

# **Knowledge Applied to New Domains: The Unconscious Succeeds Where the Conscious Fails**

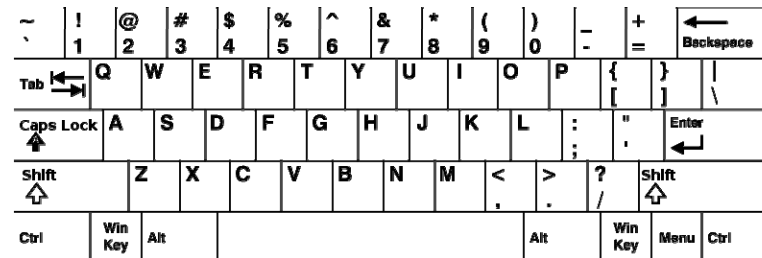
**Ryan Scott  
&  
Zoltán Dienes**

# The Flexibility of Conscious Versus Unconscious Knowledge

## A supposed advantage of conscious knowledge is its flexibility

- Conscious knowledge is flexible - it can be applied in novel ways to novel situations (e.g. Baars 1988).
- Unconscious knowledge is inflexible - it is limited in its application to the context in which it was acquired (e.g. Shiffrin & Schneider, 1977).

E.g. A touch typist has implicit knowledge of the position of the keys - knowledge available when typing but inaccessible for other tasks.



Such a difference could be valuable in understanding the role of consciousness, but is it a genuine difference?

# Artificial Grammar Learning and Knowledge Transfer

Training

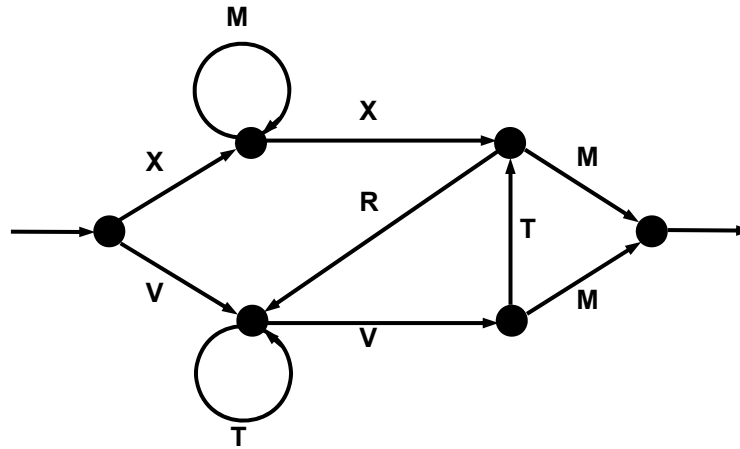
XMMXM

VTTVTM

XM XRVM

VVTRTVM

...



Testing

VTVTM

*VTRRM*

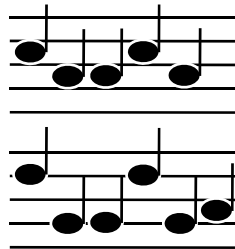
XXRVM

*XXRRM*

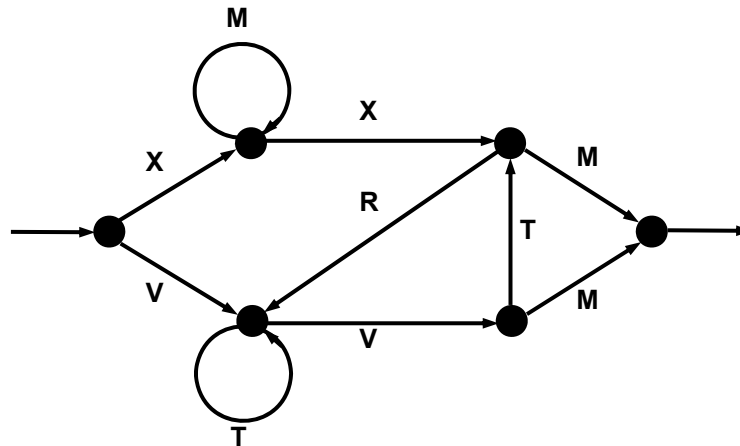
...

Non-Transfer  
Accuracy  
Typically ~70%

Training



...



Testing

VTVTM

*VTRRM*

XXRVM

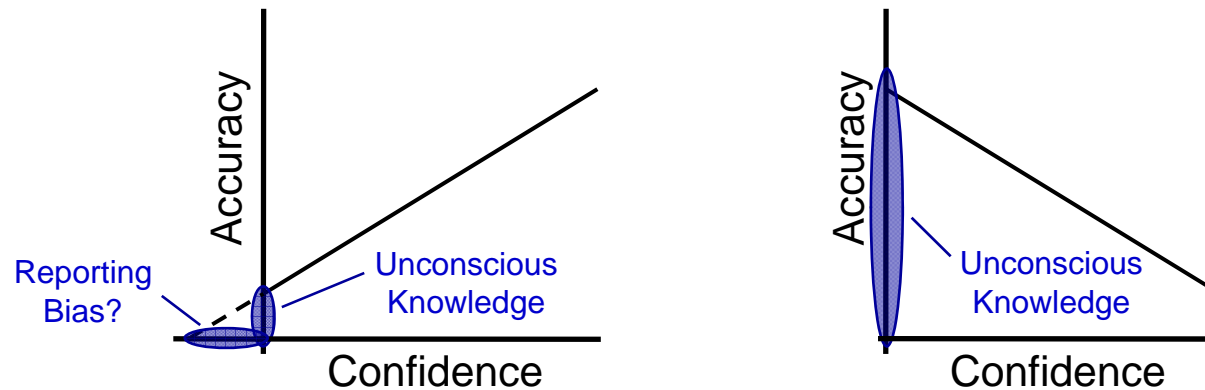
*XXRRM*

...

Transfer  
Accuracy  
Typically ~55%

# Measuring Unconscious Knowledge

- Knowledge deemed unconscious in the absence of meta-knowledge
  - The guessing criterion (Cheesman & Merikle, 1986)
  - The zero-correlation criterion (Dienes, Altmann, Kwan, & Goode, 1995)
- Evidence of unconscious knowledge by these measures in both non-transfer and transfer conditions (e.g. Dienes & Altman, 1997)
- Criticism of subjective measures (e.g. Shanks & St. John, 1994)



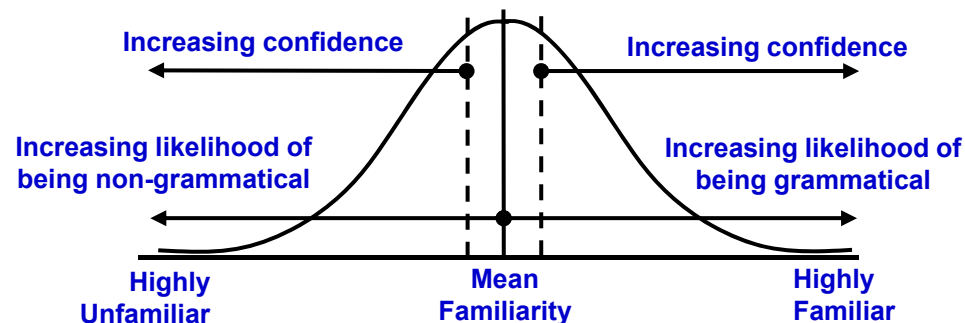
# The Basis of Knowledge in Artificial Grammar Learning

## Judgments are predicted by structural similarity

- Average frequency that chunks occurred in training (ACS)
- The presence of novel chunks (NCP)
- Similarity in repetition structure: e.g. global repetition structure (GRP)  
XYYX = 1221

## Mediated by feelings of familiarity (Scott & Dienes, 2008)

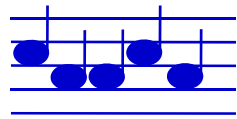
- Structural Similarity – Familiarity  $R = .40$
- Familiarity – Grammaticality Judgment  $r = .64$   
(Random Attributions)  $r = .34$
- Extremity of familiarity – Confidence  $r = .46$



# The Basis for Knowledge Transfer

- **Repetition Structure**

- Unchanged by transfer
- Default mechanism when repetitions present (e.g. Gomez et al., 2000)

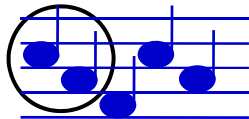


Global repetition structure : 12212

**XMMXM**

- **Mapping between vocabularies**

- Based on location and frequency of occurrence
- Demonstrated in absence of repetitions (Tunney & Altman, 2001 )



**XMTXM**

**Prediction: Transfer performance will be based on feelings of familiarity derived from similarities in repetition structure**

# Experimental Design

- 90 Participants
- 3 transfer conditions
  - Same modality, different vocabulary
  - Different modality
  - Different modality with novel test stimuli
- 3 Key responses
  - How familiar the string felt (0 – 100)
  - If the string was grammatical (Yes / No)
  - The basis for that judgment

## Training

XXRTV



## Testing

ZZWPH

ZWWZW

∩7ΔCΔ

Random  
Intuition  
Familiarity  
Rules  
Recollection

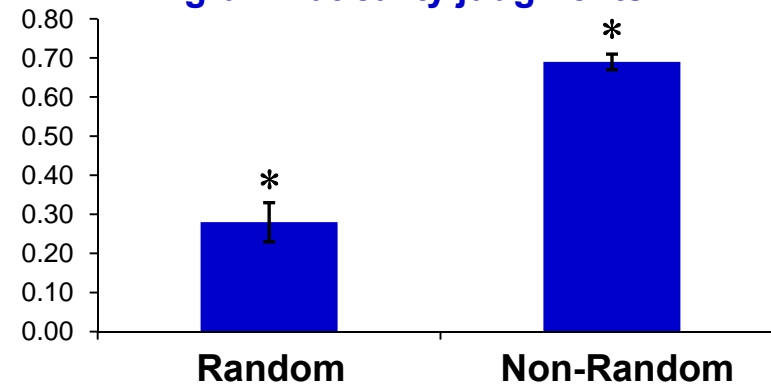
} No confidence  
picked at random

} Some confidence /  
employed strategy

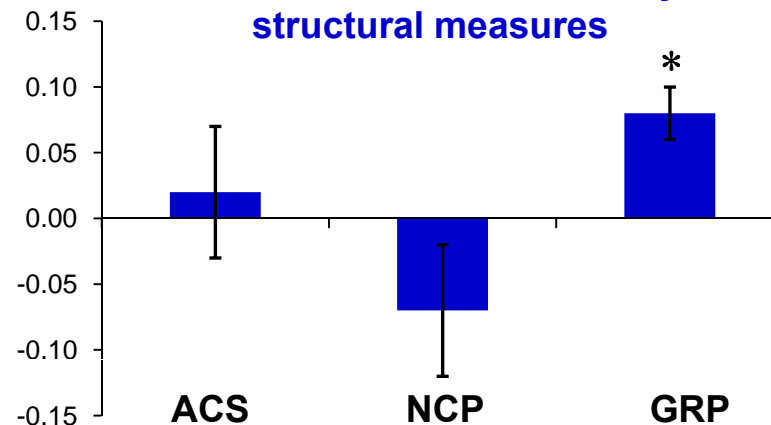
# Results: The influence and source of feelings of familiarity

- Familiarity significantly predicted grammaticality judgments mean  $r = .66$  (consistent with non-transfer  $r = .64$ )
- Remains significant examining only random attributions mean  $r = .28$  (consistent with non-transfer  $r = .34$ )
- Only GRP significantly predicted higher ratings of familiarity
- GRP related to grammatical status mean  $r = .40$ ,  $p < .001$ .
- Consequently familiarity significantly related to grammatical status, mean  $r = .07$ ,  $p < .001$ . (BUT less than under non-transfer conditions where  $r = .40$ )

Correlation between familiarity and grammaticality judgments



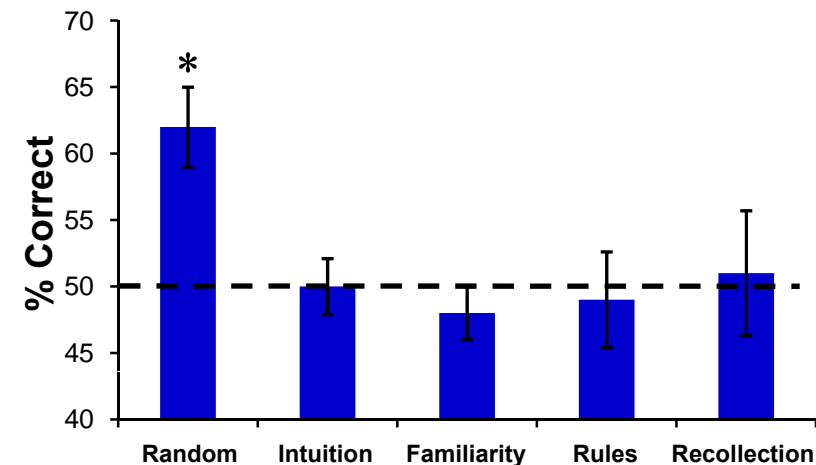
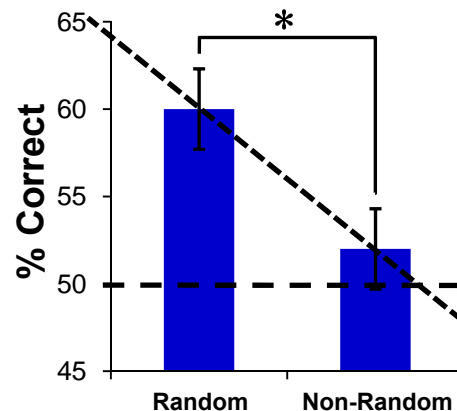
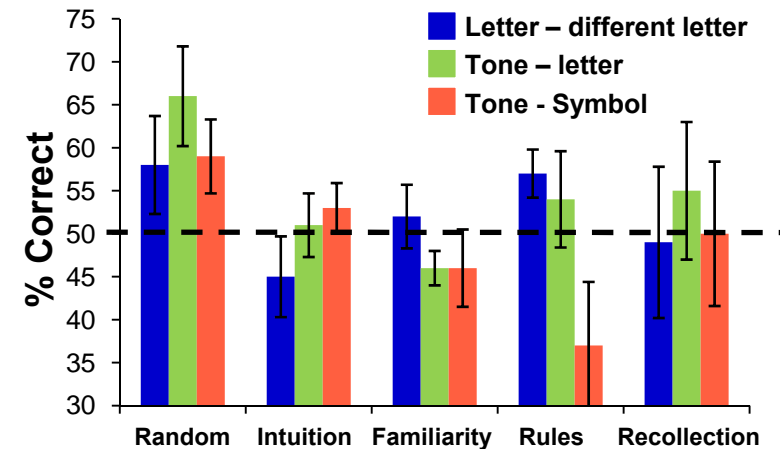
Correlation between familiarity and structural measures





# Results: Accuracy of conscious versus unconscious knowledge

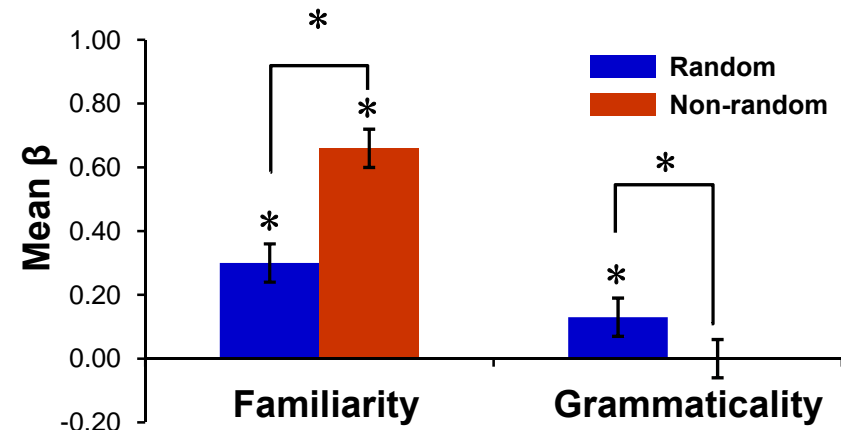
- ANOVA on % Correct
  - Main effect of decision strategy
  - No main effect of transfer condition or interaction
- Accuracy greater than chance ONLY for random attributions
- Random attributions significantly more accurate than non-random attributions



# Results: The differential basis of conscious and unconscious knowledge

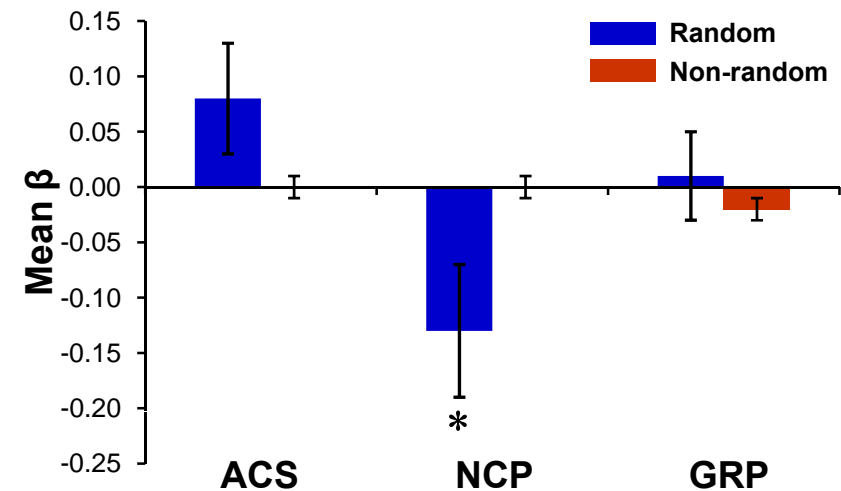
## Grammaticality judgment regressed on Familiarity and Grammaticality

- A contribution independent of familiarity occurs only in Random attributions.



## Grammaticality judgment regressed on ACS, NCP, and GRP while controlling for familiarity

- Chunk novelty contributes independently of familiarity but only in Random attributions (c.f. Dienes et al., 1995).



# Summary and Conclusion

- **Familiarity was a source of accuracy in transfer as in non-transfer**
  - It reflected similarity in repetition structure (GRP)
  - Its influence was both conscious and unconscious
  - But it was only weakly related to grammaticality
- **Familiarity was not the only – or even primary – source of accuracy**
  - Conscious knowledge was guided by familiarity derived from GRP
  - Unconscious knowledge revealed an independent contribution of NCP
  - There had to have been an unconscious mapping between modalities

**The flexible application of knowledge can be achieved unconsciously  
and at times outperforms the conscious**