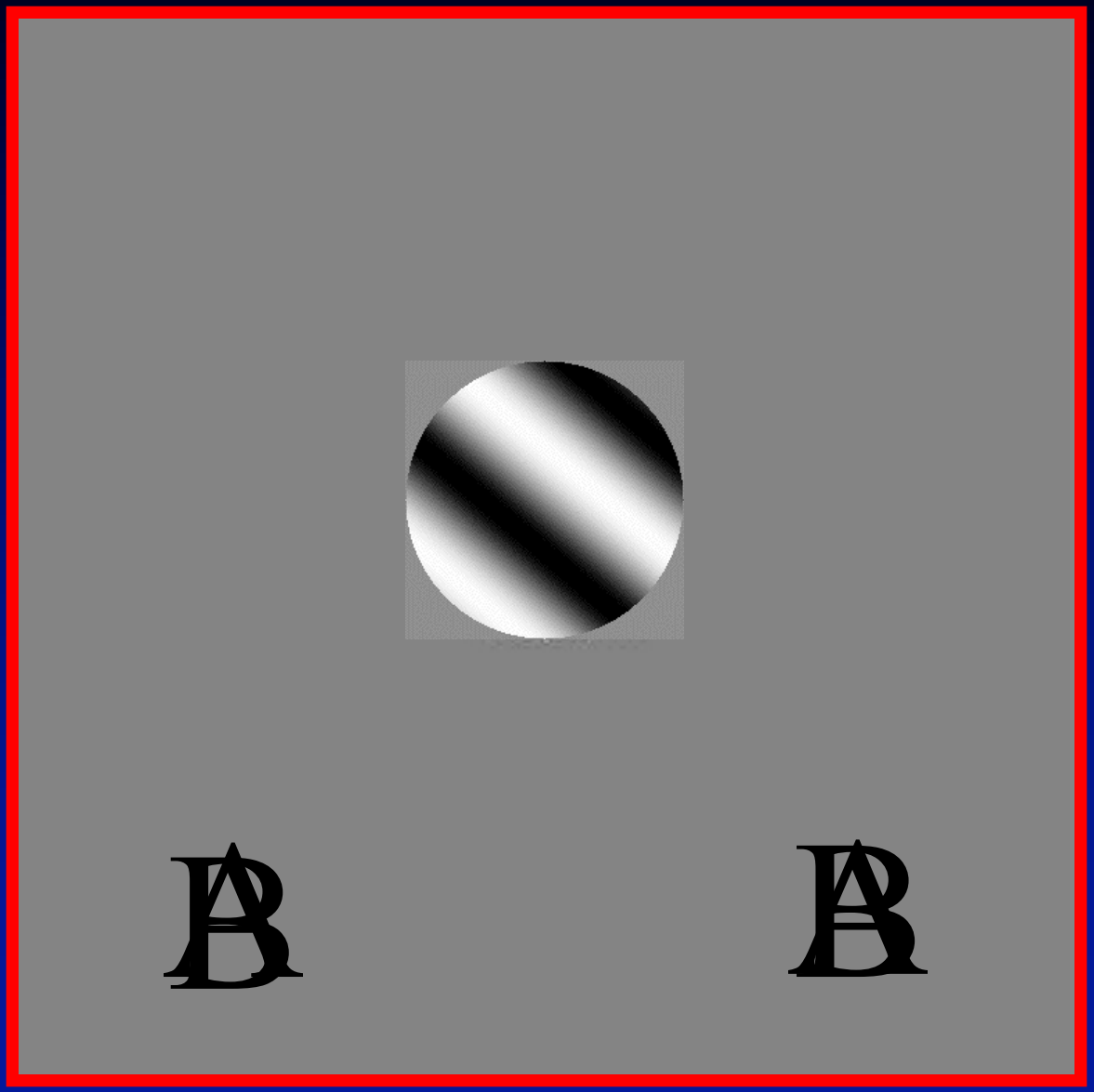
Single Trial for Control



Single Trial for Random-Color



Single Trial for Random-Letter



Method

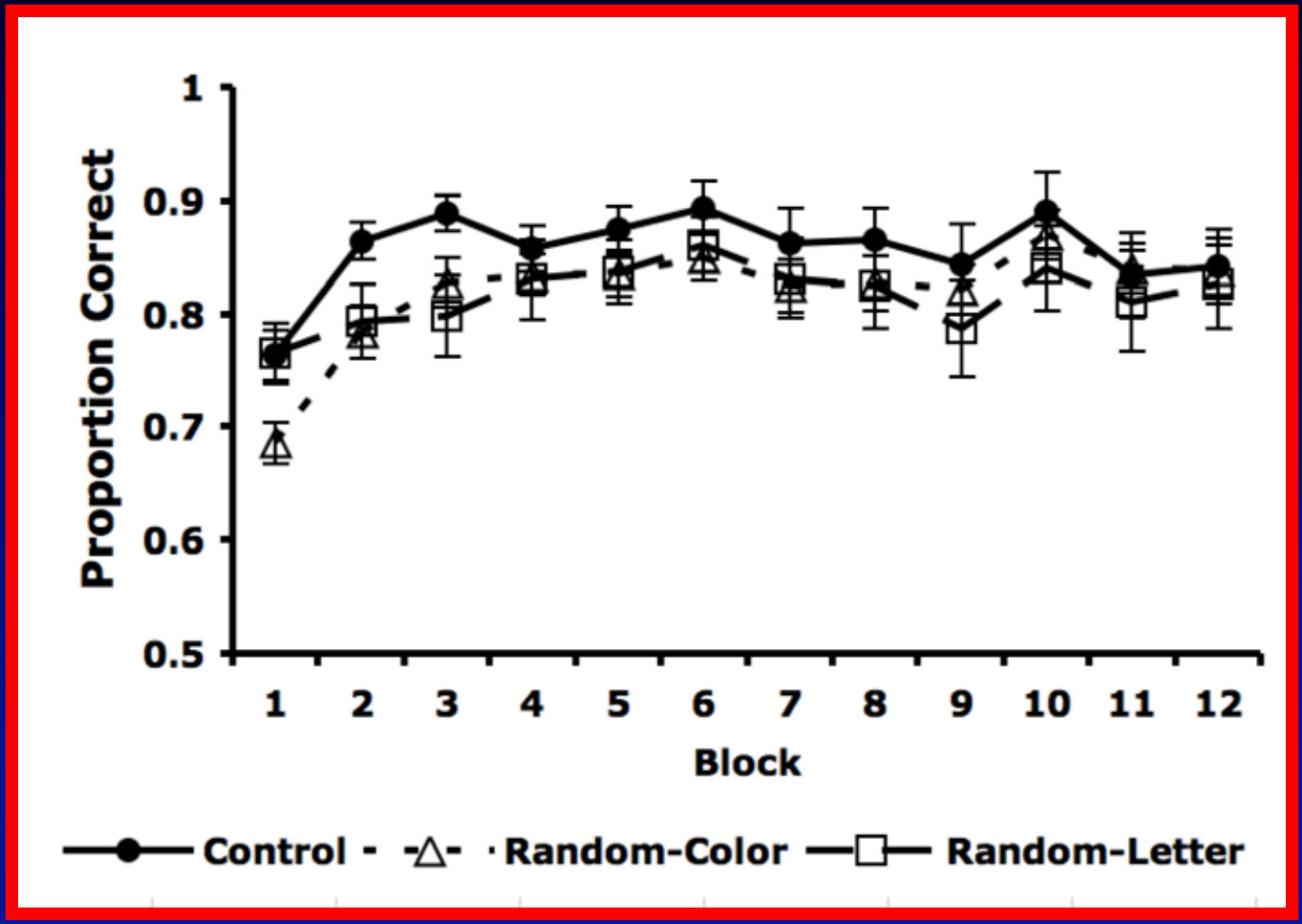
Participants

Random-Color condition - 51

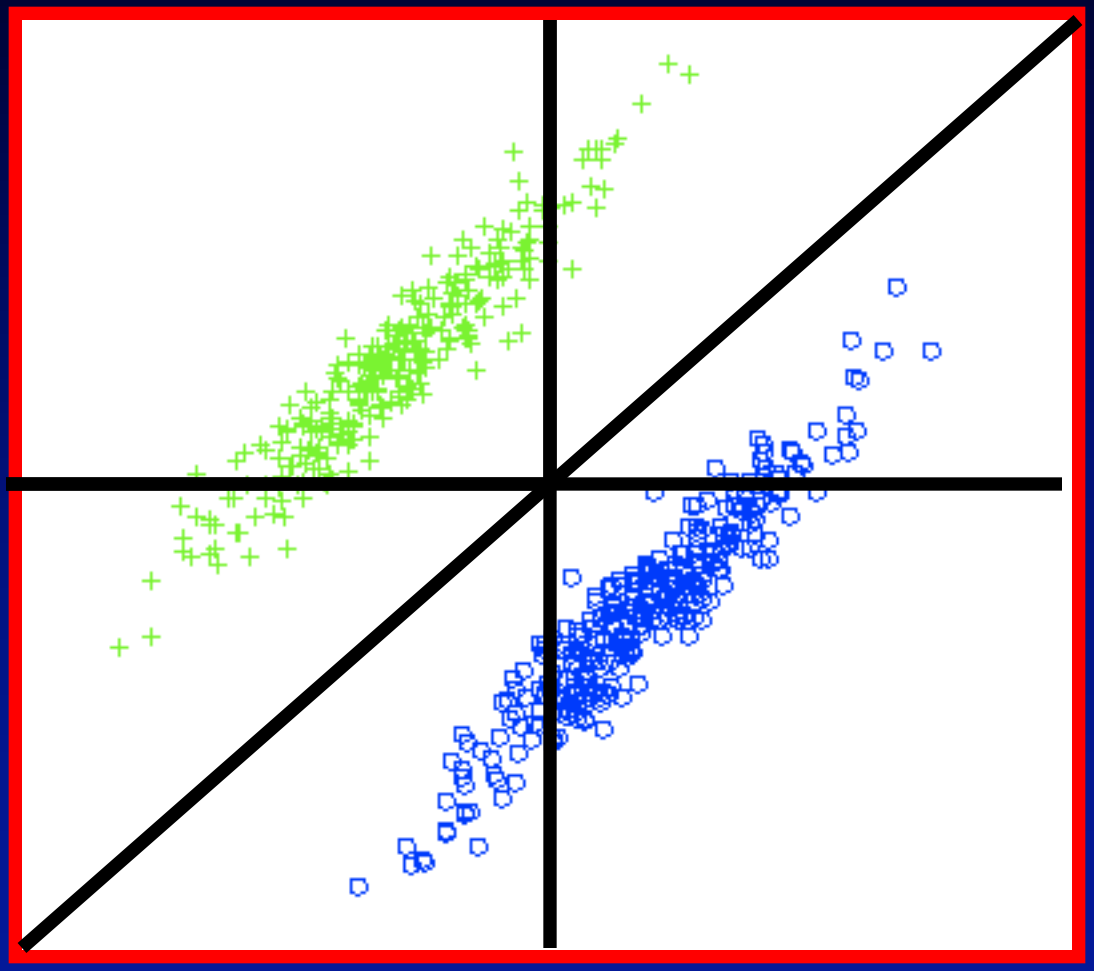
Random-Letter condition -18

Control condition - 20

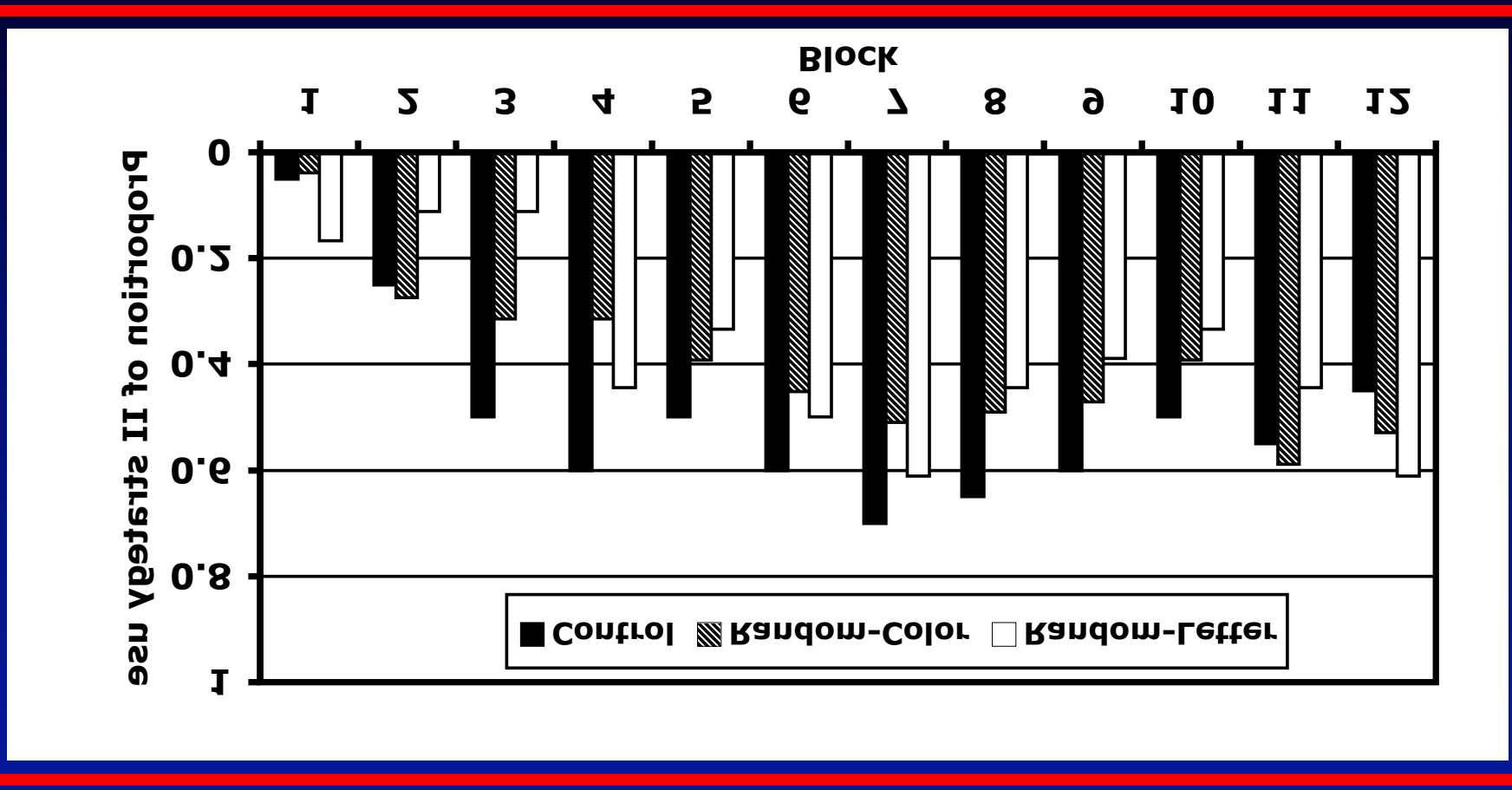
Accuracy-Based Results



Responses



Model-based Results



Discussion

- Consistent response locations are not necessary for II category learning

- Consistent feature identity is sufficient

- Learning is fastest with consistent spatial **and** feature association

What about Yes-No interference?

(Maddox et al., 2004)

Method

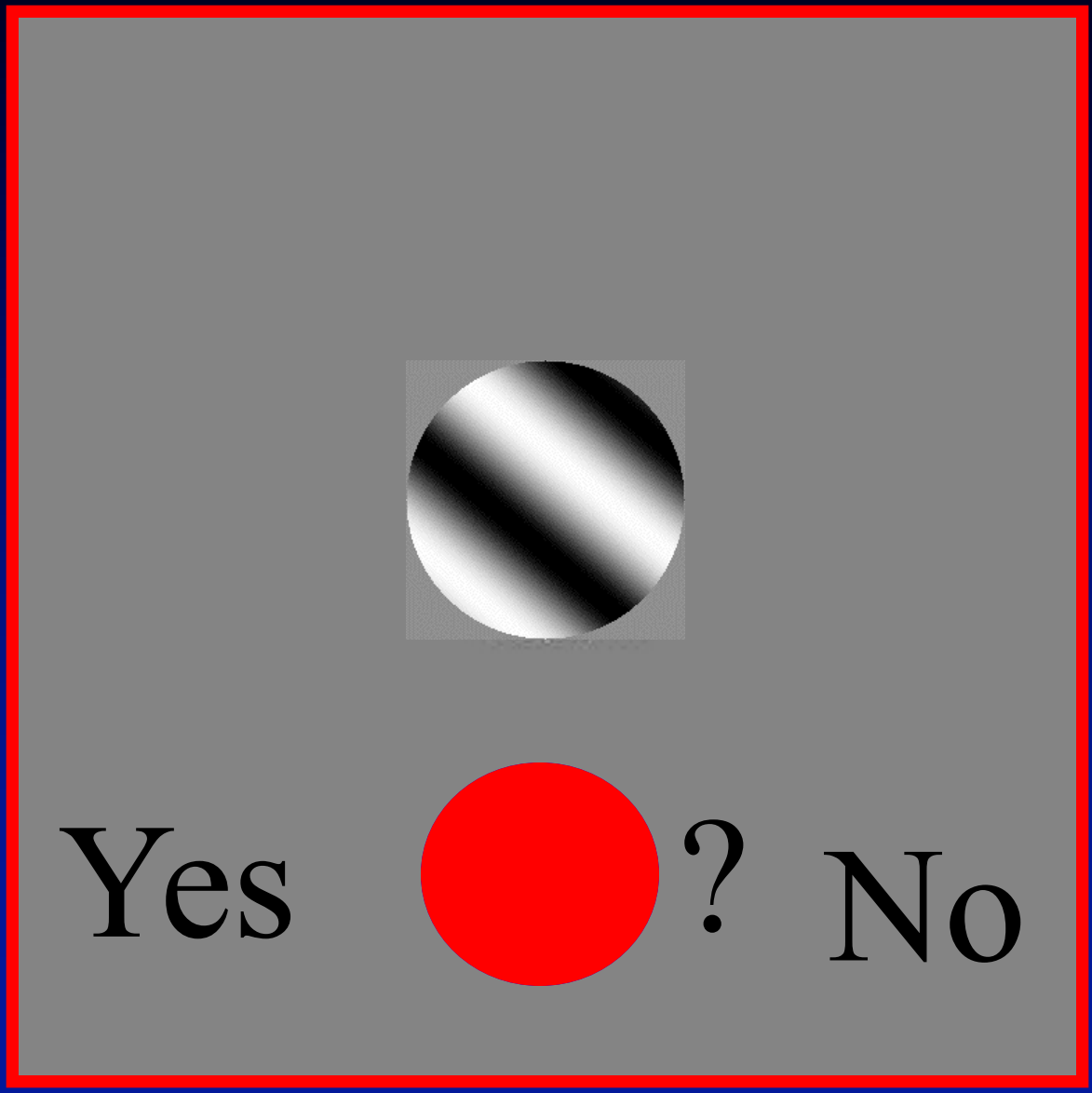
Participants

Yes-No condition - 33

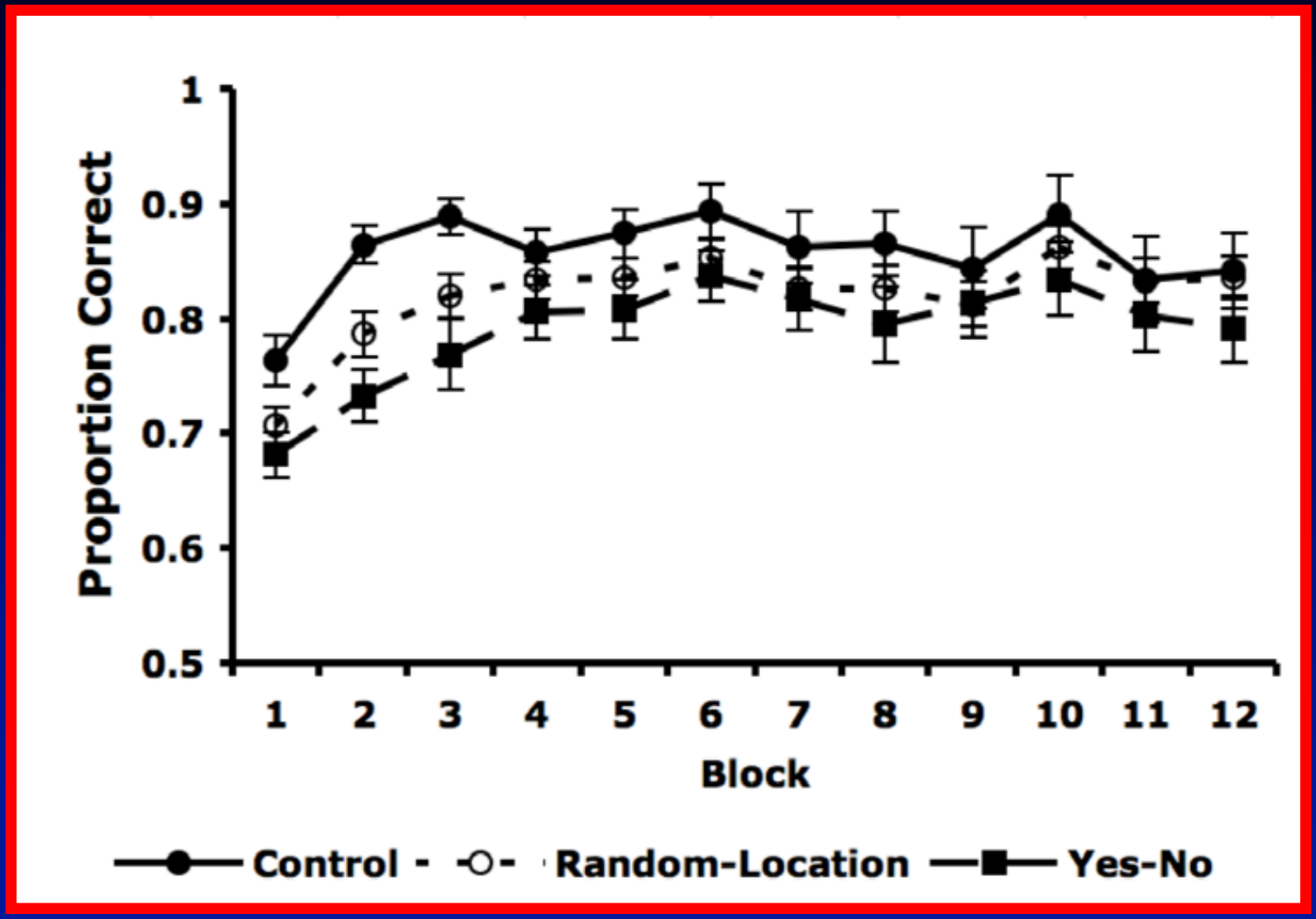
Random-Location condition - 69

Control condition - 20

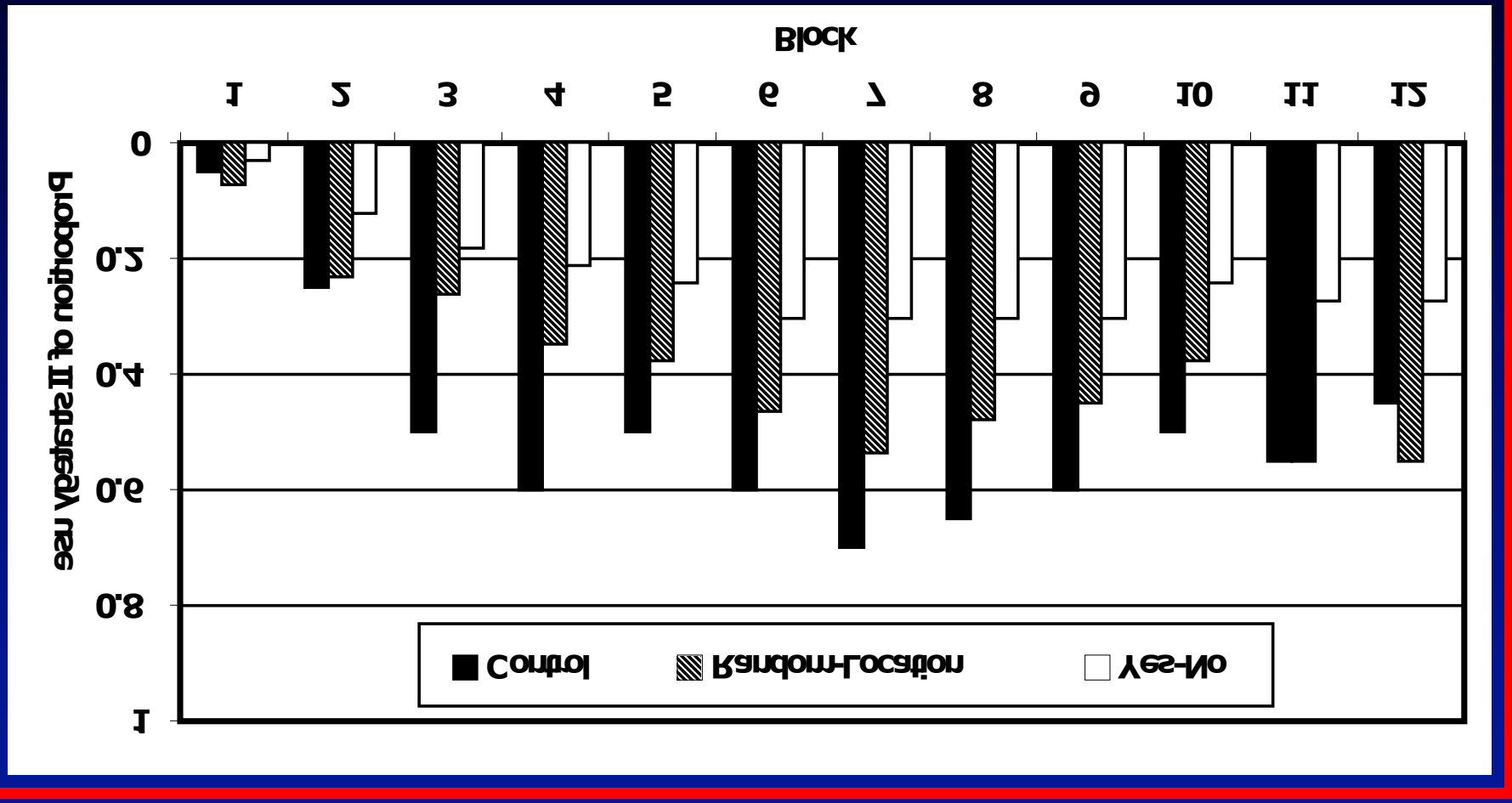
Single Trial for Yes-No



Accuracy-Based Results



Model-based Results



Discussion

- Yes-No decisions are difficult in II category learning

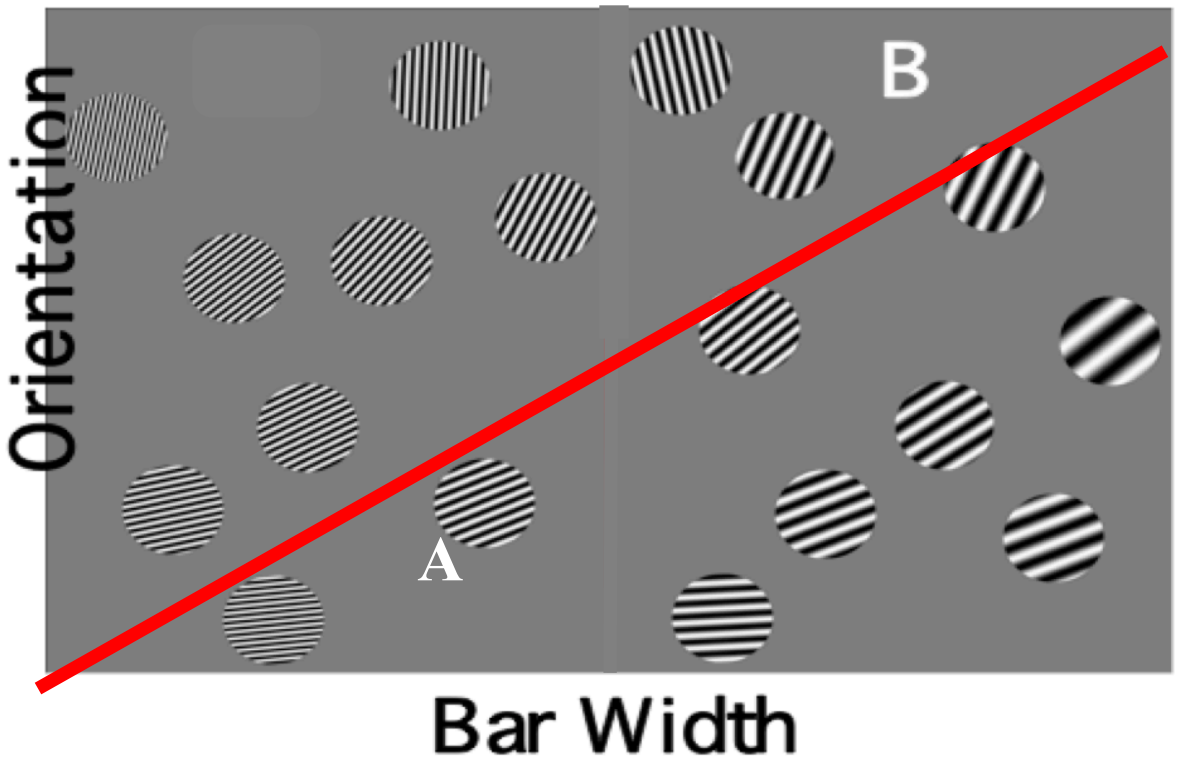
- Yes-No decisions recruit PFC

II category learning does not “depend” on PFC

Spiering, B. J., & Ashby, F. G. (2008)

Initial training with difficult items facilitates information-integration but not rule-based category learning.

Psychological Science


Orientation
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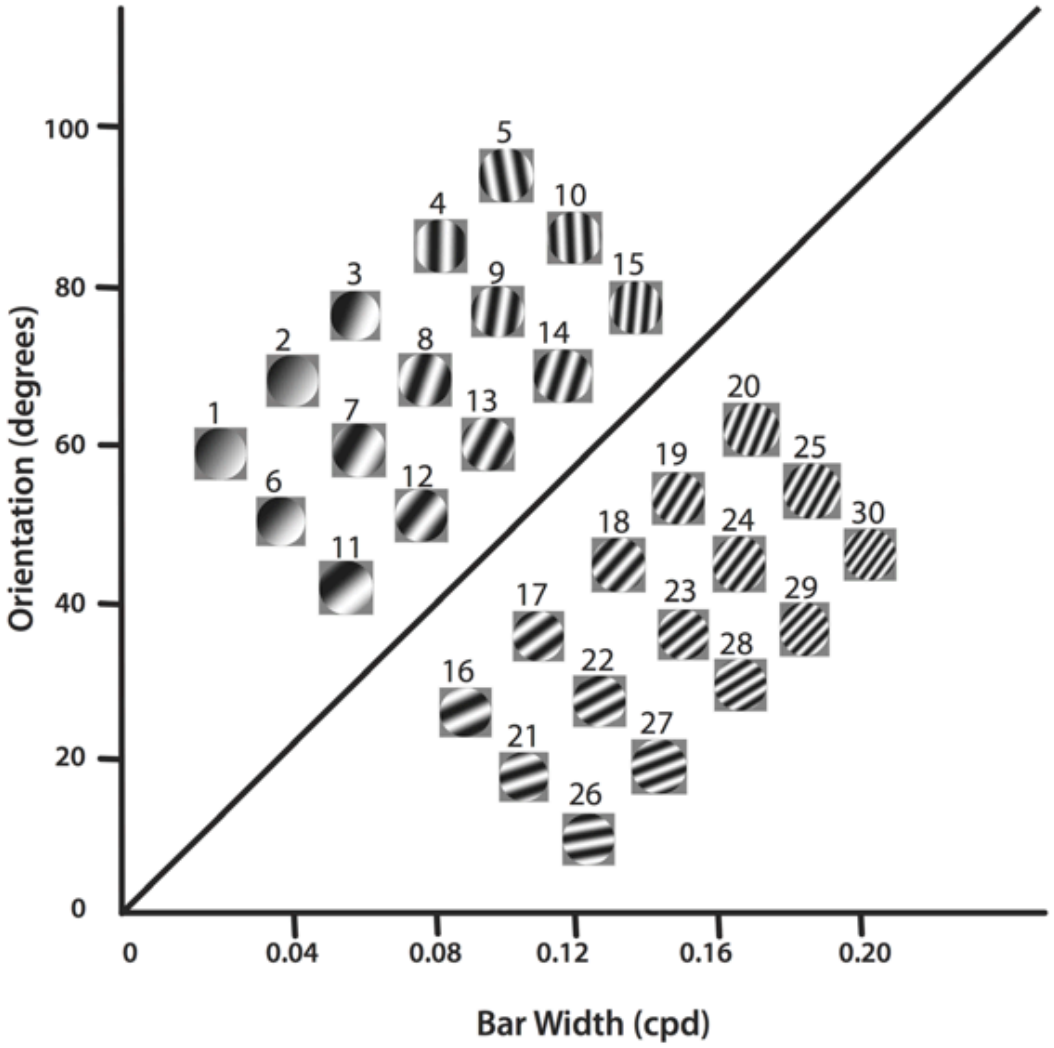
Stimuli


Orientation (degrees)
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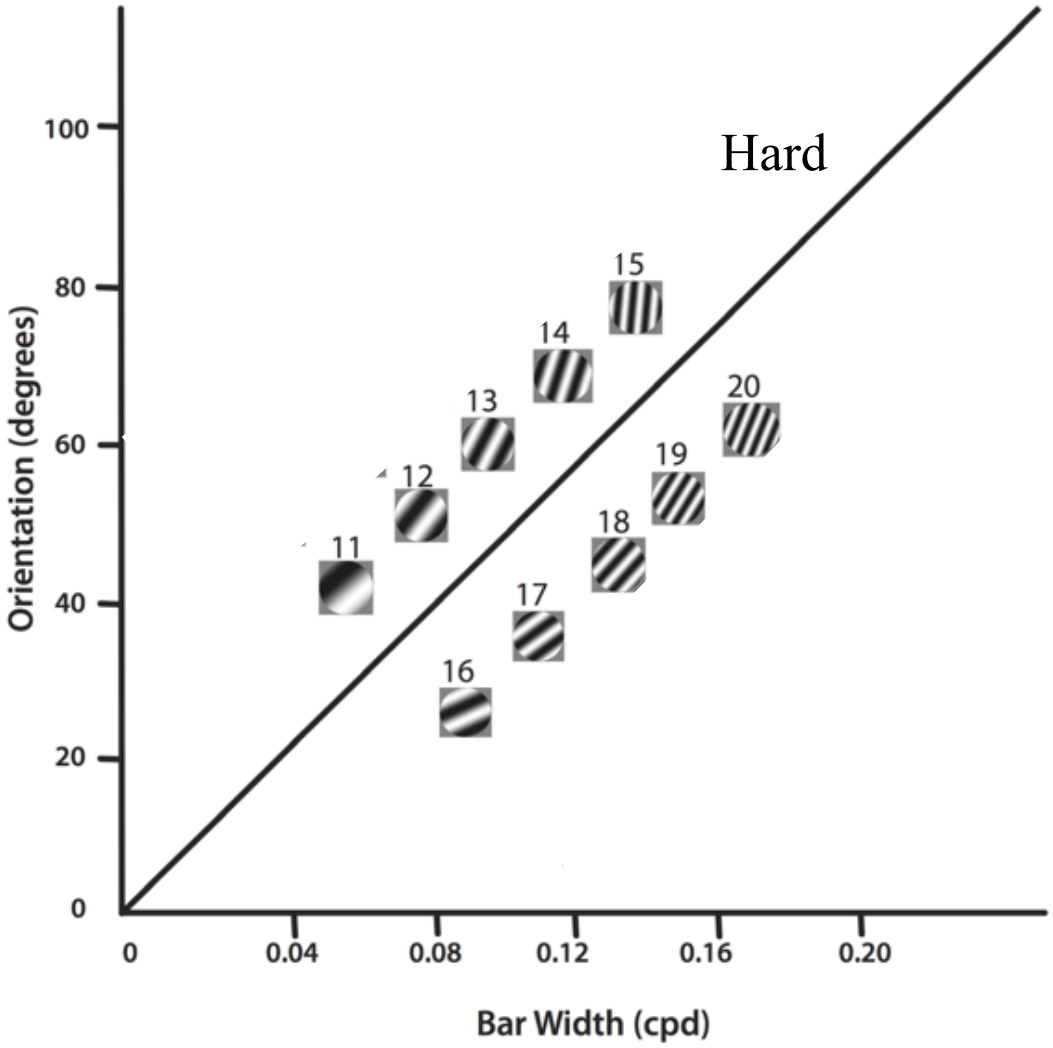
Stimuli


Hard
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Bar Width (cpd)
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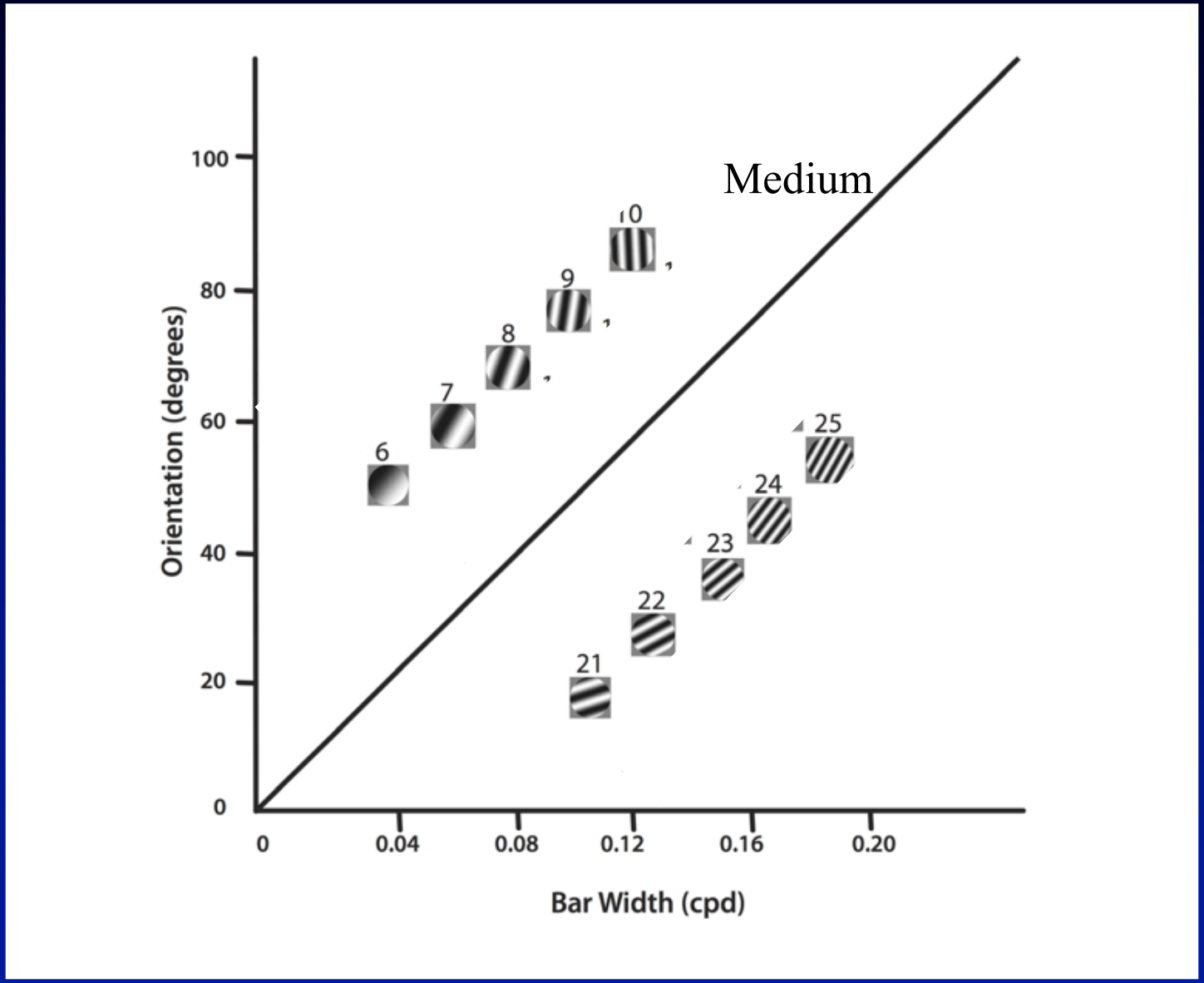
Stimuli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Bar Width (cpd)
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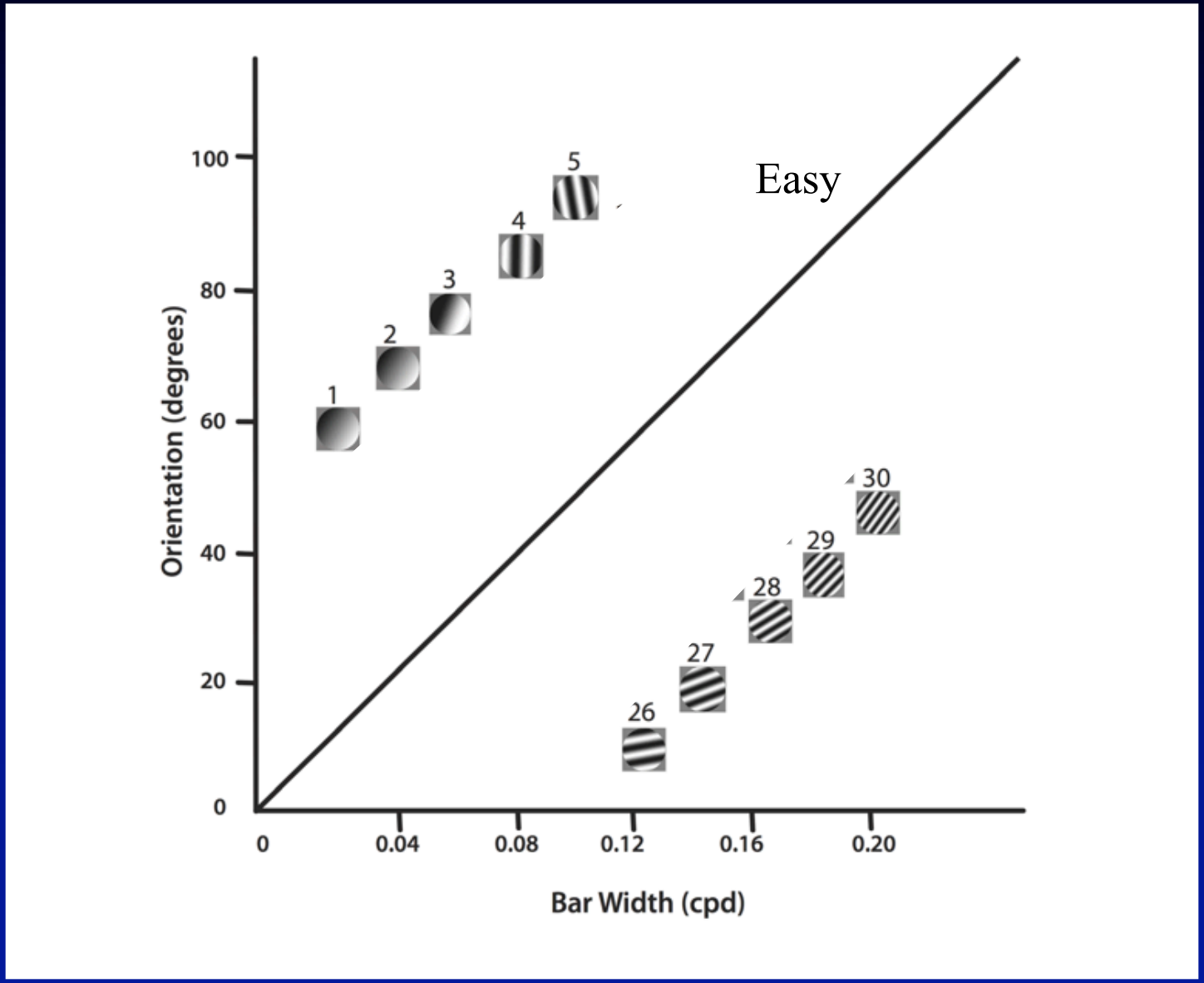
Stimuli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Bar Width (cpd)
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Method

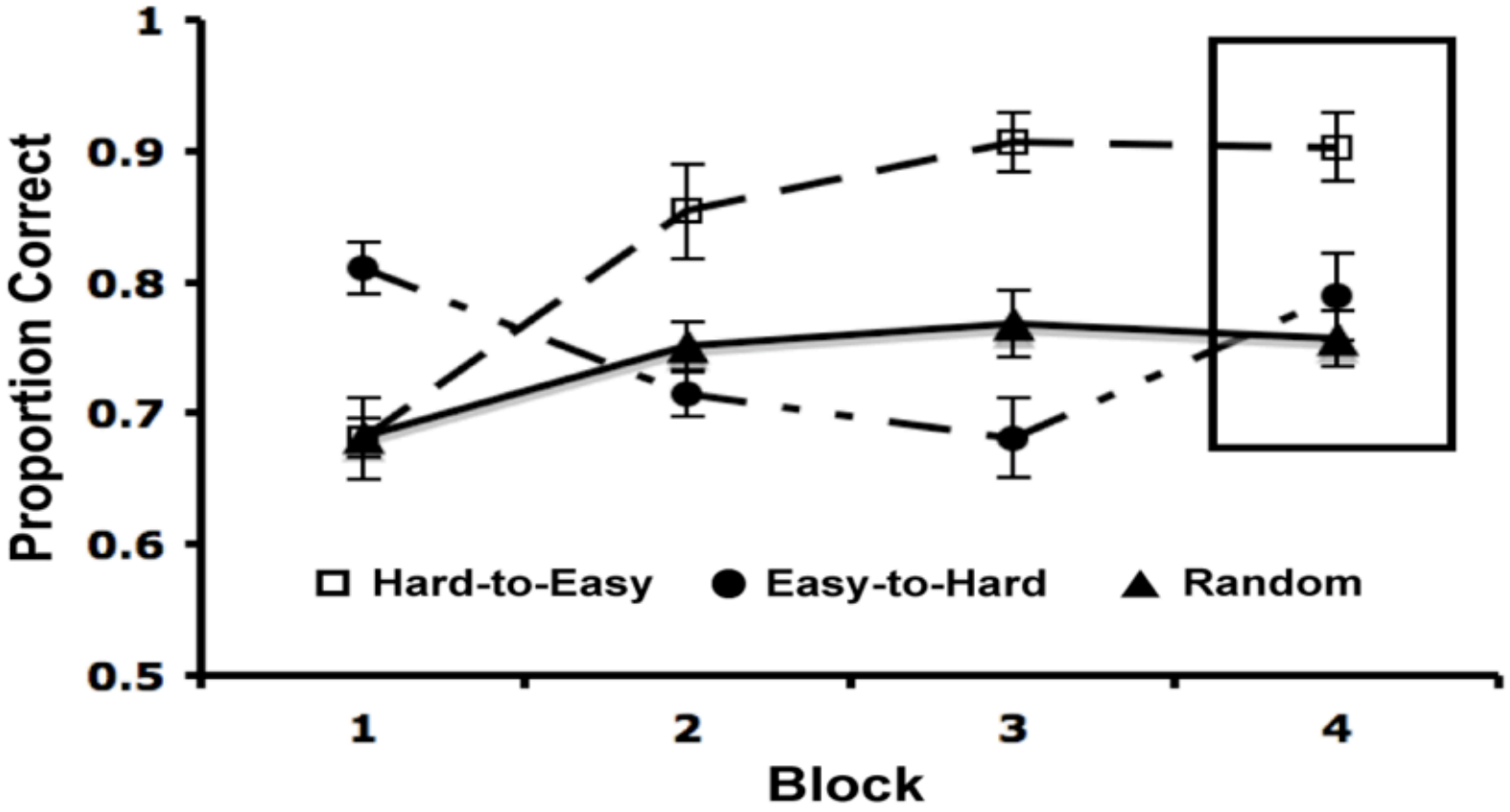
Participants

Hard-to-Easy condition - 26

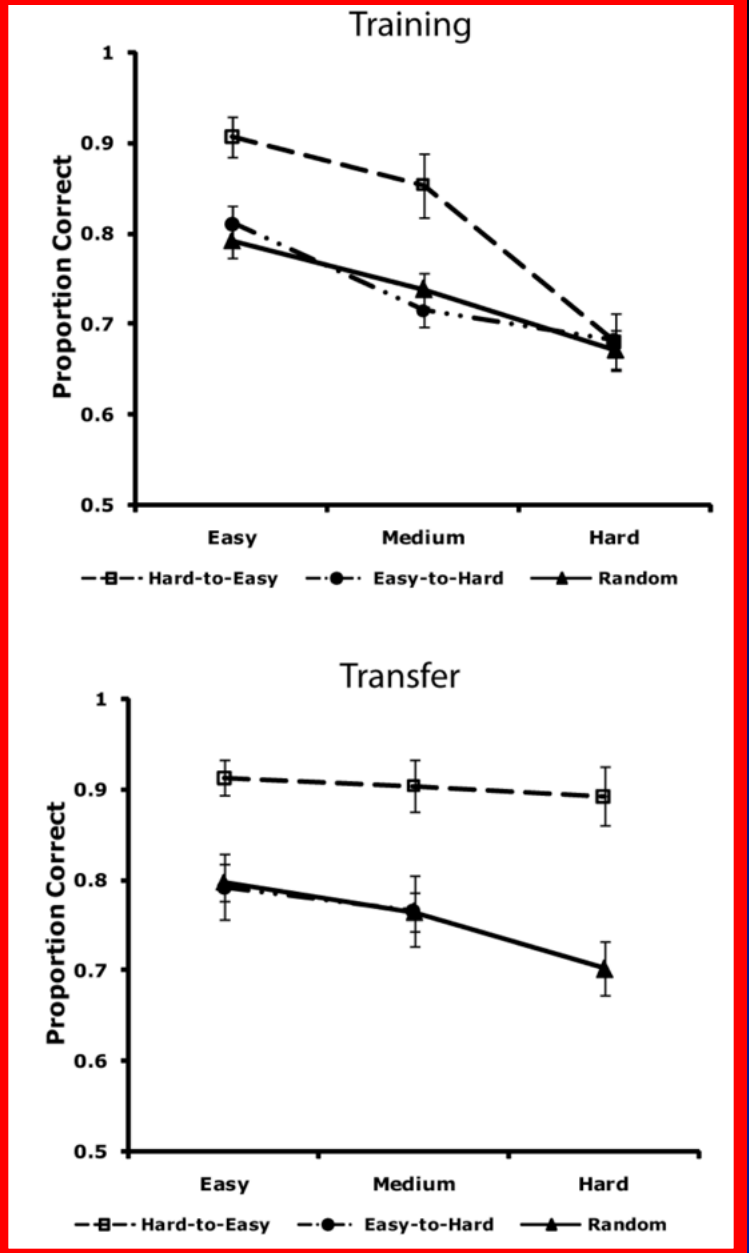
Easy-to-Hard condition - 24

Random condition - 31

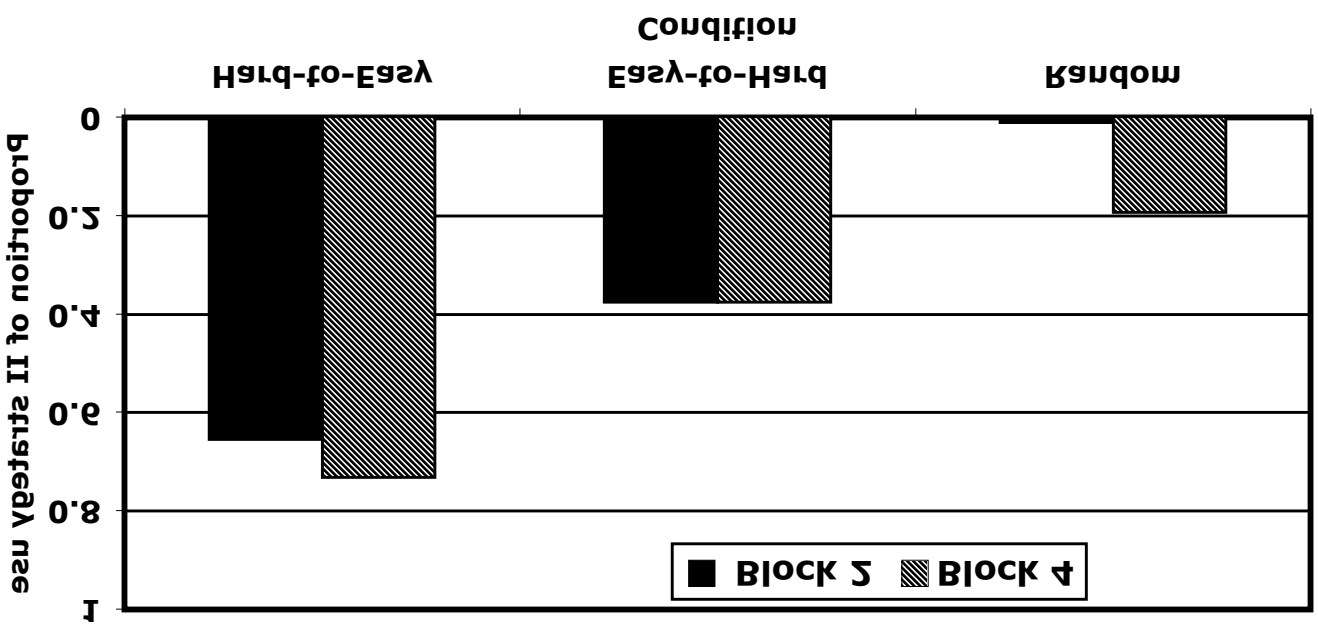
Accuracy-Based Results



Accuracy-Based Results



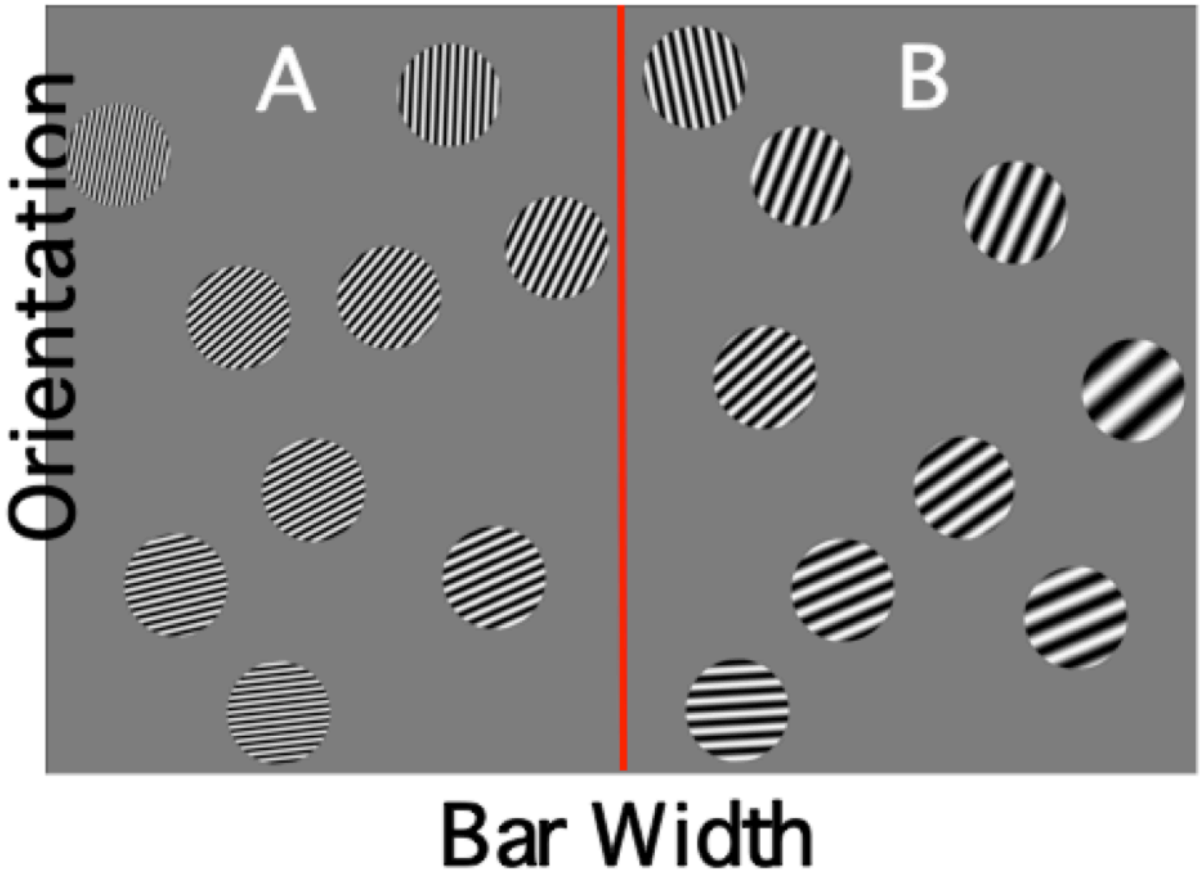
Model-based Results



Discussion

- Hard-to-Easy performed best at transfer
- Easy-to-Hard outperformed Random

What about rule-based category learning?


A
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Orientation
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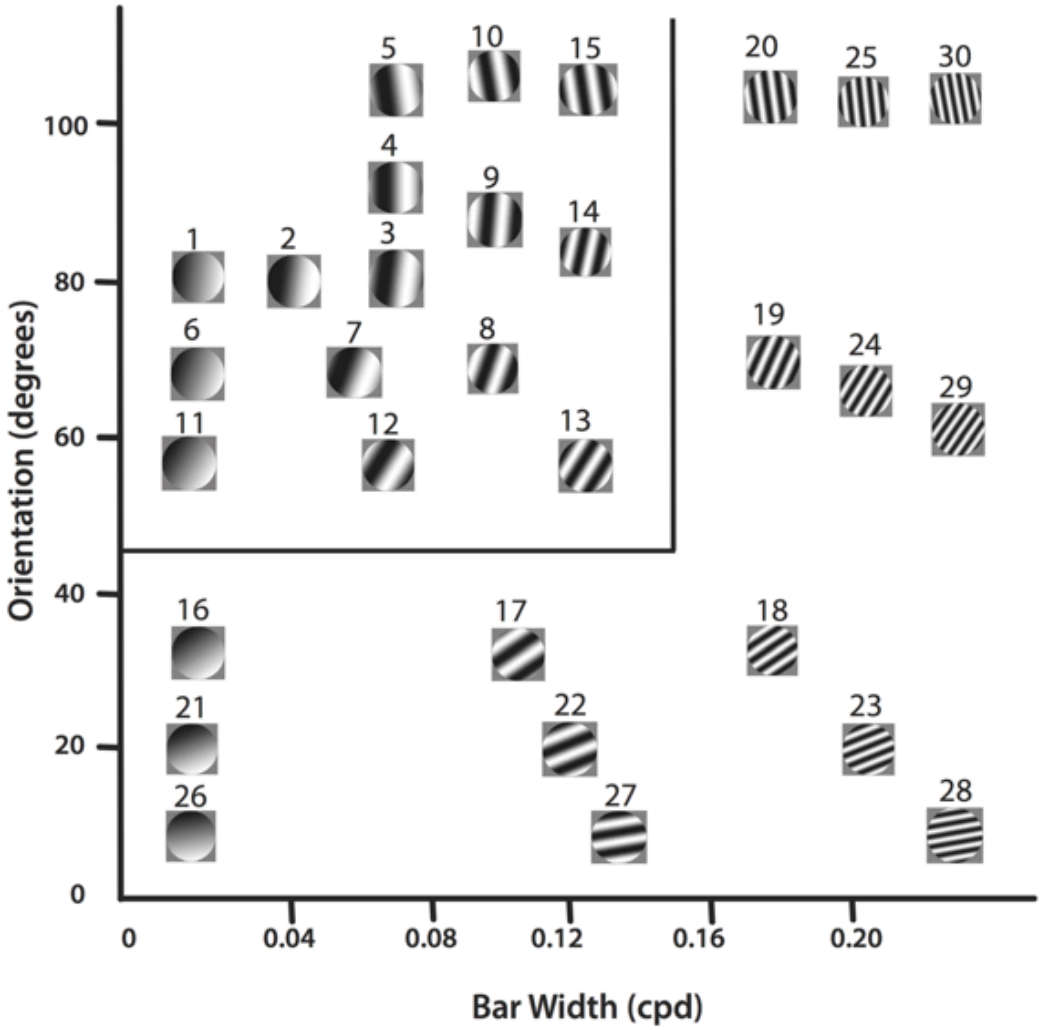
Stimuli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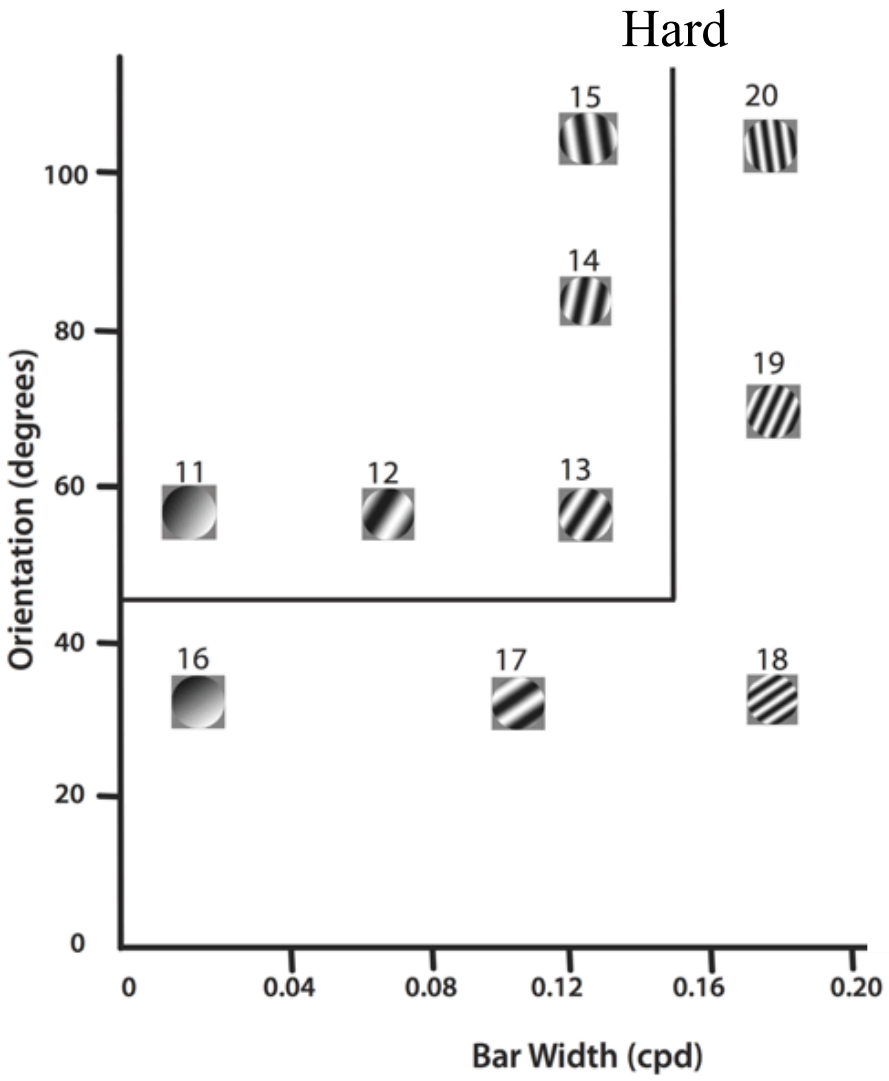
Stimuli


Hard
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Orientation (degrees)
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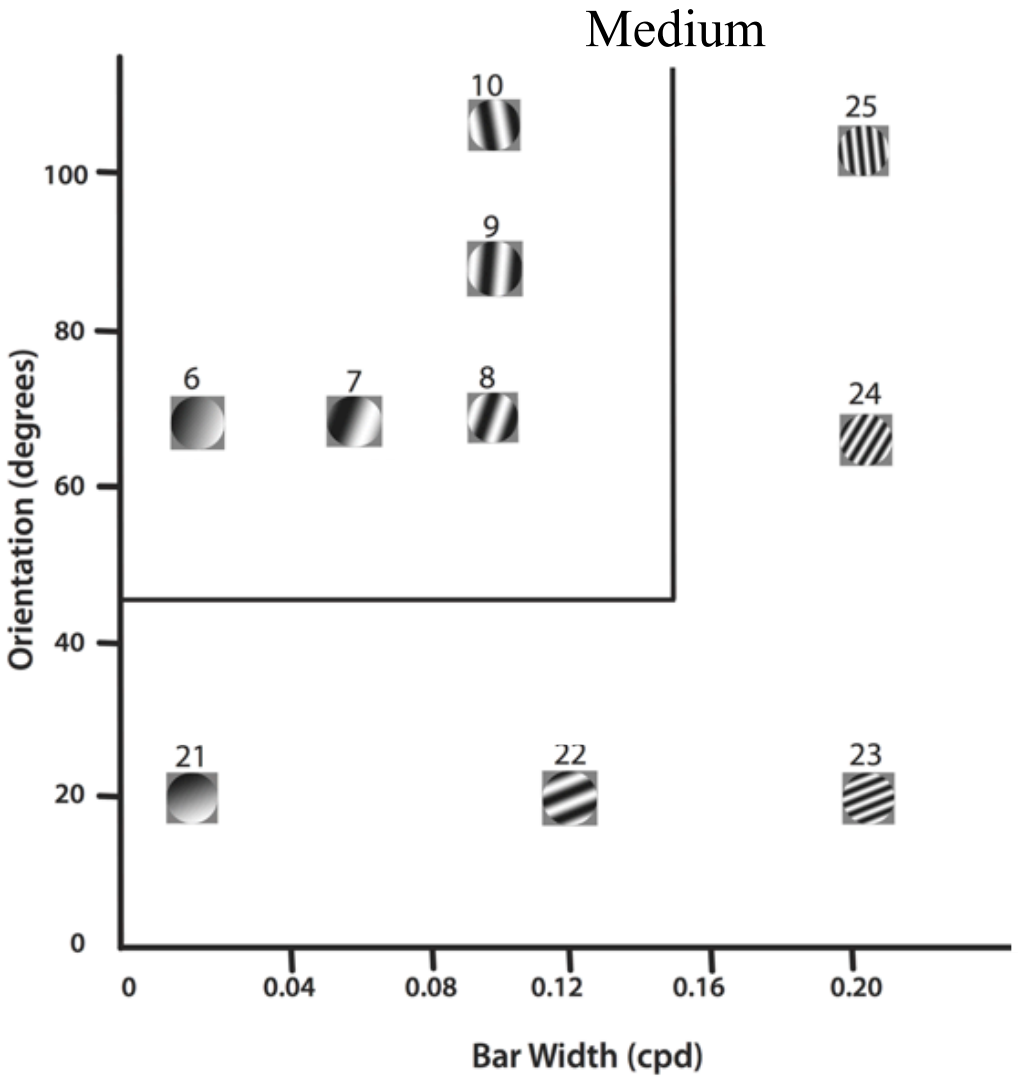
Bar Width (cpd)

Stimuli


Medium
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Orientation (degrees)
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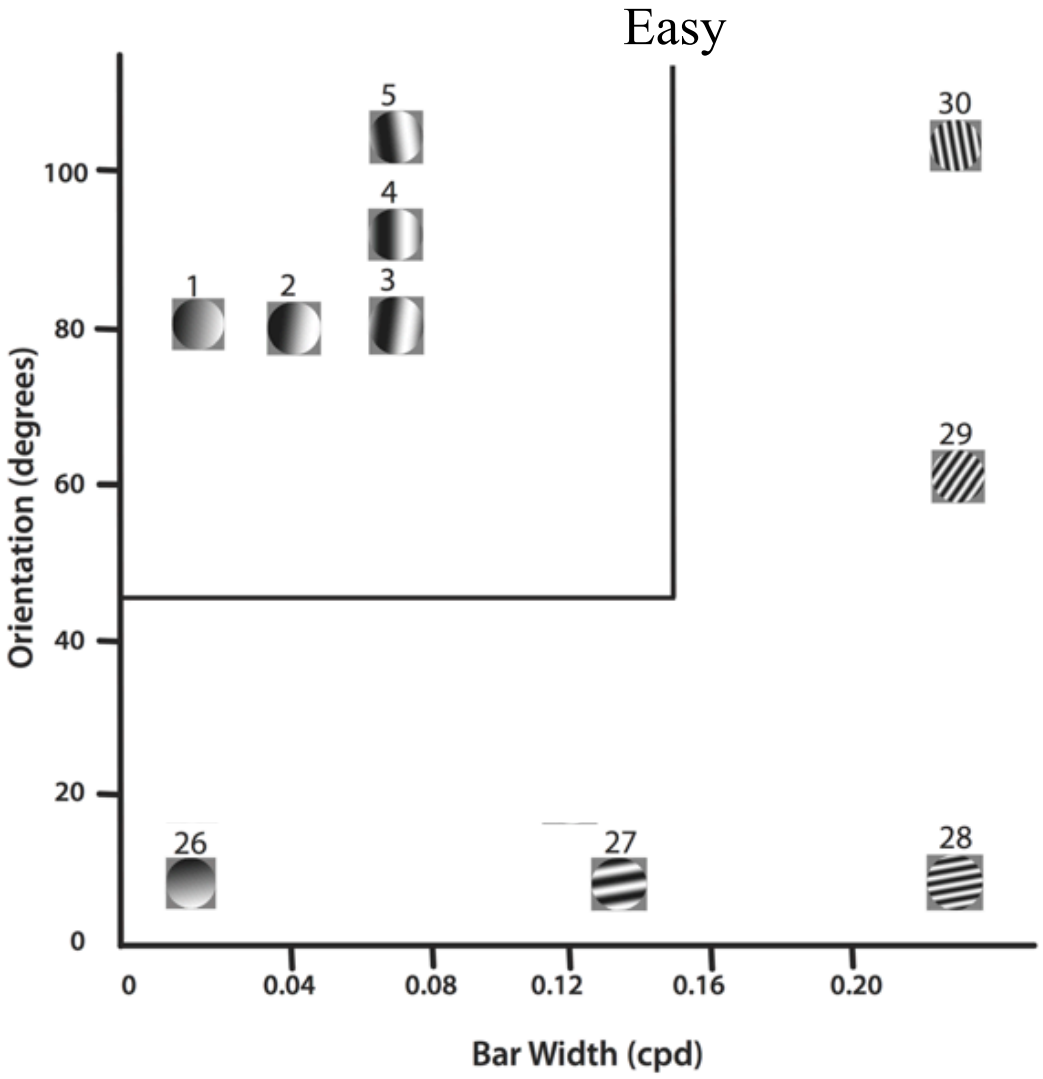
Bar Width (cpd)

Stimuli


Easy
Orientation (degrees)
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Bar Width (cpd)
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Method

Participants

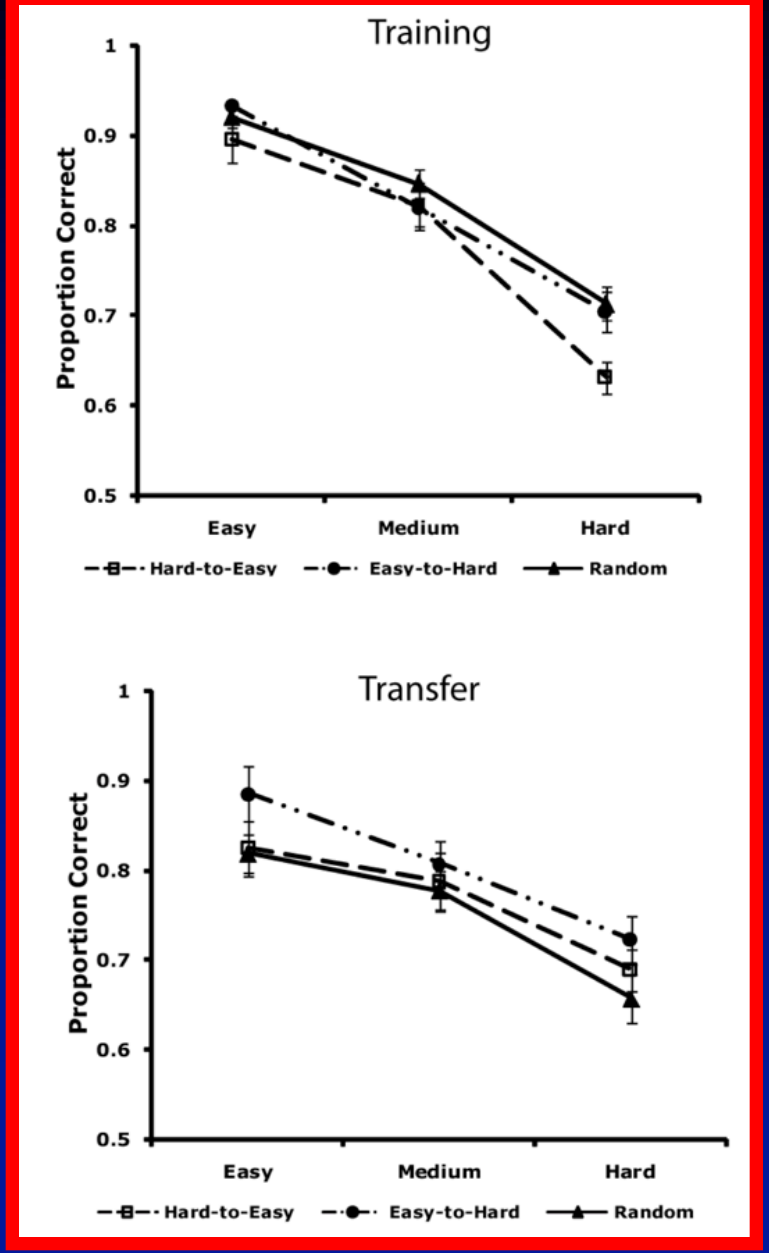
Hard-to-Easy condition - 31

Easy-to-Hard condition - 31

Random condition - 31

Accuracy-Based Results

Accuracy-Based Results



Model-based Results

Discussion

Training procedure does not matter for RB category learning

General Discussion

Cortical projection of procedural-learning system of COVIS

Competition between the systems of COVIS

Acknowledgments

F. Greg Ashby