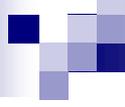


# Unitization during categorization

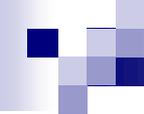
Andy Wills and Alice Welham

*Exeter University*



# Fixed or variable?

- Fixed-component models of learning
- *Feature creation* approach
  - The features one perceives in stimuli can qualitatively change as a result of experience with those stimuli
    - Schyns, Goldstone, and Thibaut (1998)

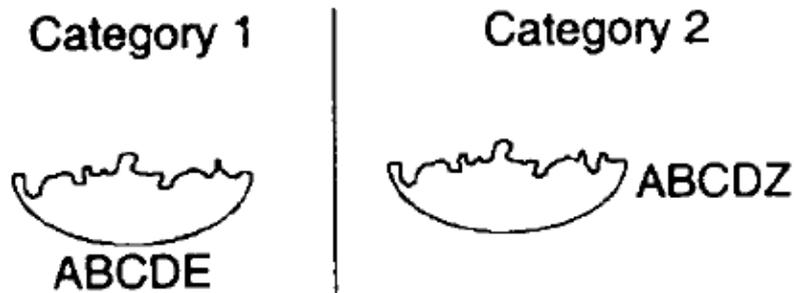
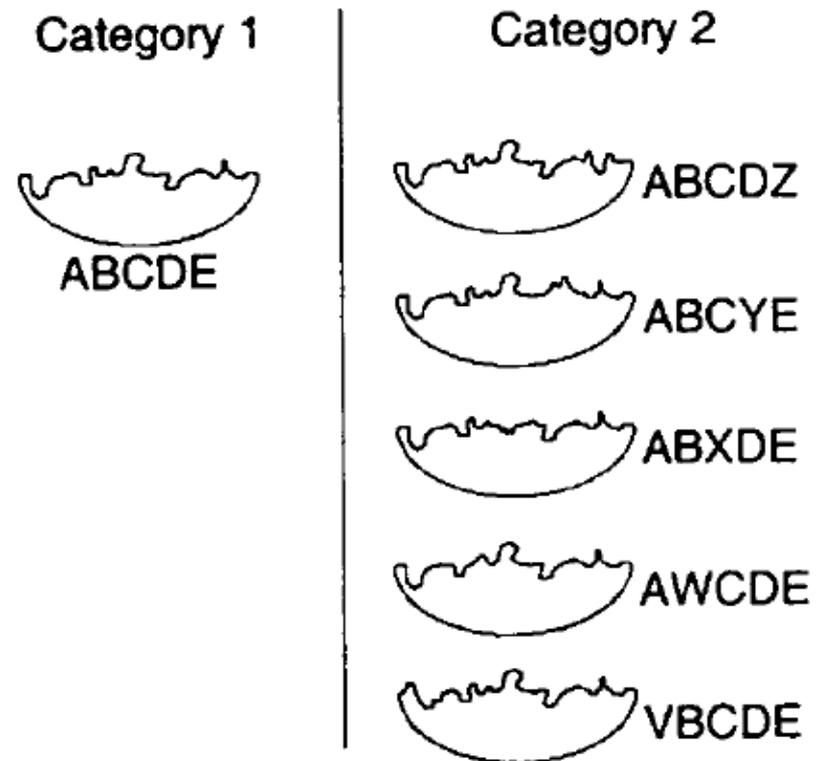


# Unitization

- The fusion of a set of pre-existing features
- Hypothesized to underlie
  - Word-superiority effect (Cattell, 1886)
  - Object-superiority effect (Weisstein & Harris, 1974)
  - Effects of extended practice on conjunctive visual search (Shiffrin & Lightfoot, 1997)

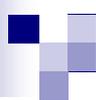
# Unitization during categorization

- Goldstone (2000)
  - Extended practice on an all-component categorization results in faster responding than predicted by an independent components model from one-component RTs.



↑ All-component categorization

← One-component categorization

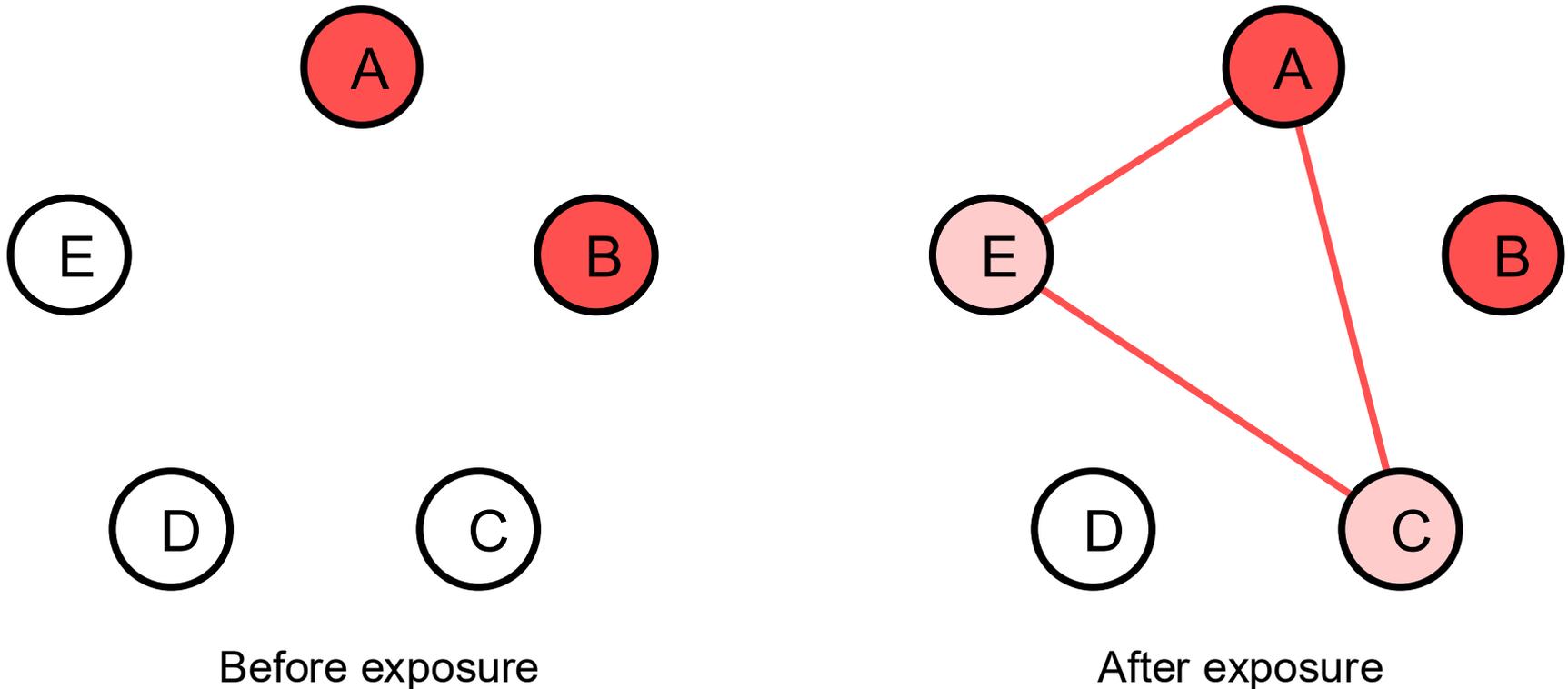


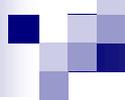
# Current work

- Provide converging evidence for unitization during categorization through two further methodologies.
- Choice of methodologies informed in part by the predictions of McLaren-Mackintosh theory of unitization.

Prediction 1: Relative salience of the unitized part of the stimulus will increase.

Following stimulus sampling theory (Estes)





Prediction 2: Unitization will occur whether or not the unit is diagnostic of some category.

- Contrast recent emphasis on the role of functionality:

“these experiments investigate whether new perceptual units can be developed *if they are useful* for a category learning task” (Goldstone, 2000, p.86)

“unitization may not occur unless the task requires unitization for success” (Shiffrin & Lightfoot, 1997, p.74)

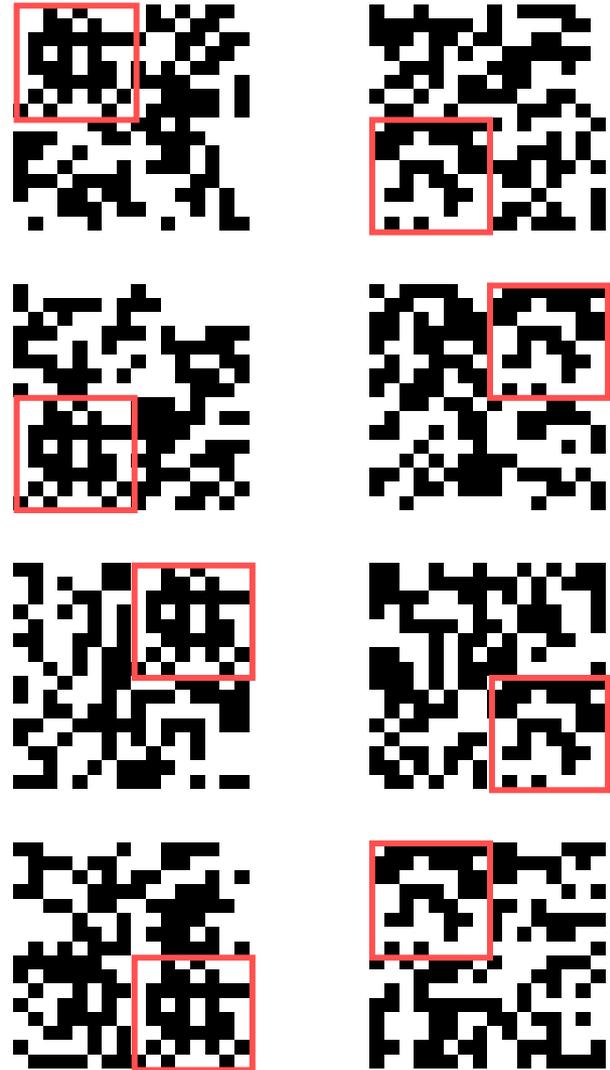
# Experiment 1

- Categorization, followed by similarity judgments to assess salience change.
- Can you spot the feature?



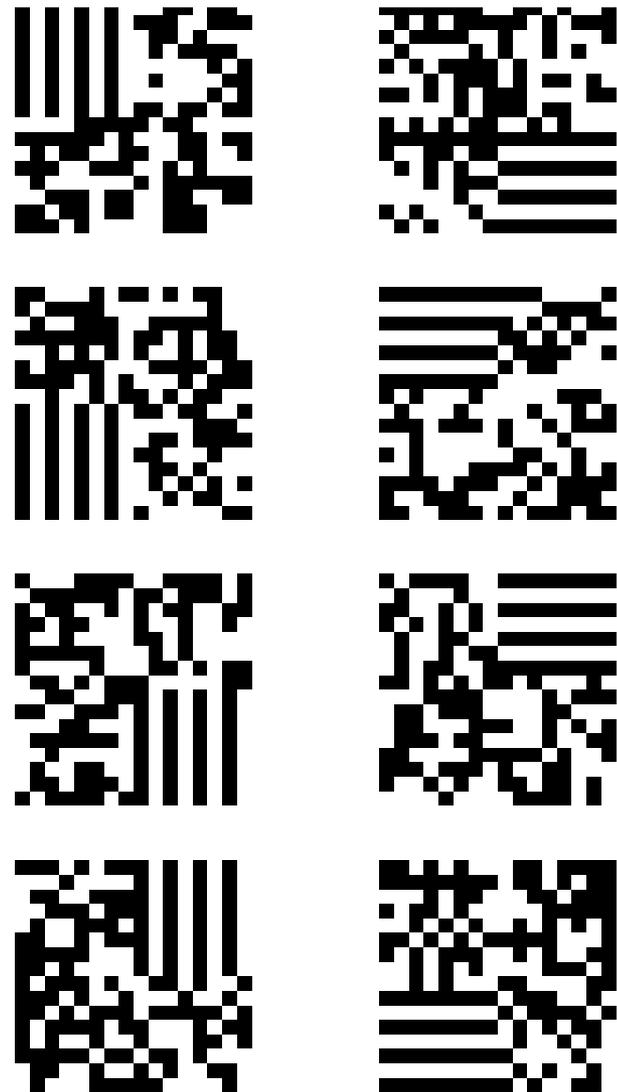
# Experiment 1

- Categorization, followed by similarity judgments to assess salience change.
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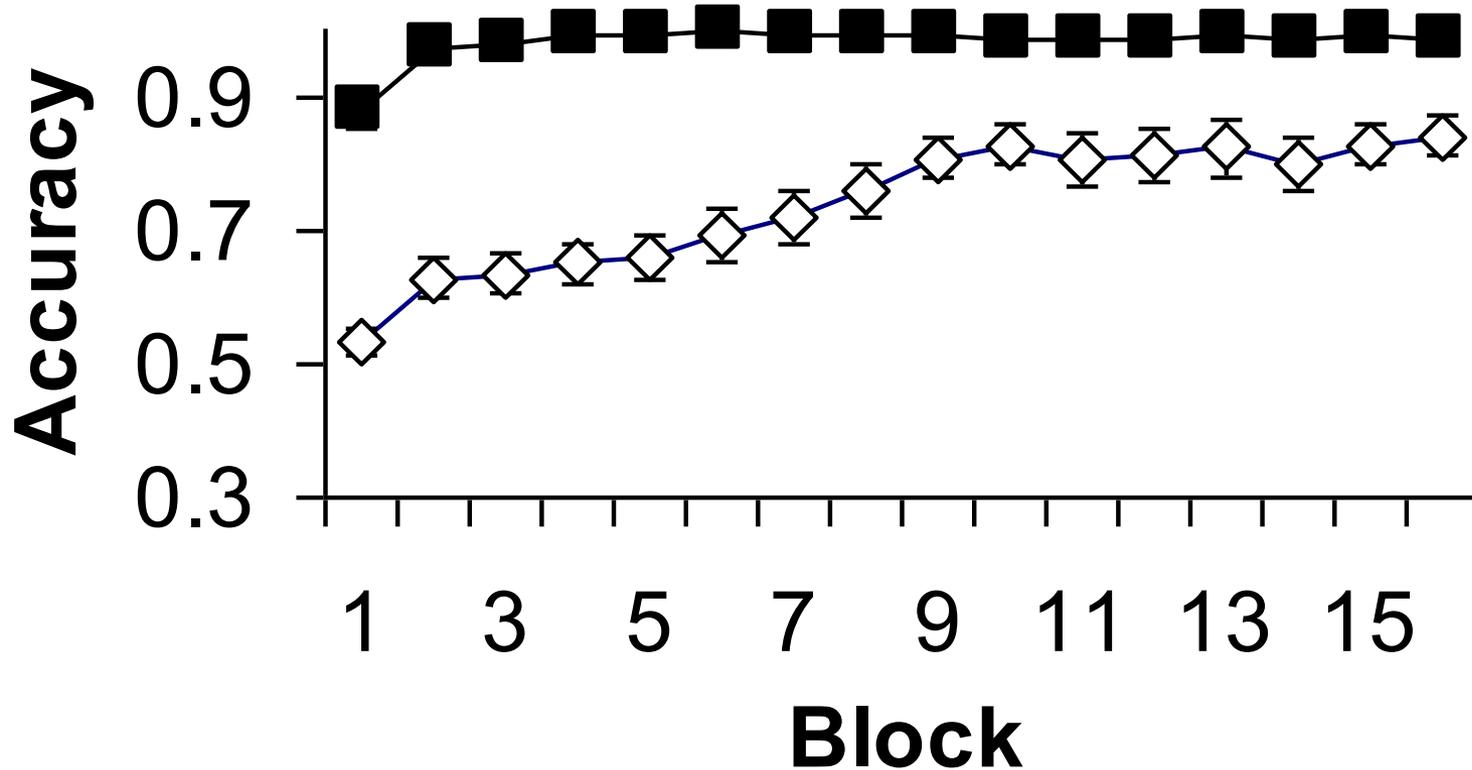


# Non-unitization-related salience changes

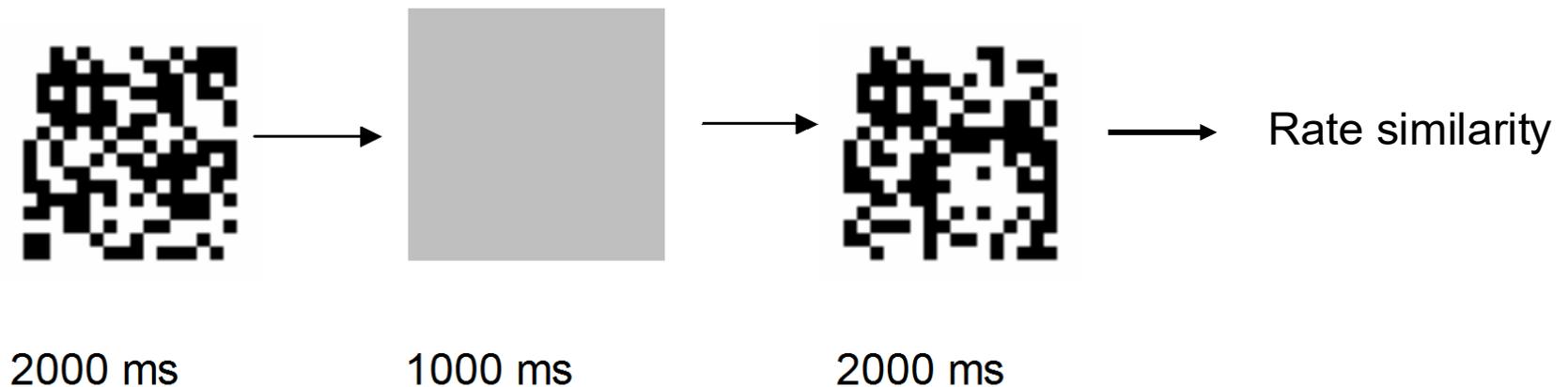
- Salience could change for other reasons.
- In particular, the attention attracted by even very familiar stimuli (e.g. words) can be modulated by the extent to which they predict an outcome (e.g. Kruschke, Kappenmann, Hetrick, 2005).



# Training

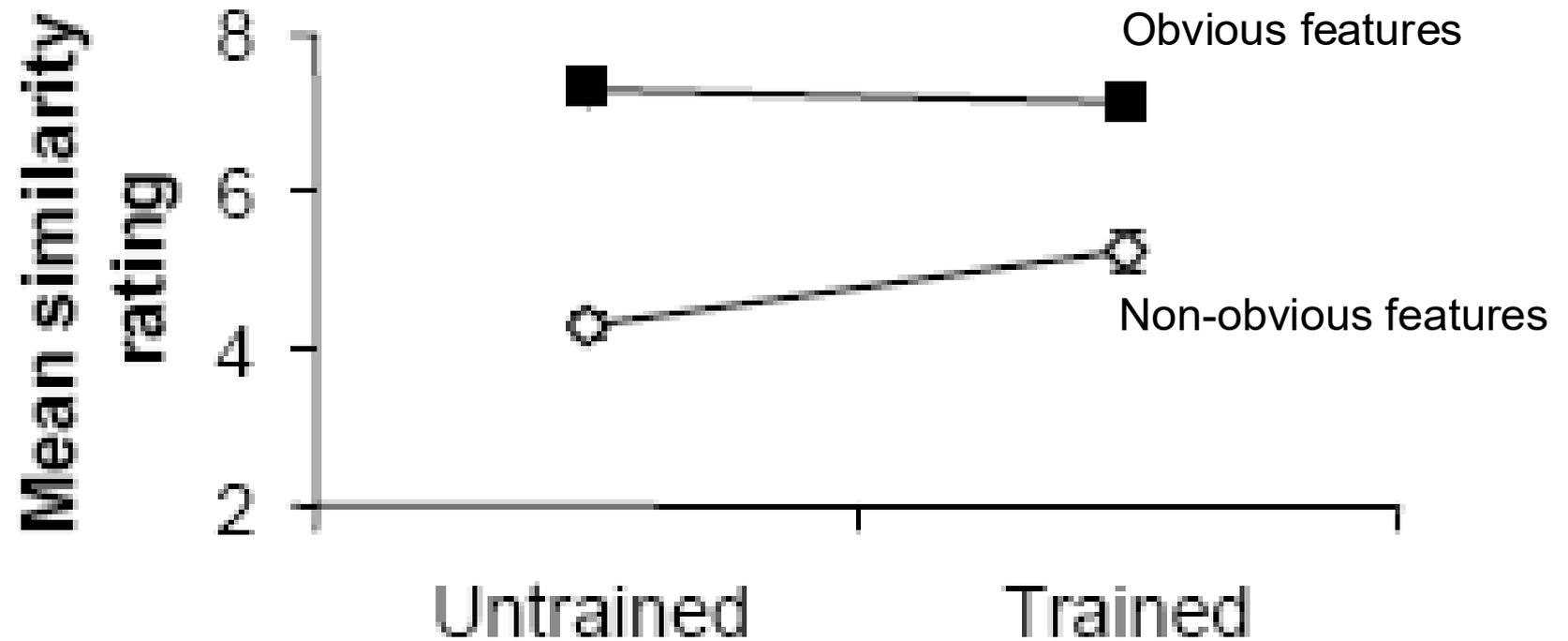


# Similarity rating: Task 1



- The two patterns share the feature, but have different noise.
- Unitization should result in an increase in similarity (because the unitized component is more salient)

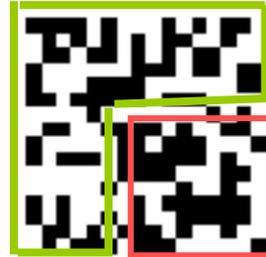
# Results



# Similarity rating: Task 2

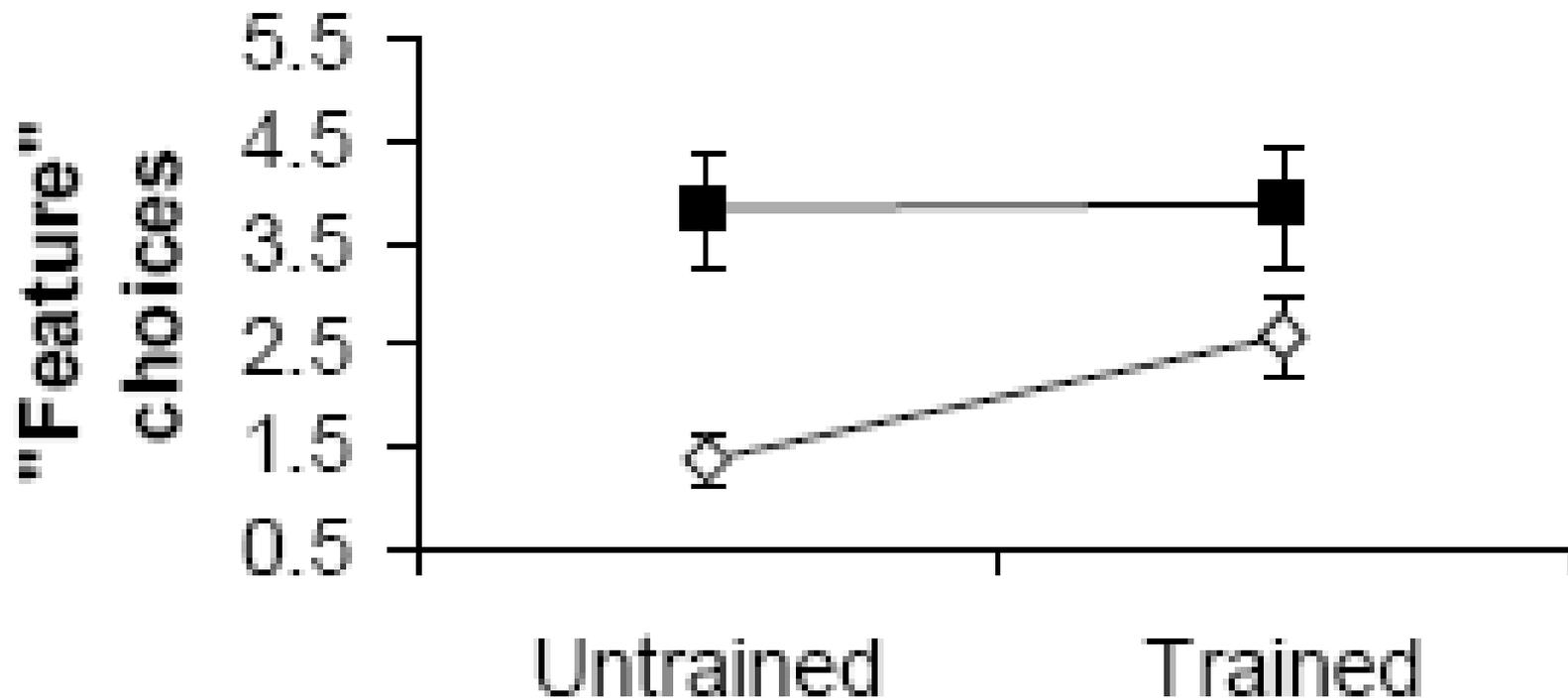


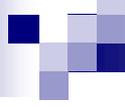
- Pick the two stimuli which are most similar (standard triad task)



- Pick the two stimuli which are most similar (standard triad task)

# Results





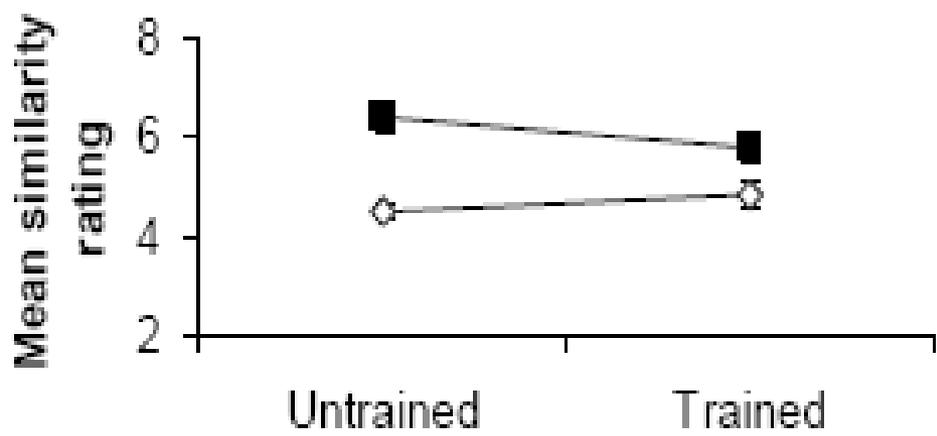
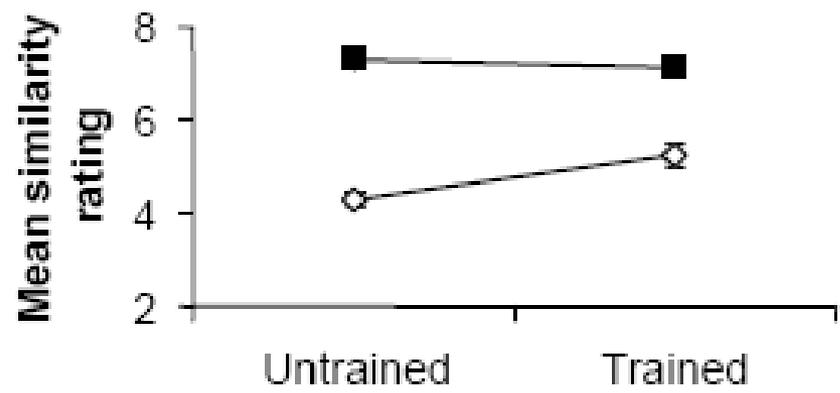
# Experiment 1: Summary

- Categorization training seems to lead to an increase in the salience of category-diagnostic configurations
- This increase only occurs when the configurations are non-obvious.
- This pattern of salience change is predicted by McLaren-Mackintosh theory of unitization
- However, this theory also predicts that the same pattern of results should be observable when the stimuli are simply exposed...



# Experiment 2: Exposure

- As Experiment 1, except categorization responses are replaced by attractiveness ratings.



Exp.1: Categorization

↑

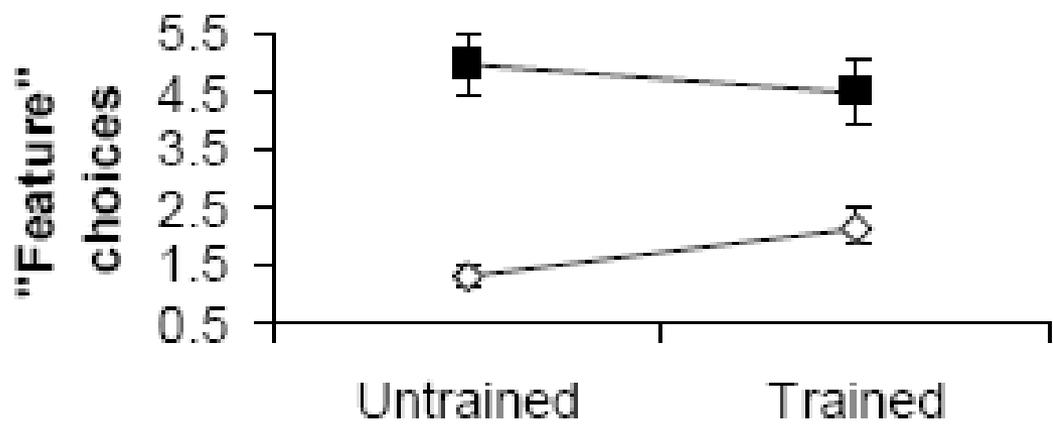
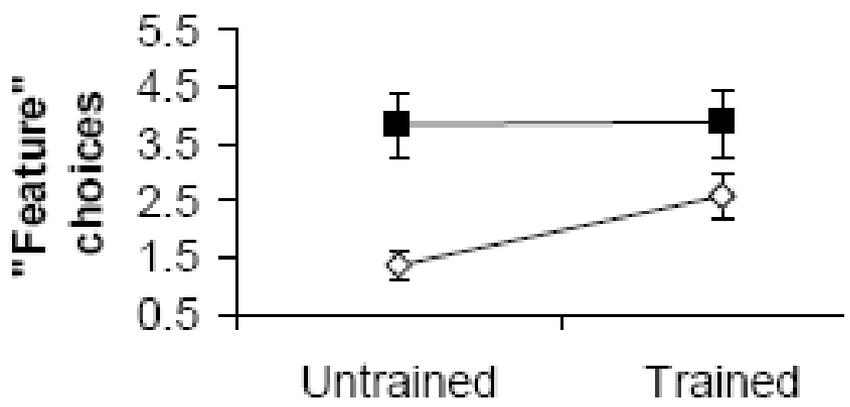
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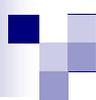
Features

Exp.2: Exposure

↑

↓



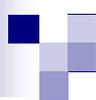


# Converging evidence

- Experiments 1-2 based on similarity ratings.
  - Some have argued that similarity ratings are “particularly prone to task demands and explicit strategies” (Goldstone, Lippa & Shiffrin, 2001, p. 30).
  - A task demands explanation of Exp 2 is not immediately apparent but, nevertheless, converging evidence from a different measure of salience might support the case made by Experiments 1-2.

# Eye-tracking

- Eye-tracking dwell time is increasingly being used as a measure of overt attention in studies of categorization
- Examining an overt attention measure should give additional information. It is not immediately obvious what effect unitization should have on overt attention:
  - Overt attention could be directed towards salient parts of the stimulus. **Increased unitization = increased overt attention**
  - Alternatively, one of the benefits of unitization might be to reduce the need for foveation. **Increased unitization = decreased overt attention.**

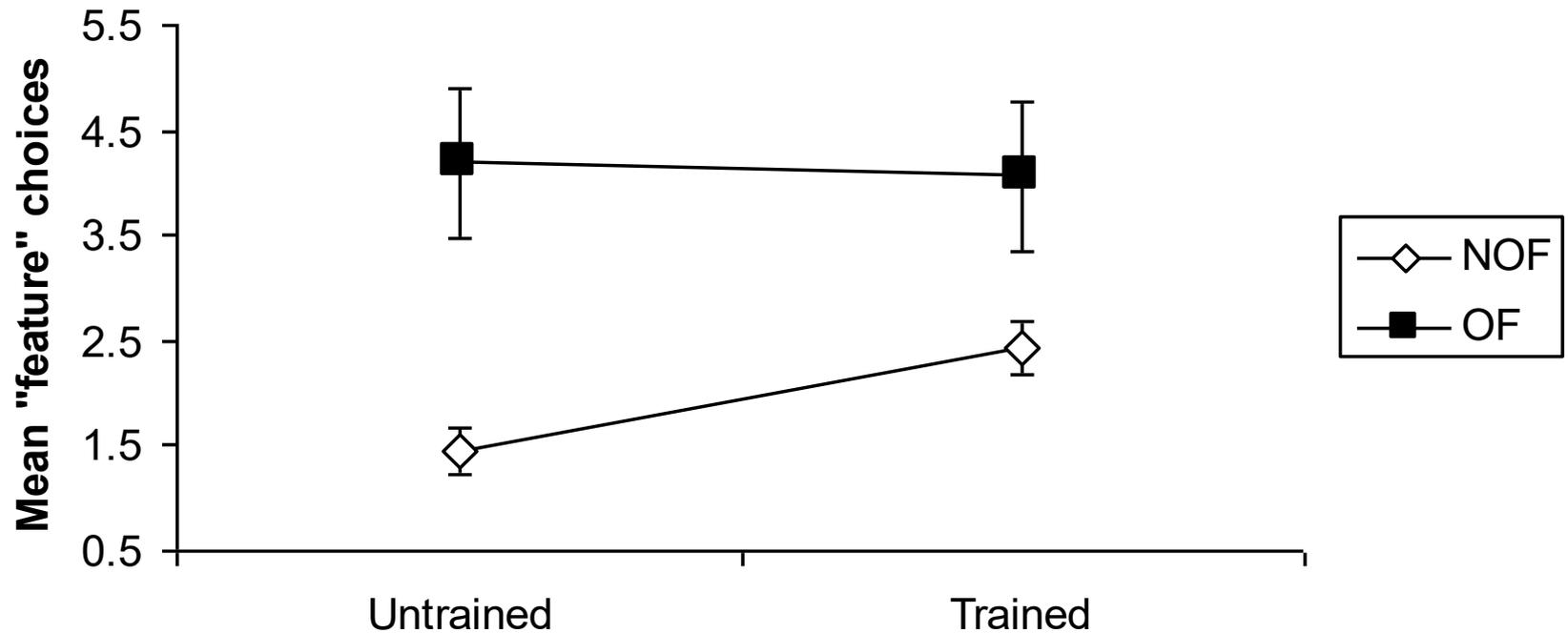


# Role of functionality

- Cross-experiment comparison of Experiments 1 and 2 fail to reveal any significant differences of different types of exposure.
- Re-examined in this experiment – which has both categorization and simple exposure conditions.
- This experiment only used the triad similarity task.

# Results

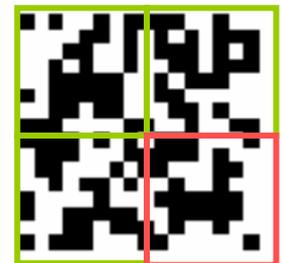
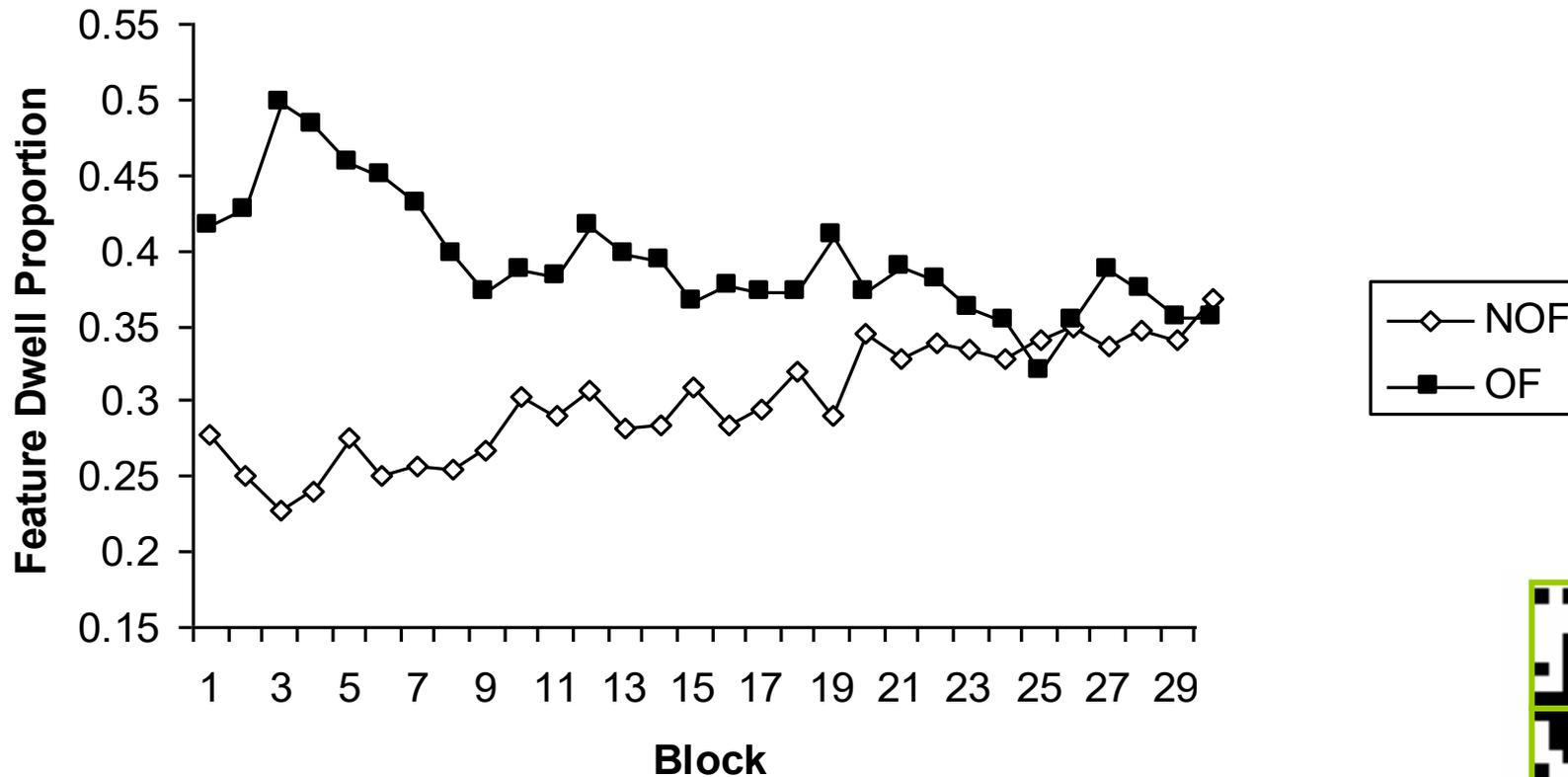
## Triads



Again, no effect of exposure type (graph above shows average)

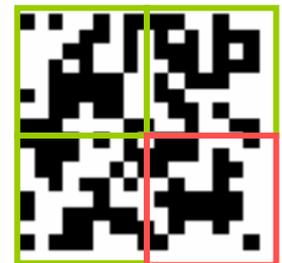
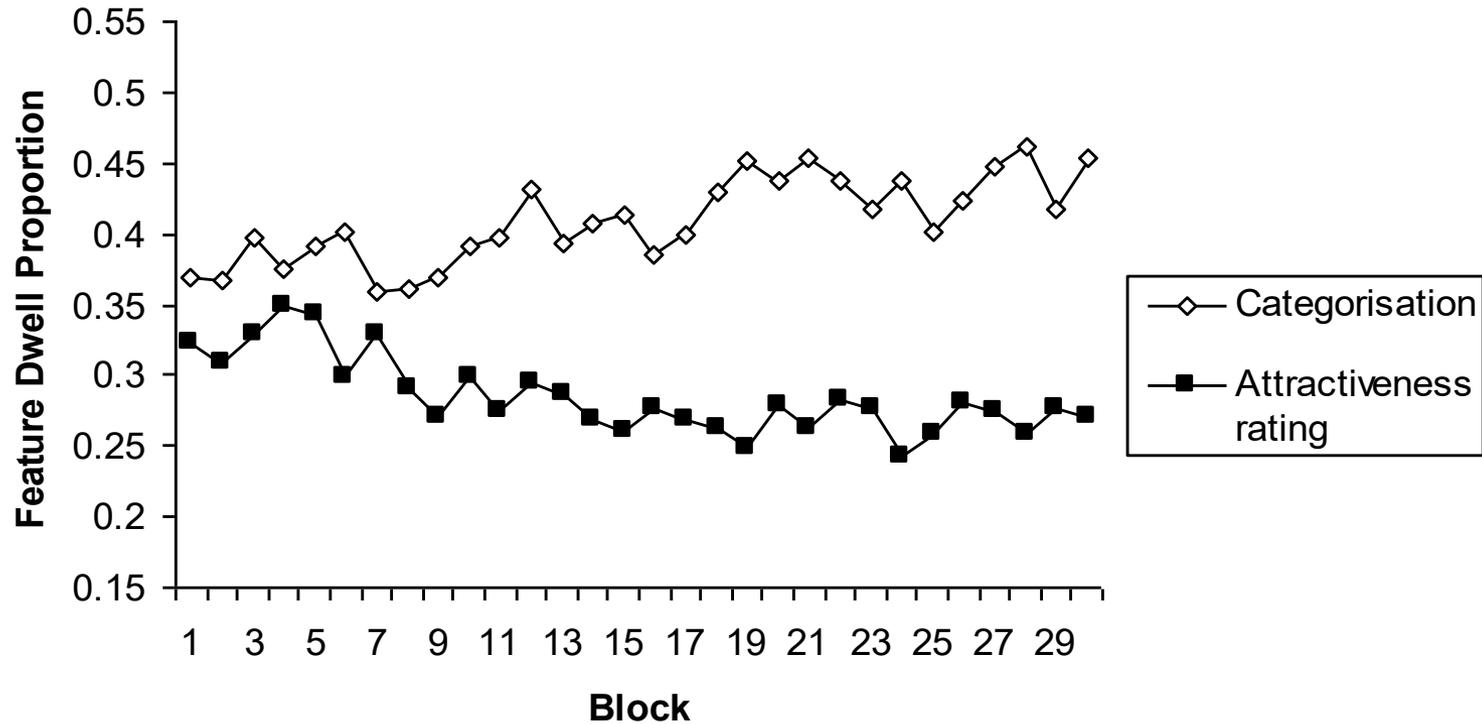
# Eye-tracking

Feature Dwell Proportion: Block x Feature type interaction



# Eye-tracking

Feature Dwell Proportion: Block x Training Type interaction



# Summary

## ■ Exposure and salience

- Repeated exposure to already-familiar features tends to reduce their salience.
- Repeated exposure to non-obvious unfamiliar features increases their salience.
- These effects are predicted by McLaren-Mackintosh unitization, i.e. by
  - Within-compound associations, plus
  - Estes stimulus sampling theory.

## ■ Diagnosticity and salience

- Features that predict category membership increase in salience.
- Features that predict no particular outcome decrease in salience.
- These effects are predicted by e.g. Mackintosh (1975).