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No Role for Perceptual Fluency in the Implicit Learning of Artificial Grammars

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Artificial Grammar Learning (AGL)

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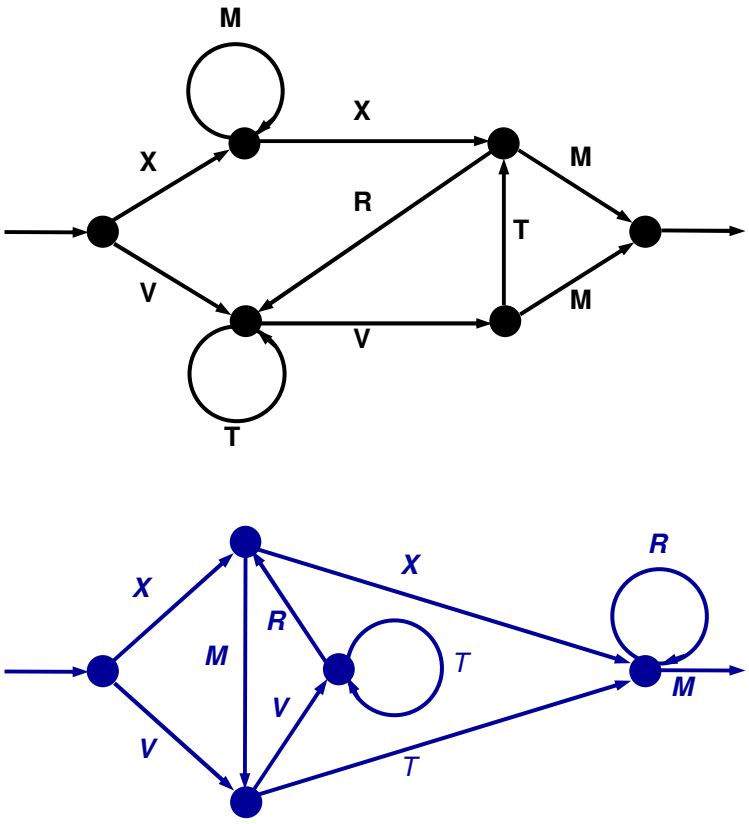
Training

Group A

XMMXM
VTTVTM
XMXRVM
VVTRTVM
…

Group B

XMTRM
VVRMTM
XMTRRM
VTRRRRM
…



Testing

Group A & B

VTVTM
VTRRM
XXRVM
XXRRM
…

Perceptual Processing Fluency

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- The ease with which a stimulus is initially perceived
- Fluency or surprising fluency a potential source of familiarity (Jacoby & Dallas, 1981; Whittlesea & Williams, 2000)
- Assessed and manipulated using a perceptual clarification task

Assessing Natural Fluency Differences

XXRVM

Manipulating Fluency – Slow vs. Fast clarification rates

VTVTM **VTRRM**

Why should we care?

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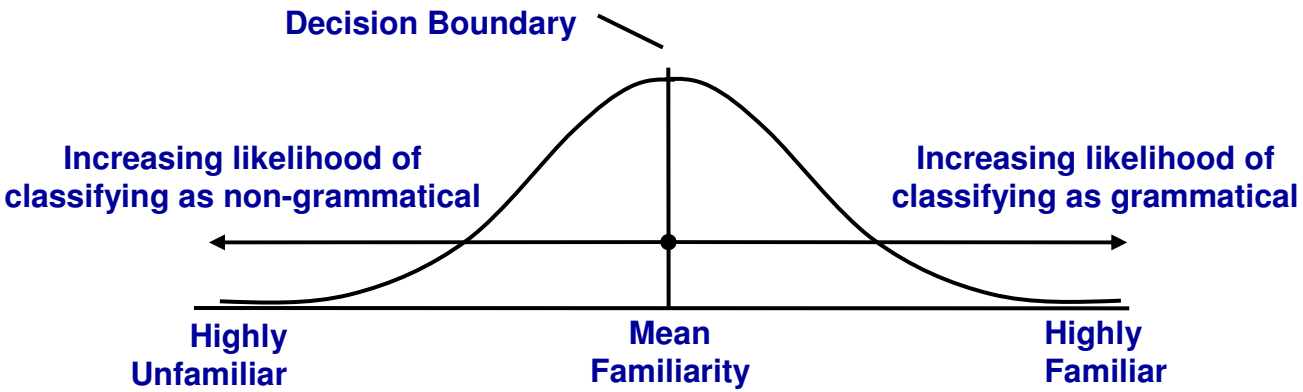
- Feelings of familiarity predict judgments in AGL (Scott & Dienes, 2008)



- Fluency could influence responding either via familiarity or directly
- In short, *fluency could be the source of implicit knowledge*

BUT

- Fluency as a source of feelings of familiarity in AGL was untested
- Evidence for its relation to judgments in AGL has been contradictory

The Contradiction

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Evidence For

- Fluency measured using perceptual clarification differed for grammatical and ungrammatical strings (Buchner, 1994)
- Fluency manipulated using perceptual clarification influenced grammaticality judgments (Kinder et al., 2003)

Evidence Against

- Fluency measured using perceptual clarification found to affect recognition but not grammaticality judgments (Buchner, 1994)
- Varying surface features to manipulate fluency affected liking but not judgments (Newel & Bright, 2001; Zizak & Reber, 2004)
- Regions of differential brain activity are not those associated with perceptual fluency (Skosnik et al, 2002; Lieberman et al, 2004)

Alternative Explanations – Potential Confounds

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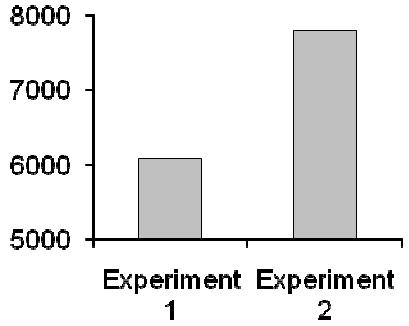
- **String Complexity Confounded with Grammaticality**

Grammatical TXXTVV → Ungrammatical TVXTVV

- **Decision processes**



Mean reaction time was 1.7 seconds longer when Grammaticality judgments subsequently required

- **Constraining other sources of judgment**

Evidence that fluency is employed as a strategy of last resort (e.g. Kinoshita, 2002; Whittlesea & Leboe, 2003).

Testing the alternatives

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- 4 experiments (2 x 2 design) using the perceptual clarification task

	Strings Present	Strings Absent
Fluency Natural	**Exp 1**	**Exp 2**
Fluency Manipulated	**Exp 3**	**Exp 4**

- Evaluate decision influences by including 2 experiments were strings are present for grammaticality judgments and 2 where they are absent
- Eliminate complexity confound with dual grammar design in all cases
- Subjective familiarity ratings to allow contrast with fluency measure

Predictions

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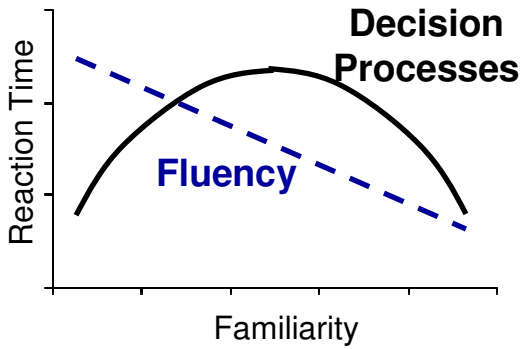
- Greater letter changes = slower reaction times
- Where strings absent for judgments (Exp 2 and 4)
  - Slower average RTs in clarification task
  - Faster RTs the more extreme familiarity (Based on decision bound theory, Ashby, Boynton, & Lee, 1994)



- With both confounds removed (Exp 1 and 3) no significant relationship between RT and Grammaticality.

Experiment 1 – Natural Fluency & Strings Present for Judgement

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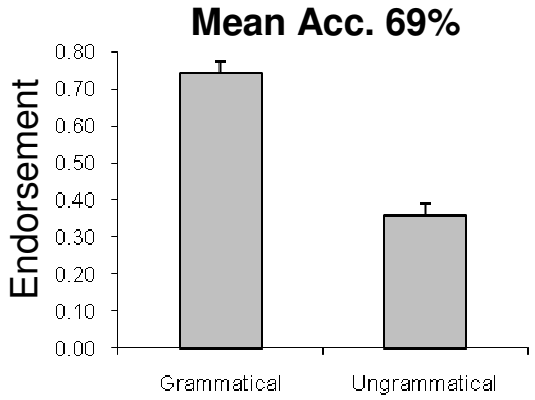
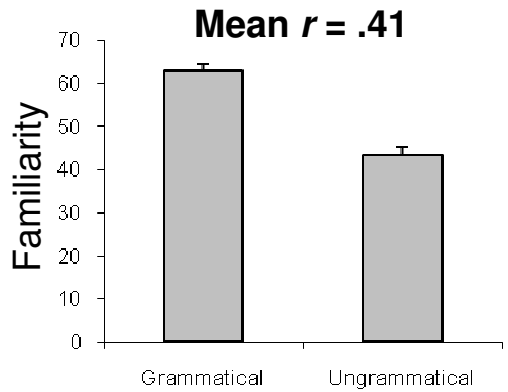
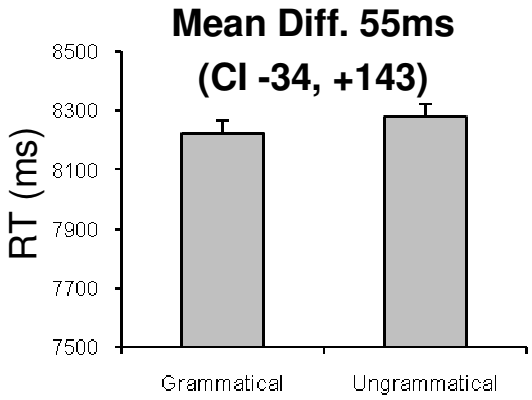
- RT predicted by Pass, Length, & *letter changes* (All $p < .05$)
- RT unrelated to extremity of familiarity (abs z-fam), $r = .02$, *CI* -.02, +.07

- Endorsement rate strongly related to Grammatical status
- Familiarity ratings strongly related to Grammatical status
- RT (perceptual fluency) not related to Grammatical status







Experiment 2 – Natural Fluency & Strings Absent for Judgement

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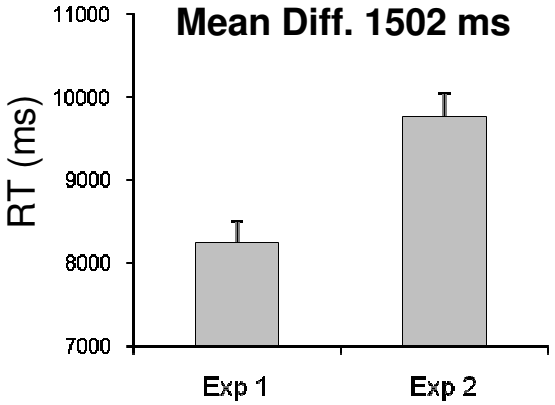
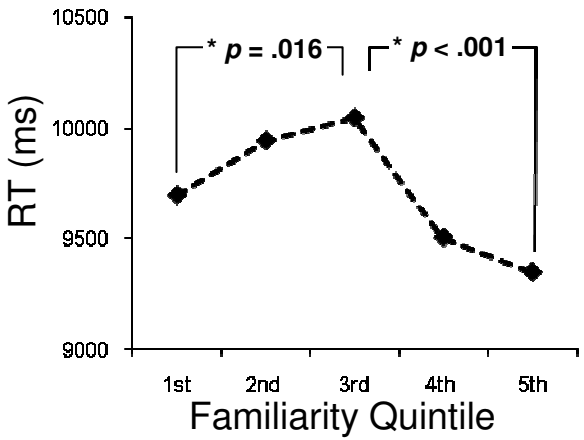
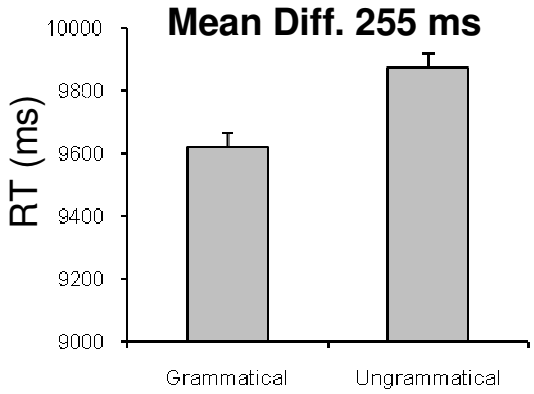
- RT predicted by Length, & *letter changes* (All $p < .05$)
- RTs significantly longer than Experiment 1
- RT related to the extremity of familiarity, $r = -.13$, $t(39) = 6.55$, $p < .001$
- Extremity of Familiarity (abs z-fam) greater for grammatical strings, *Mean diff* = .11, *SE* = .02, $t(39) = 5.28$, $p < .001$, hence RTs shorter







Experiment 3 – Manipulated Fluency & Strings Present for Judgement

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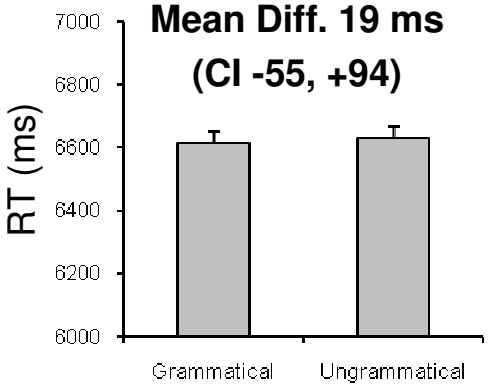
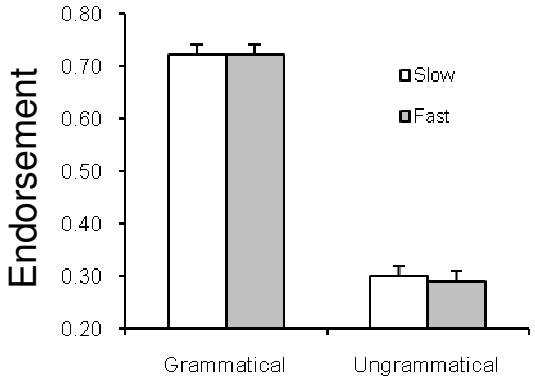
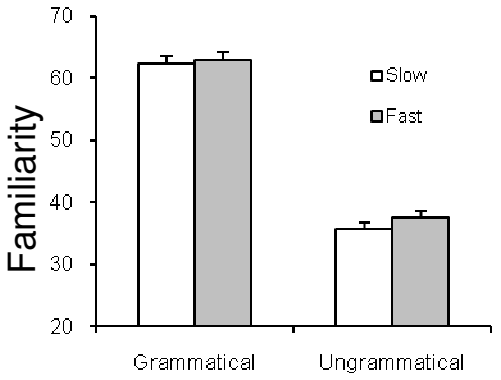
- RT predicted by Rate, Pass, Length, & *letter changes* (All $p < .05$)
- RT unrelated to extremity of familiarity (abs z-fam), $r = .01$, *CI* -.03, +.05
- RT (averaged across rates) not related to Grammaticality
- Endorsement predicted by Grammaticality but not Clarification Rate
- Familiarity predicted by Grammaticality but not Clarification Rate







Experiment 4 – Manipulated Fluency & Strings Absent for Judgement

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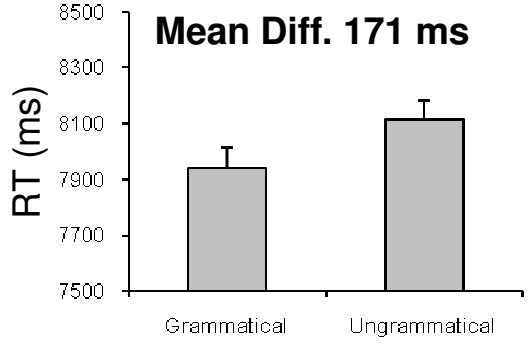
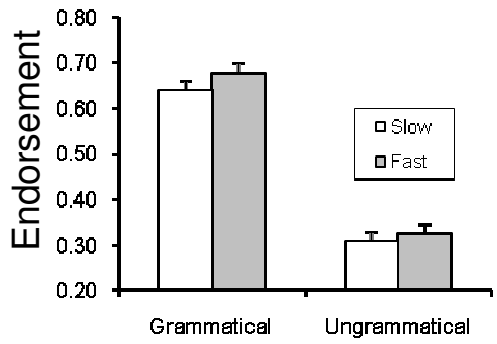
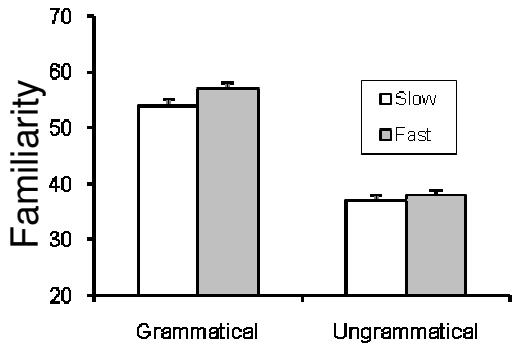
- RT predicted by Rate, Pass, Length, & *letter changes* (All $p < .05$)
- RTs longer than Experiment 3, Mean diff. = 1402 ms, $p < .001$
- RT related to the extremity of familiarity, $r = -.06$, $t(39) = 2.77$, $p < .05$
- Extremity of Familiarity (abs z-fam) greater for grammatical strings, *Mean diff* = .11, *SE* = .02, $t(39) = 6.05$, $p < .001$, hence RTs shorter
- Endorsement predicted by Grammaticality and Clarification Rate
- Familiarity predicted by Grammaticality and Clarification Rate







Summary

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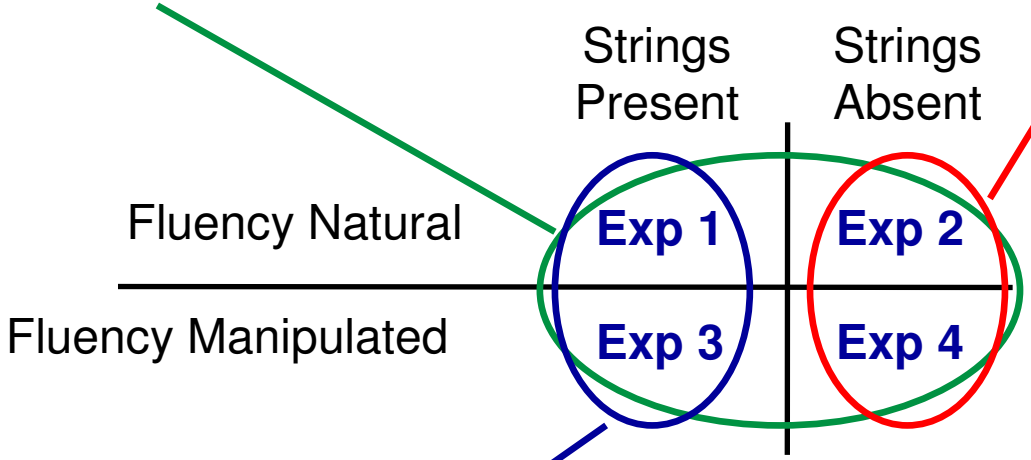
Decision processes confound the clarification task when strings aren't present for judgments

String Complexity (letter changes) is a source of fluency differences



With both confounds removed fluency is not related to grammaticality

Conclusions

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Perceptual processing fluency

- Does not express implicit knowledge in artificial grammar learning
- It is a *dumb heuristic (*Higham, unpublished manuscript) that influences responding in the absence of genuine knowledge