Aging and Distinctiveness Encoding: Implications for Metacognitive Retrieval Monitoring

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Metamemory and Aging

- Metamemory → monitoring of internal memory states and control of cognitive processes
  - Better monitoring → better control (Hertzog, 2016)

- Metacognitive judgments
  - Judgments of Learning (JOLs)
    - Confidence during study that you will retrieve the target item at test (0 – 100)
    - JOL accuracy spared across the lifespan (Connor, Dunlosky, & Hertzog, 1997)
    - Accuracy (resolution): within-person correlations between JOL and recall

Metamemory and Aging

- Metacognitive judgments
  - **Feelings-of-knowing (FOKs)**
    - Confidence during cued recall that you will correctly recognize the target word later (0 – 100)
    - Accuracy (resolution) : correlation between FOK and recognition
    - Different results regarding aging & FOK accuracy
    - e.g. Souchay et al. (2007) → YAs more accurate
    - e.g. Hertzog, Dunlosky, & Sinclair (2010) → Age invariance
  - **Post-recognition Confidence Judgments (RCJs)**
    - Older adults prone to giving high RCJs for lures that are familiar (e.g., Hay & Jacoby, 1999; Dodson et al., 2007)
    - Particularly true when lures are semantic associates of the target (*semantic confusion*; e.g., Jacoby, 2001)

Metamemory and Aging

- Interventions targeting metacognitive monitoring can increase cognitive functioning in everyday life (Hertzog & Dunlosky, 2011)
  - *See Chris + Emily's project!*

- **Question: How can we improve metacognitive monitoring in older and younger adults?**
  - Particularly interested in FOK & RCJ accuracy for semantically-related items

Encoding Affects FOK Judgments

- Metacognitive judgments about episodic memory including feeling-of-knowing (FOK) are influenced by variations in quality of encoding
    - (e.g., Hertzog et al., 2010; Lupker et al., 1991; Nelson et al., 1982; Sacher et al., 2014)
- Quality of encoding affects FOK accuracy (resolution) for unrecalled items
    - Hertzog et al. (2014)
- High-quality encoding operations (e.g., repetition, 'deep' orienting tasks, associative mediators [interactive imagery]) create **noncriterial recollection** of encoded features & context that benefits FOK accuracy, even when target itself cannot be recalled
    - Brewer et al., 2010; Hertzog et al., 2014; Isingrini et al., 2016

Encoding Affects Confidence Judgments

- High RCJ recognition memory errors can be reduced using encoding strategies that increase access to discriminating info. at test

- Demonstrated encoding strategy - focusing on distinct features of target at study
  - **Distinctiveness heuristic**
    - Gallo et al. (2006)

- Access to distinctive info. at recognition can reduce probability of being lured by familiar items
    - e.g. Hunt & Smith (1996; 2014)

Distinctiveness and Metacognition

- We follow the approach of Reed Hunt, Rebekah Smith, and colleagues in evaluating distinctiveness effects

- General question: will manipulating item distinctiveness affect FOK and RCJ resolution by reducing the magnitude of false memory effects?
  - Is the magnitude of impact similar across age groups?

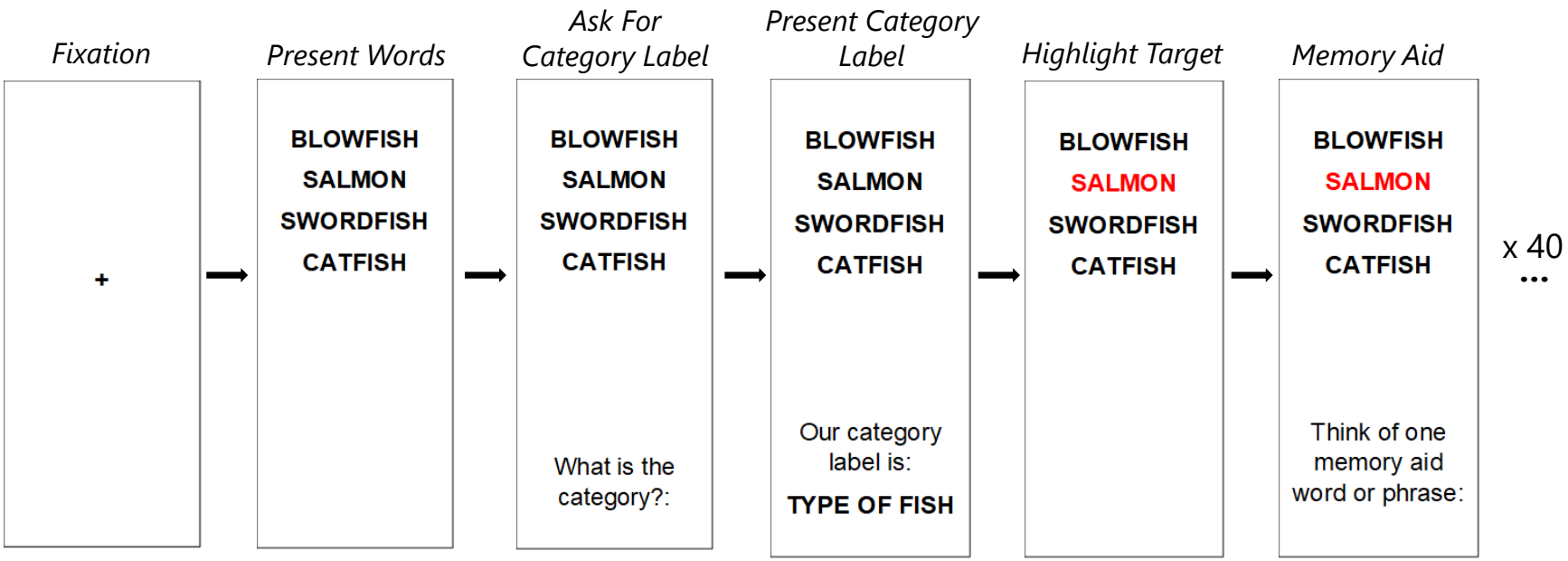
- Distinctiveness known to affect judgments of learning in Isolation paradigm, but little is known about relation of distinctiveness encoding on FOKs and FOK accuracy
  - Challenge: FOK resolution for associatively related items is high (for all items) but at chance for unrecalled items (Eakin & Hertzog, 2006; 2012a, b)

Categorical Stimuli Create Similarity Context

- Task adapted from Hunt & Smith (1996)
- Categorizable nouns used as stimuli for study
- 40 categories used for items
- Stimuli constructed from van Overschelde et al (2004) norms for categorizable nouns (e.g., FISH, FRUITS) omitting 2 highest typicality items but allowing typicality of selected nouns to vary
- Items selected at random to serve as either target, co-presented nouns, or new lures in 5AFC recognition memory test

First Session

- 4 concrete nouns drawn at random from taxonomic category set presented in column
- Category queried, then explicitly presented exactly as cued in future
- One element highlighted in RED FONT to designate it is the target for future recall



Between-Subjects Manipulation of Shared versus Different Features

- At final stage of item study individuals prompted to type in a feature that is shared by all 4 nouns or distinguishes the target from its companions (item distinctiveness)

Think of one memory aid word or phrase that you know is SHARED between the word in red and the other words:	***OR***	Think of one memory aid word that you know is DISTINCT about the word in red compared to the other words:

Feature Generation Examples

- Distinctiveness manipulation: Generate either a **SHARED** feature of all nouns OR a **DISTINCTIVE** feature for the designated target
- Example from Fish category, taken from actual responses

BLOWFISH
SALMON
SWORDFISH
CATFISH

Shared memory aid example:
- "Live under water"

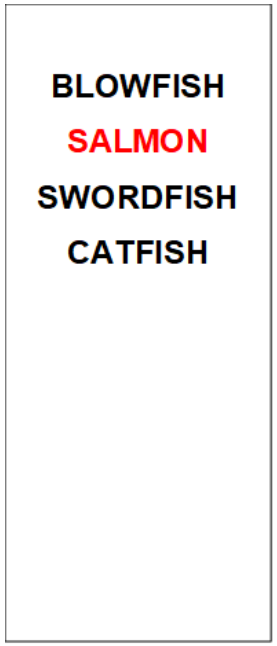
Distinctive memory aid example:
- "Jumps up stream"

Feature Generation Compliance

- Coded as compliant ("**1**") if feature matches condition
- Coded as non-compliant ("**0**") if feature matches the other condition
- Not coded if we have no idea what the heck they're talking about

Between-subjects condition

Memory aid example	Similar Condition	Different Condition
"Live under water"	**1**	**0**
"Jumps up stream"	**0**	**1**
"Super cool"	**NA**	**NA**



Feature Generation Compliance

- YA participants were more likely than OAs to "correctly" produce shared vs distinctive feature

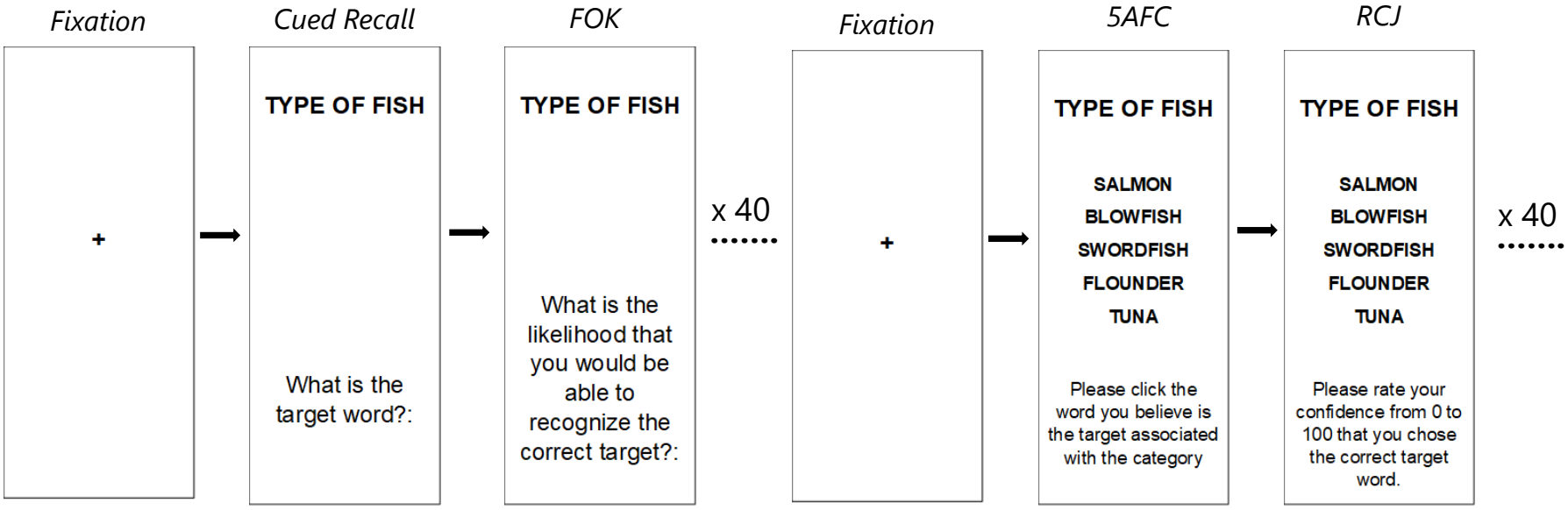
- YA Memory aid compliance:
  - Similarity: 93%
  - Difference: 96%

- OA Memory aid compliance:
  - Similarity: 82%
  - Difference: 90%

- 2 OAs excluded on basis of low compliance

Second Session

- Hart (1965) Recall-Judge-Recognize task
- (0-100% confidence) FOK after category-cued recall attempt for all items
- 5-Alternative Forced Choice recognition test (target, 2 **OLD** lures (presented at study), 2 **NEW** lures from category norms)
- (0-100% confidence) RCJ collected after each recognition response



YA Participants

- N = 86 volunteers from GT & KSU Psychology participant pools randomly assigned to:
  - Similar (n=43) vs. Difference (n=43) encoding

- 7-day delay between Session 1 and 2 to bring memory performance for Difference encoding off ceiling
  - (selected after pilot data & based on previous FOK experiment in our lab manipulating repetition (Hertzog, Dunlosky, Sinclair, 2010)

OA Participants

- N = 20 volunteers from Adult Cognition Lab older adult participant pool
  - Similar (n=9) vs. Difference (n=11) encoding

- 2-day delay between Session 1 and 2 to match recall performance to that of GT YAs
  - Also selected on the basis of Hertzog, Dunlosky, & Sinclair (2010)

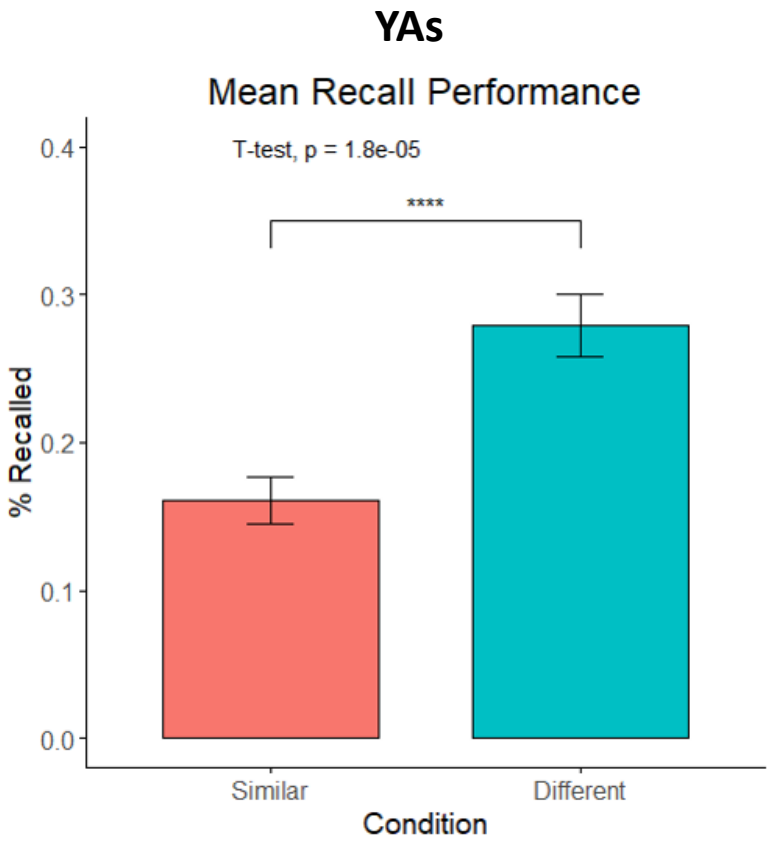
variable	**Female**	**Age**	**Pattern Comparison**	**Shipley Vocab.**
Mean (*SEM*)	***n* = 11**	**71.36 (*0.80*)**	**27.75 (*0.42*)**	**35.36 (*0.72*)**

Hypotheses

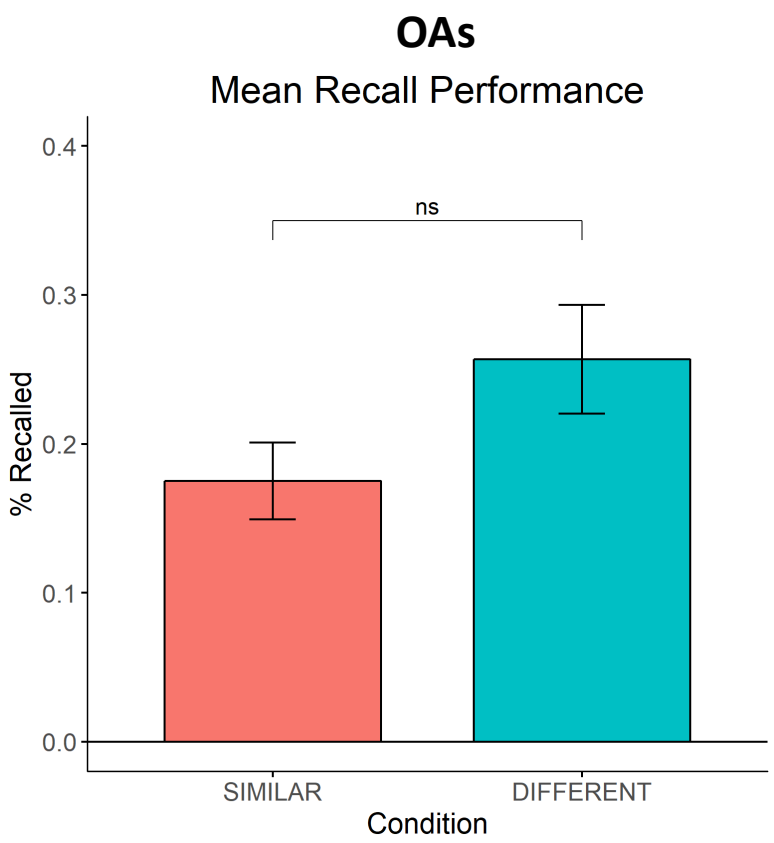
Generating a Distinctive feature (relative to Shared feature) at encoding will:

1. Increase FOK magnitudes (FOKs sensitivity to type of encoding)
2. Increase FOK accuracy (resolution: gamma correlations) for all items & for unrecalled items
3. Increase RCJ accuracy, (resolution: gamma correlations) for all items by reducing false memory effect
4. Reduce high-confidence 5AFC false alarms (false memories)

Distinctive encoding improves recall with large effect sizes in both age groups

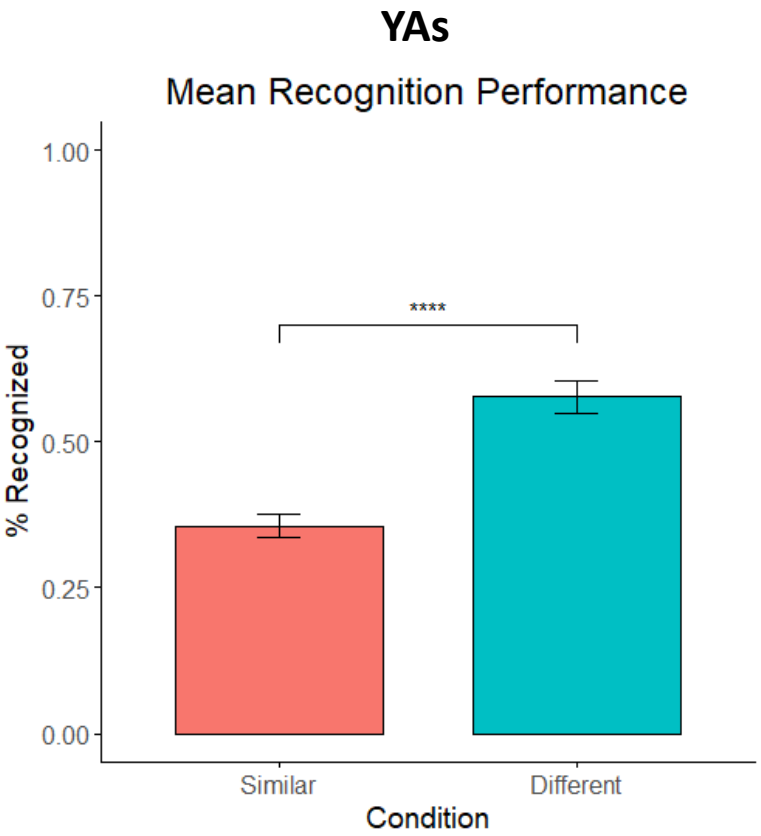


***d* = 0.98**

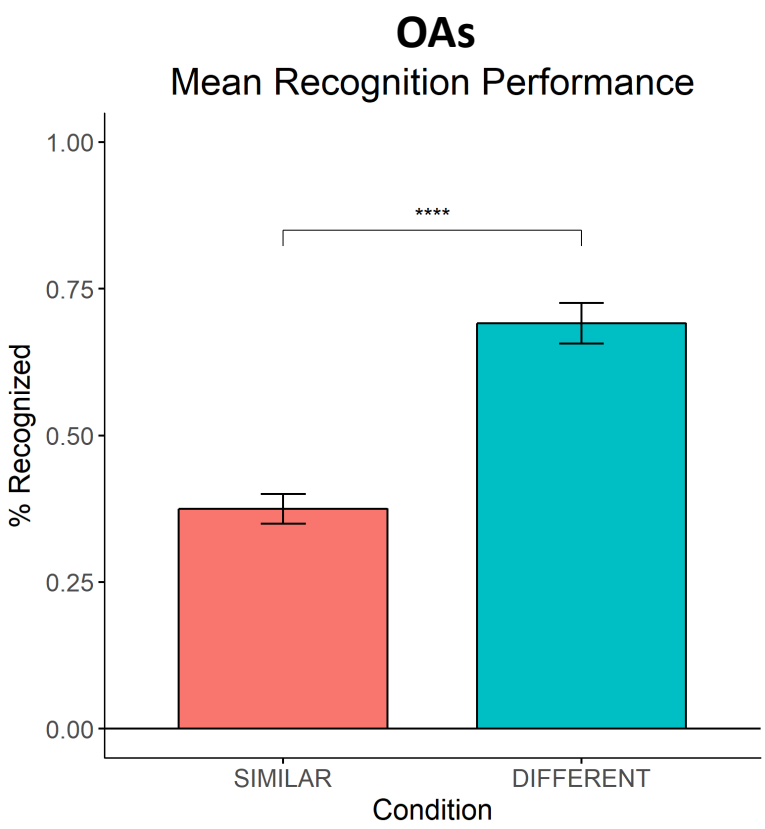


***d* = 0.79**

Distinctive encoding improves recognition with (unbelievably) large effect sizes



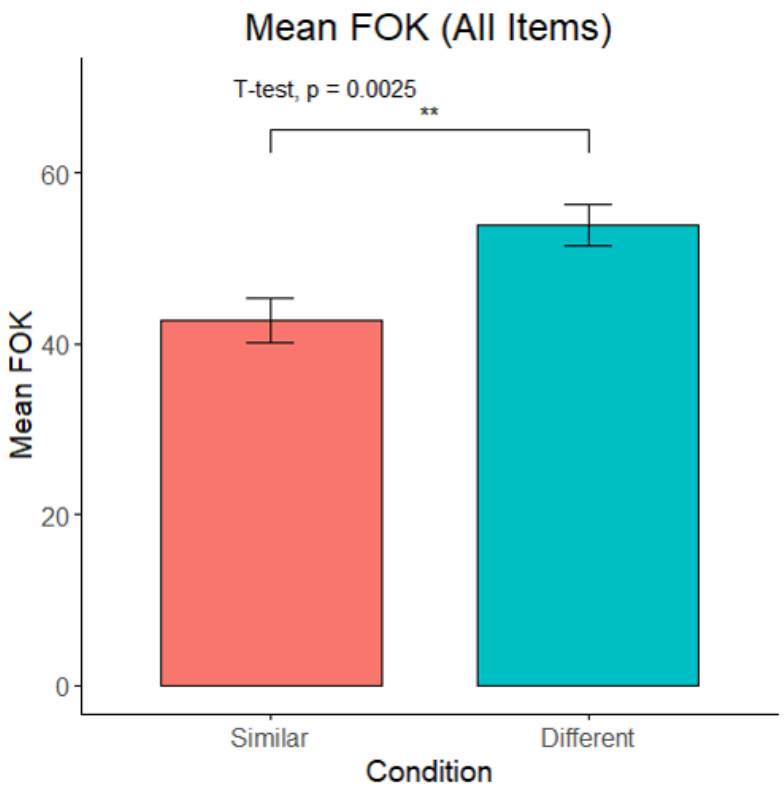
***d* = 1.39**



***d* = 3.17?**

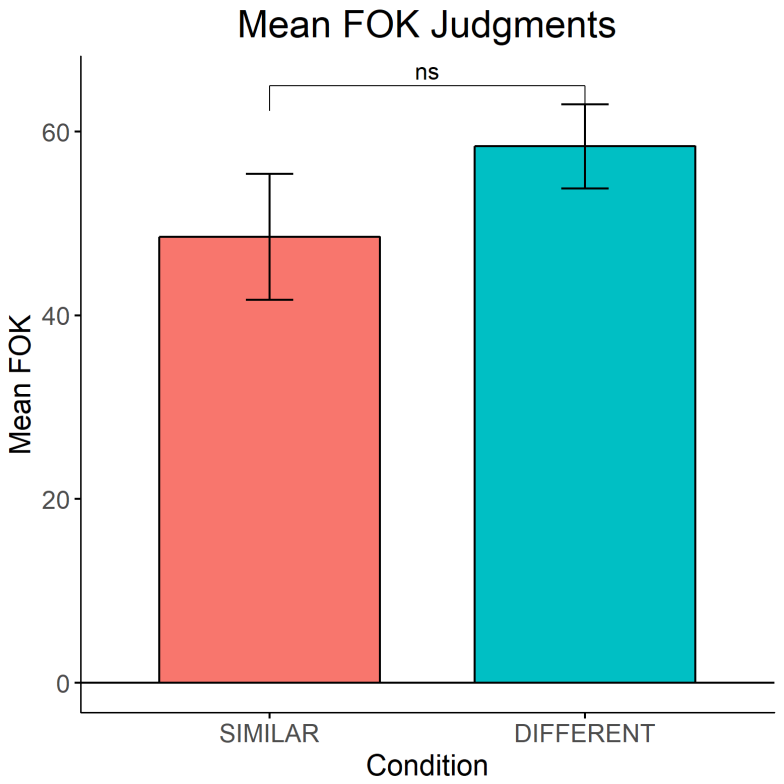
Distinctive encoding affects mean FOKs for all items in all ages w/ similar effect sizes

YAs



***d* = 0.67**

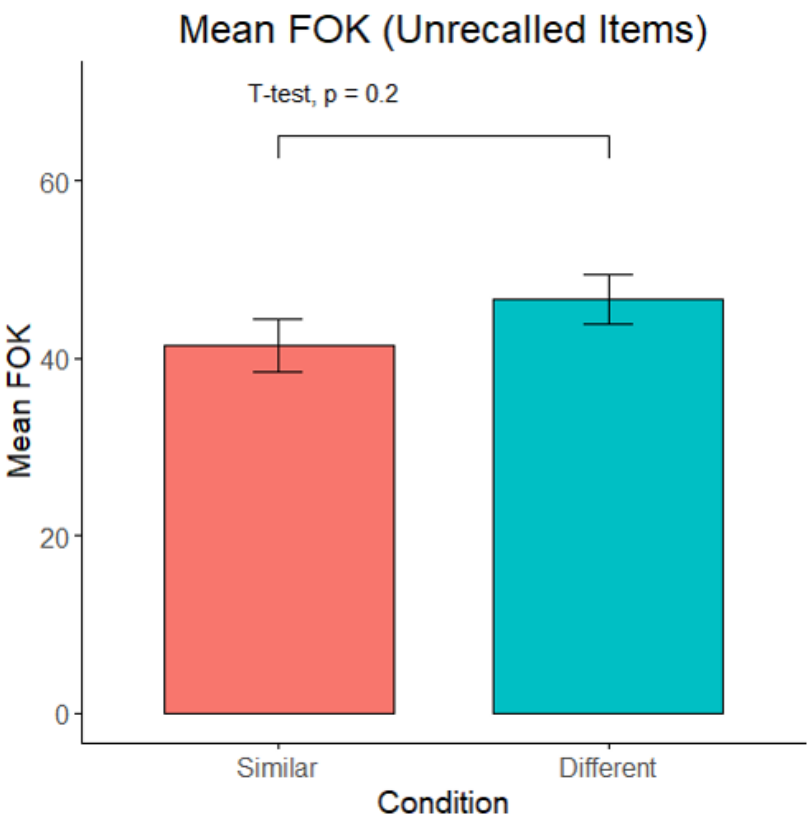
OAs



***d* = 0.55**

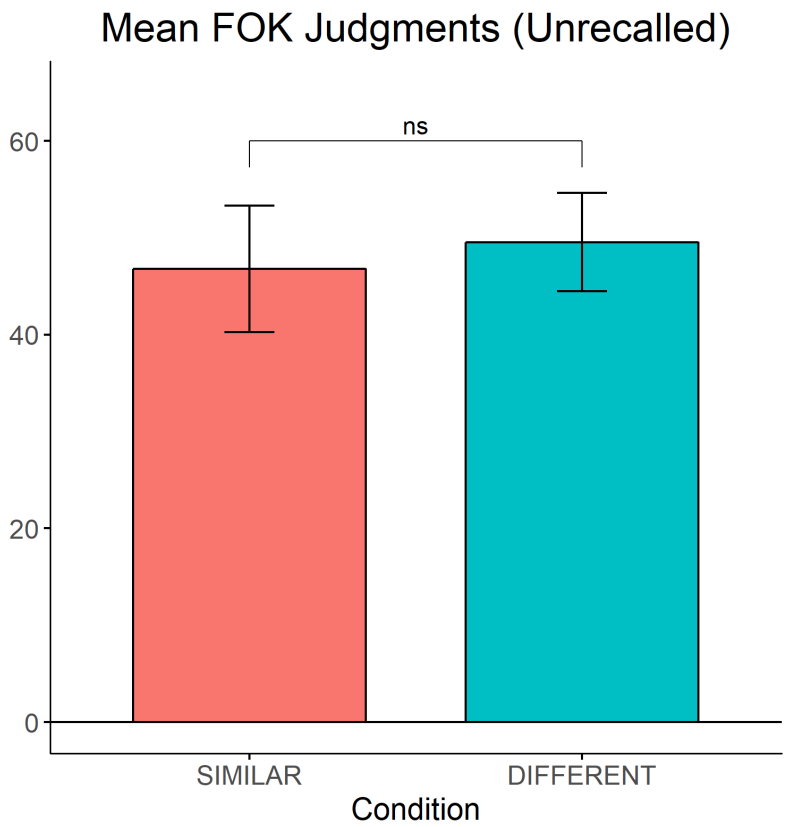
Distinctive encoding affects mean FOKs for all items; small effect for unrecalled items

YAs



***d* = 0.30**

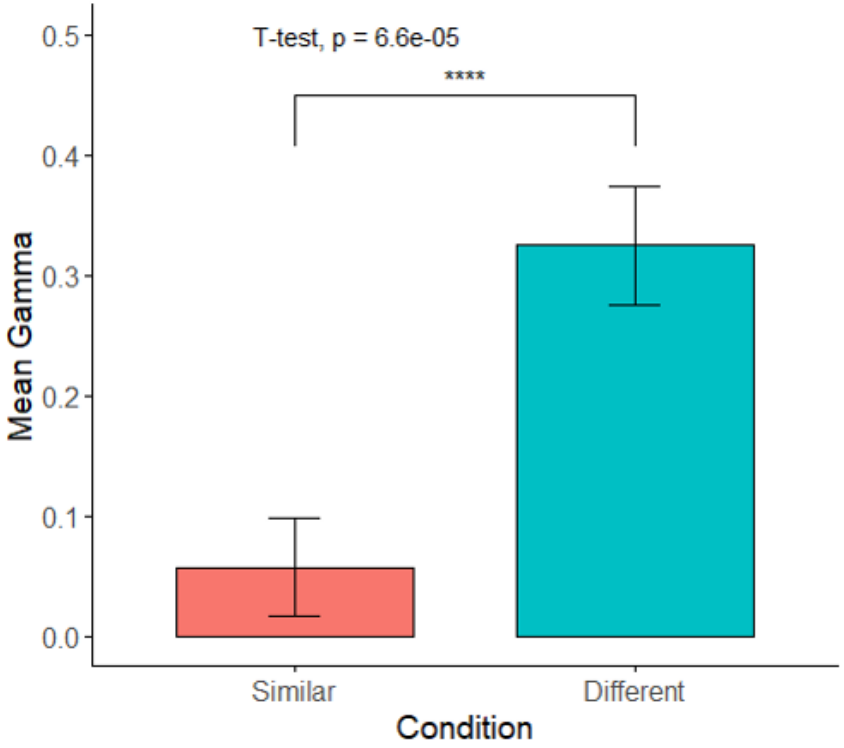
OAs



***d* = 0.15**

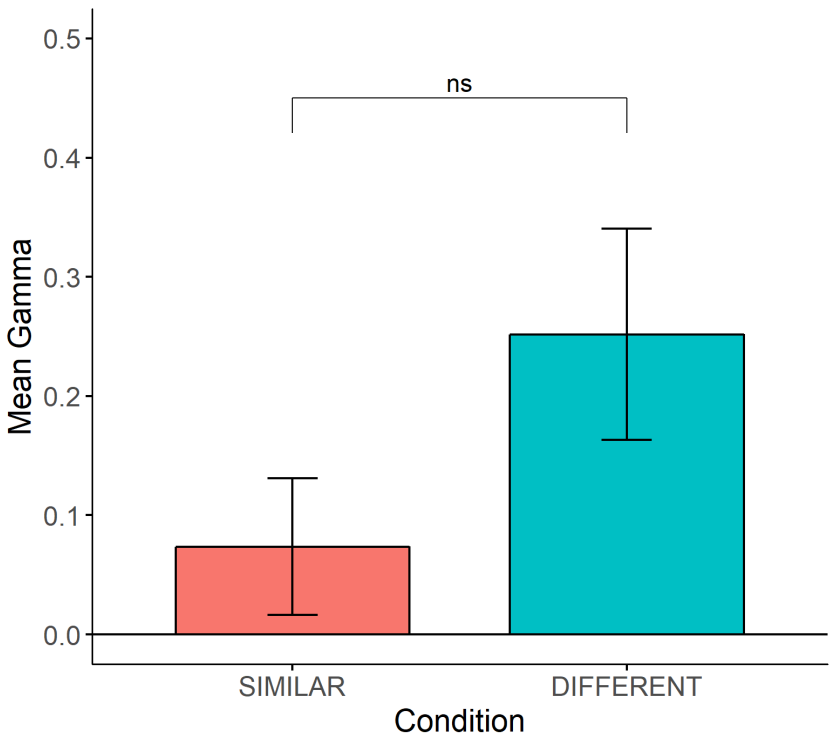
Distinctiveness affects FOK resolution; small gammas for all items; "chance" gamma for Similar condition

YAs



***d* = 0.92**

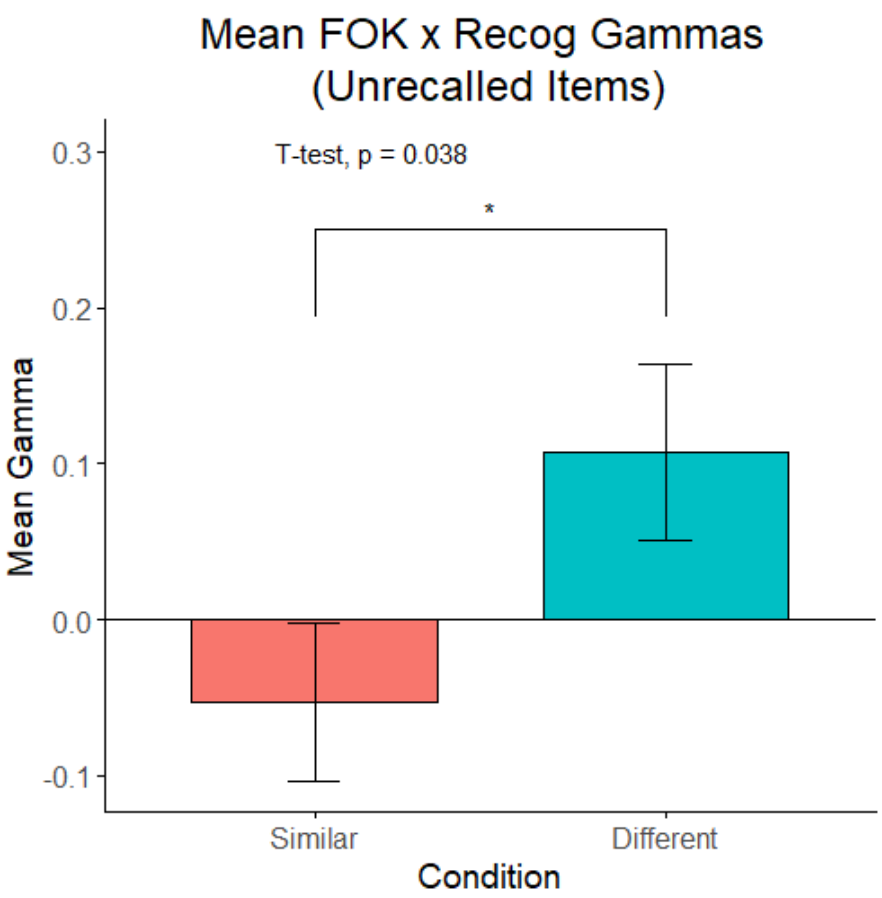
OAs



***d* = 0.72**

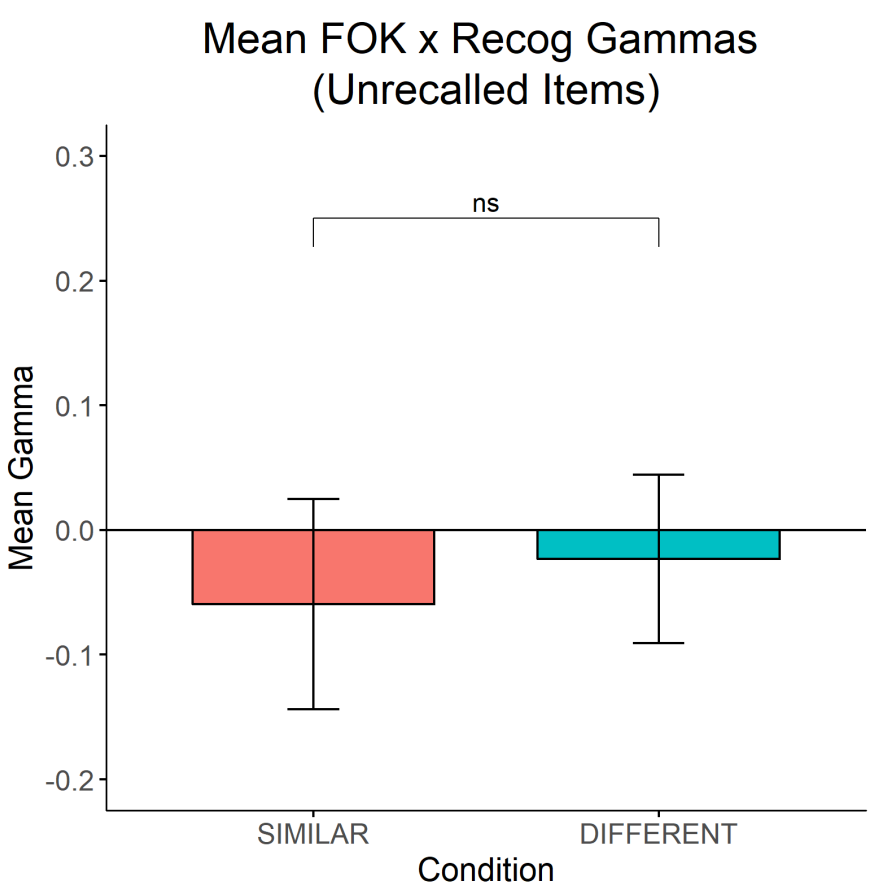
Distinctiveness affects FOK resolution; small gammas for all items; "chance" gamma for Similar condition

YAs



***d* = 0.46**

OAs

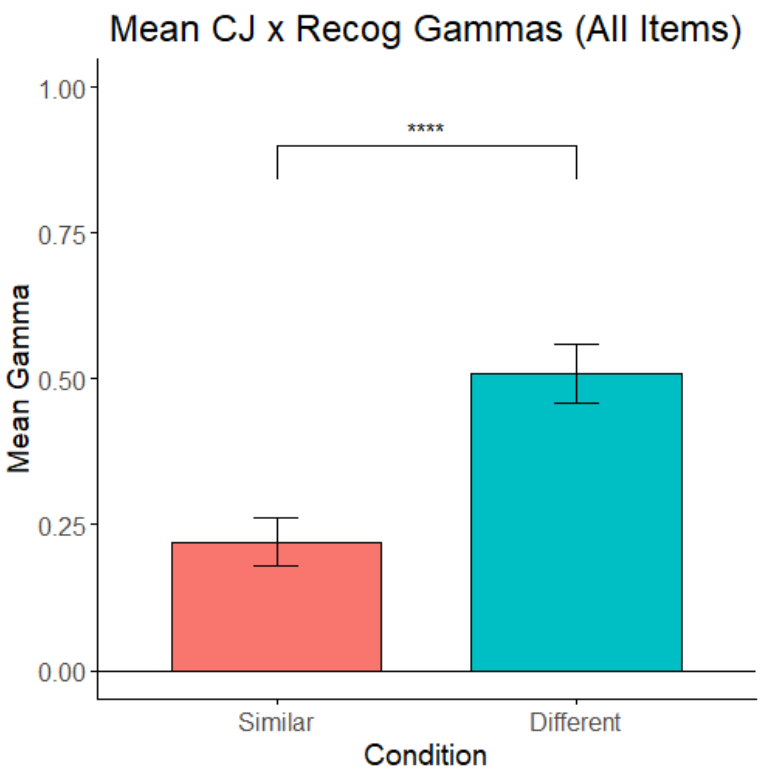


***d* = 0.16**

Distinctiveness affects RCJ resolution for all items

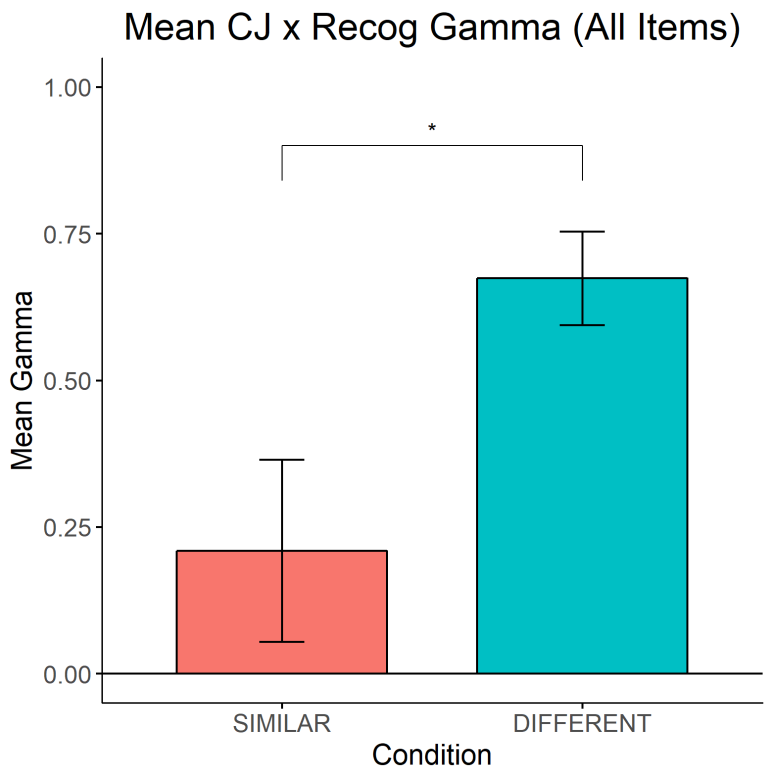
- Surprisingly low magnitude of gamma in Similarity condition!

YAs



***d* = 0.94**

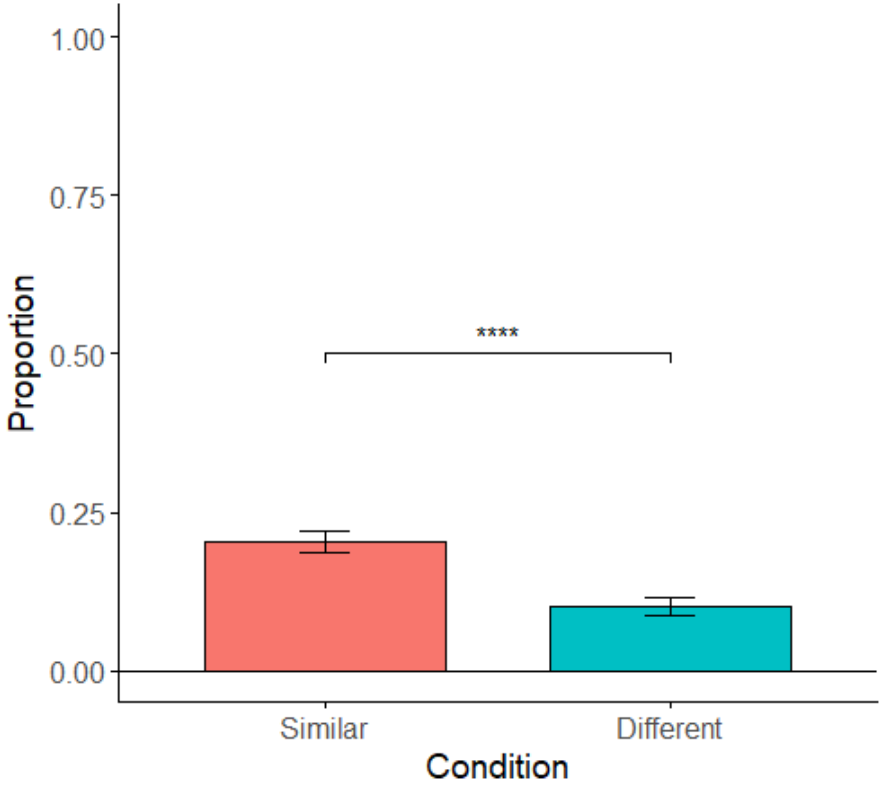
OAs



***d* = 1.26**

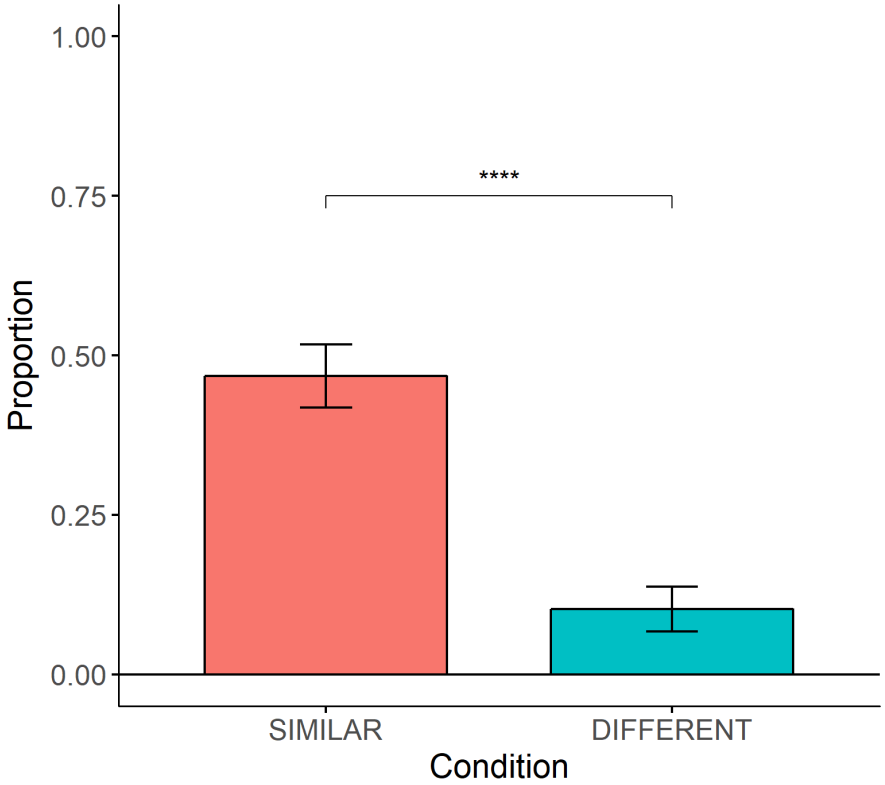
False memory revealed by high-confidence memory errors that are more likely for Similarity encoding

YAs



***d* = 0.96**

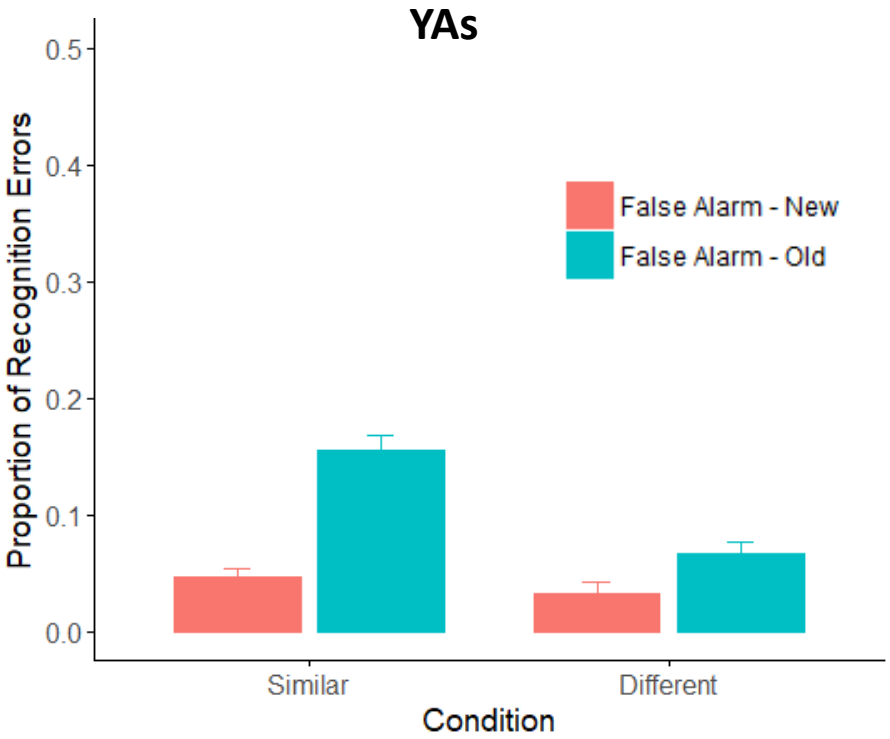
OAs

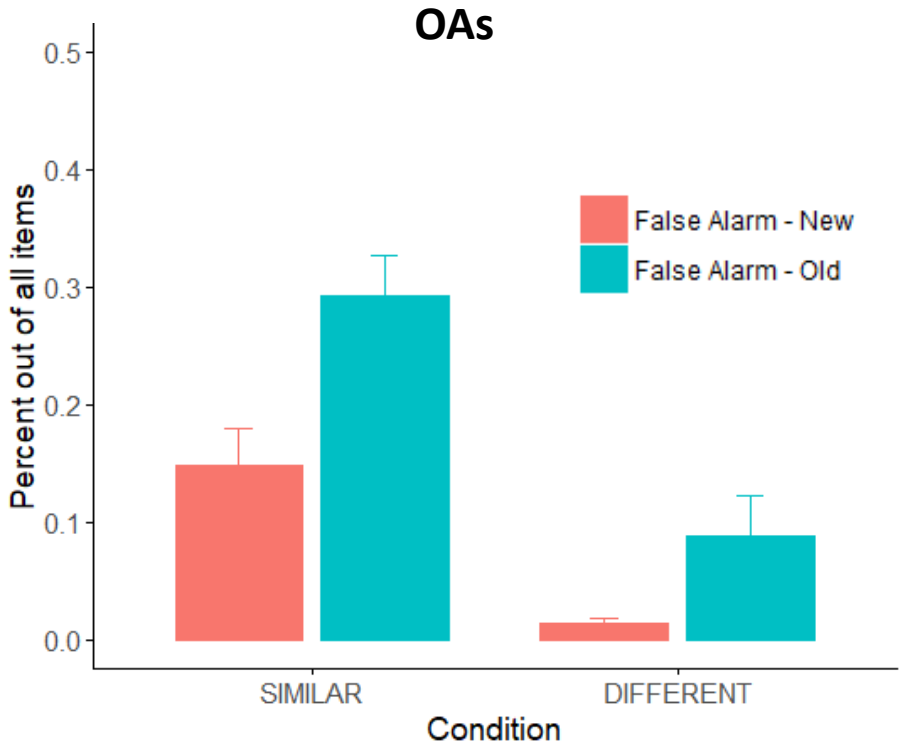


***d* = 2.76**?

RESULTS

- False memory effect generated by familiarity of co-presented exemplars (Old lures) affected by Difference encoding
- High confidence false alarms: recognition errors w/ CJs >= median CJ





ME Condition*:
- F(1,168) = 14.58, p < .001, η_p^2 = .08

ME Lure Type*:
- F(1,168) = 68.20, p < .001, η_p^2 = .29

Condition x Lure Type*:
- F(1,168) = 8.56, p = .004, η_p^2 = .05

ME Condition*:
- F(1,36) = 37.277, p < .001, η_p^2 = .42

ME Lure Type*:
- F(1,36) = 14.686, p < .001, η_p^2 = .16

Condition x Lure Type:
- F(1,36) = 1.545, p = .222, η_p^2 = .02

Distinctiveness and False Memories

- Distinctiveness reduces high-confidence FAs
  - Higher % of high-confidence FAs in Similar Condition
    - Particularly for OAs!
  - Equal % of high-confidence FAs in both age groups for Difference Condition overall
  - However, differences in % by *type* of FA

- Low RCJ resolution associated with familiarity of co-presented items (old lures), producing higher FA rates than for semantic associates (new lures)
  - Degree of false memory in Similarity condition particularly large in OA group
  - OAs in Similarity Condition more likely to confidently choose new lures than YAs

Distinctiveness and False Memories

- Difference encoding instructions reduce high-confidence FAs (but do not eliminate them), increasing RCJ resolution

- Difference encoding helps OAs overcome effects of age-related illusory familiarity

- 'Early selection' and 'late correction' may both be operating to generate distinctiveness effects on FA (Hunt et al., 2011; Hunt & Smith, 2014; Rhodes & Jacoby, 2006)
  - Additional manipulations will be needed to estimate relative contributions

Distinctiveness and FOKs

- Distinctiveness increased FOKs for all items (but not for unrecalled items)
  - Memory benefit for all items
- Distinctiveness had a modest benefit for FOK resolution in both age groups
  - Consistent with other data on encoding quality effects on FOKs
- However, results largely consistent with pattern of nil or near-nil FOK resolution for associatively related paired associates (unrecalled items)
- Still much lower resolution for all items with this task, even under Difference encoding

Increasing episodic FOK accuracy for related verbal items remains a challenge!

- Further experiments needed to test explanations for nil & near-nil resolution
  - e.g., Interference at test, poor accessibility of discriminating cues during FOK, category cues limit search for context cues during FOK, category-cue (prompt) familiarity, overshadowing of (weak) mnemonic cues by semantic activation

- Current task structure affords additional experimental manipulation to evaluate how to
  - further increase FOK accuracy after Difference encoding
  - generate above-chance accuracy for Similarity encoding

Future Directions

- Run more older adult participants!
- Vary delay between Part 1 & Part 2
  - Perhaps current delays are too long to leverage non-criterial recollection for FOK judgments
  - "Goldilocks Zone"
- Manipulate explicit retrieval of memory aid at FOK
  - Recall of aid → non-criterial recollection
- Semantic network analyses (**RIP PIG**)