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Experimental Syntax-Semantics Lab

MIT Linguistics

Anaphoricity, Presuppositions, and Memory Retrieval Processes

Sherry Yong Chen (MIT)

Joint work with E. Matthew Husband (Oxford)

THE BIG PICTURE: MEMORY ARCHITECTURE OF LANGUAGE PROCESSING

- Language comprehension involves establishing linguistic dependencies:
  - To study comprehension, we can look at real-time processing, partly because its inherently linear organization mirrors speech in some ways.
  - To establish linguistic dependencies, the comprehender must successfully retrieve the memory representation of an antecedent.
  - How is the representation of an antecedent retrieved from memory?

ROADMAP

- Presuppositions and memory retrieval
- Drift Diffusion Modelling (DDM)
- Experimental design
- Results & Conclusions
- Discussions

TOO AS AN ANAPHORIC TRIGGER

- Treating presuppositions analogously to anaphoric expressions such as pronouns (Kripke, 1990/2009; van der Sandt, 1992; Beck, 2007; a.o.).
- "Anaphoric" is taken to mean "requiring a contextually provided antecedent".
- *too* establishes an anaphoric dependency between the trigger and the presupposed content.

TOO: FOCUS SENSITIVITY

- For example:
  - John went swimming. Mary went swimming *too*.

- Note: *too* is actually Focus sensitive and is not restricted to VPs (e.g. John_i went swimming; he_i went dancing *too*), but this use is not our concern here.

PREDICTION FOR TOO

- We expect to see that the processing of *too* would share the same processing signature as other anaphoric expressions.
  - e.g. Pronoun resolution, VP ellipses, Sluicing constructions
- We use a specific memory retrieval model to investigate the processing of *too*.
- Question: what is the memory retrieval mechanism that underlies the processing of *too*?

PROCESSING SIGNATURE OF ANAPHORIC EXPRESSIONS

Overview of the memory retrieval model:

(1) A memory retrieval process is initiated.

(2a) The memory retrieval process of many anaphoric dependencies uses "**direct access mechanism**".

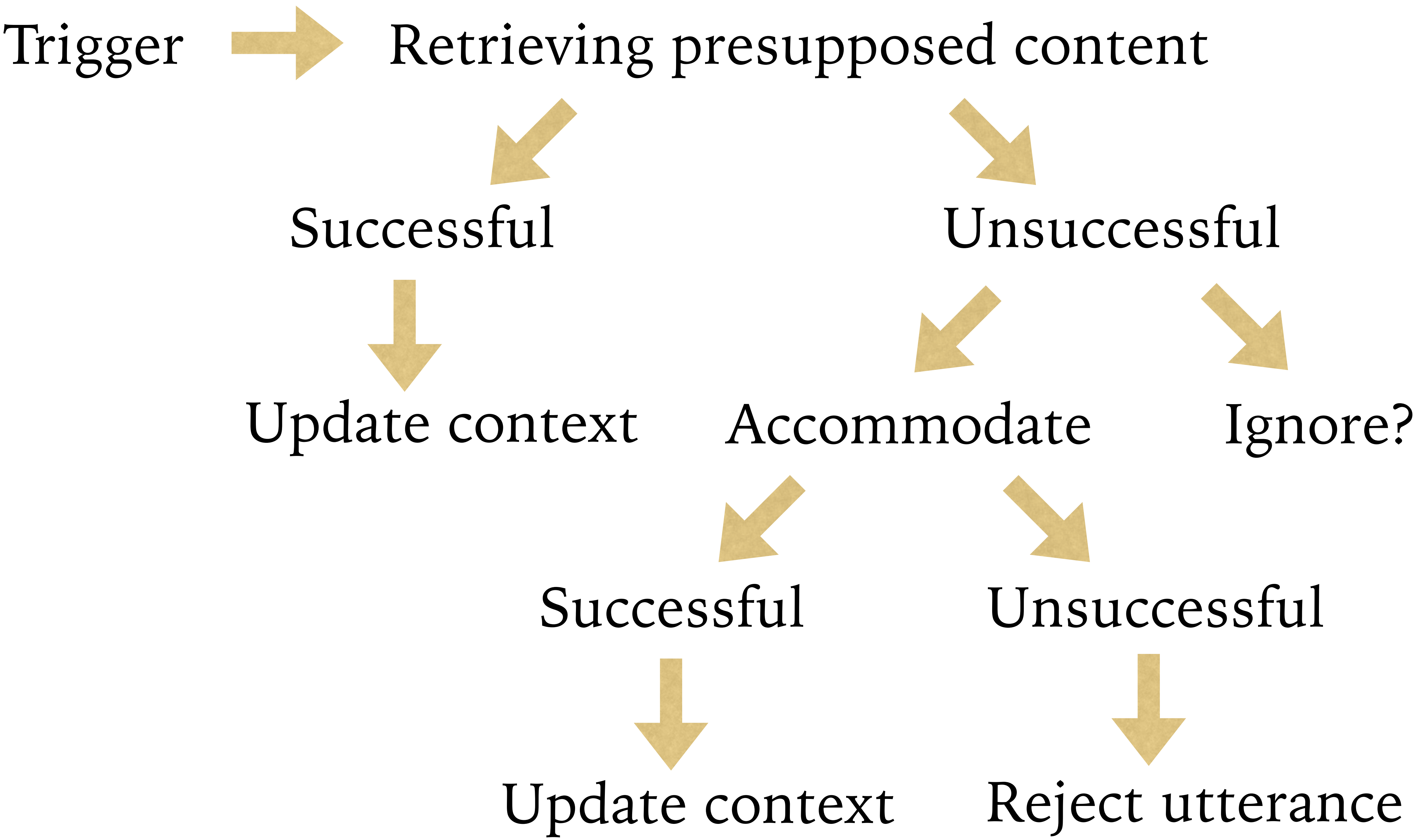
(2b) A key property of a direct access mechanism is that it is **cue-based**.

PROCESSING SIGNATURE OF ANAPHORIC EXPRESSIONS

(1) A memory retrieval process is initiated in order to establish an anaphoric dependency.

- John went swimming. Mary went swimming *too*.
- John went swimming. Mary went dancing.

HYPOTHESIS FOR THE RETRIEVAL PROCESS



TODAY'S FOCUS:

Trigger → Retrieving presupposed content

↙

Successful

↓

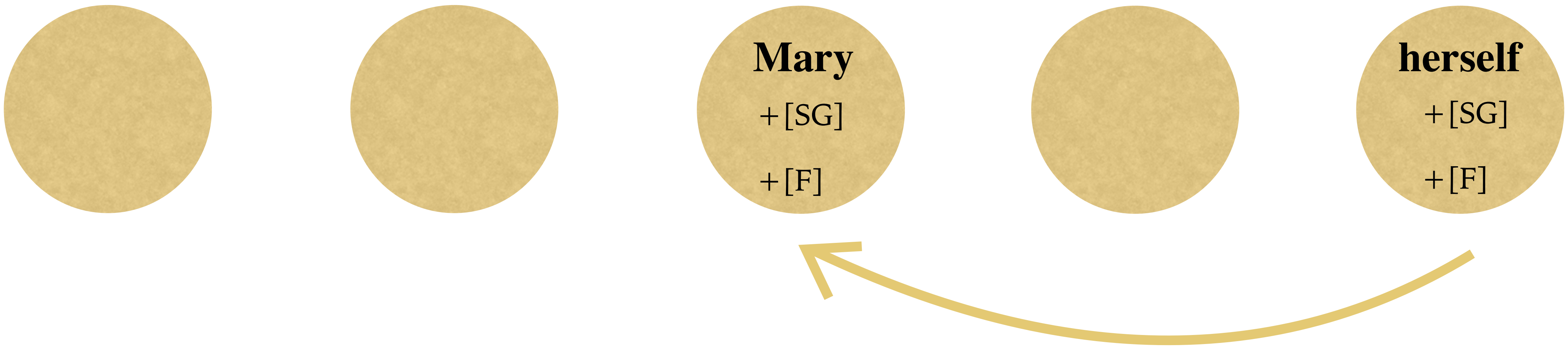
Update context

- We experimentally investigate this process.

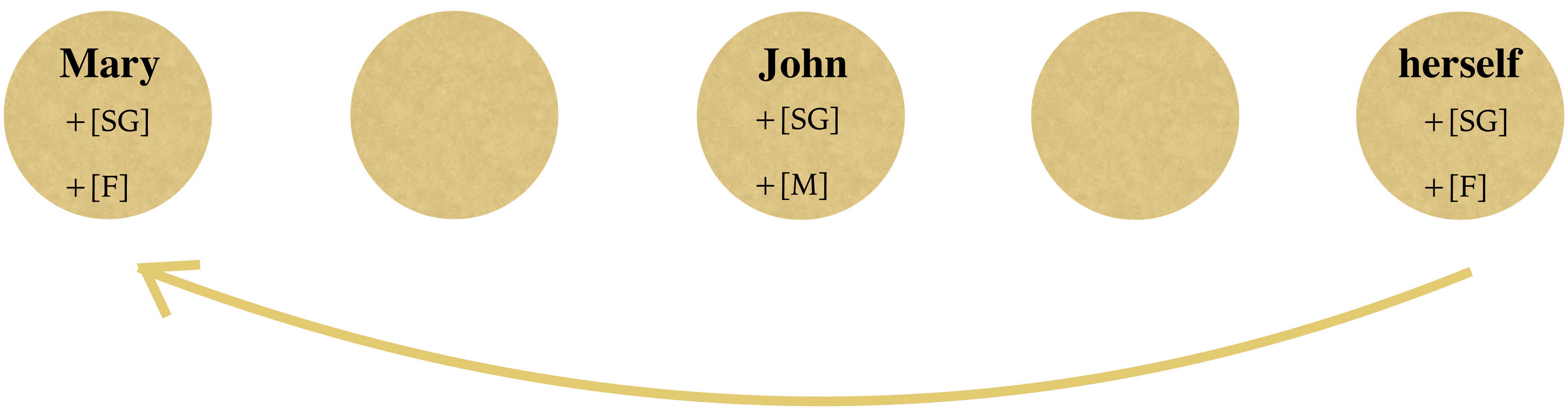
TWO HYPOTHESES ON THE MARKET

- **Direct access** mechanism: when retrieving the memory representation of an antecedent, only the target representation is considered (Foraker & McElree, 2007; Martin & McElree, 2008, 2011).
  - Quality of the representation for remote antecedents are decayed.
  - But increased distance between the antecedent and the retrieval site has *no effect* on retrieval speed.

Set of representations being inspected: {Mary}



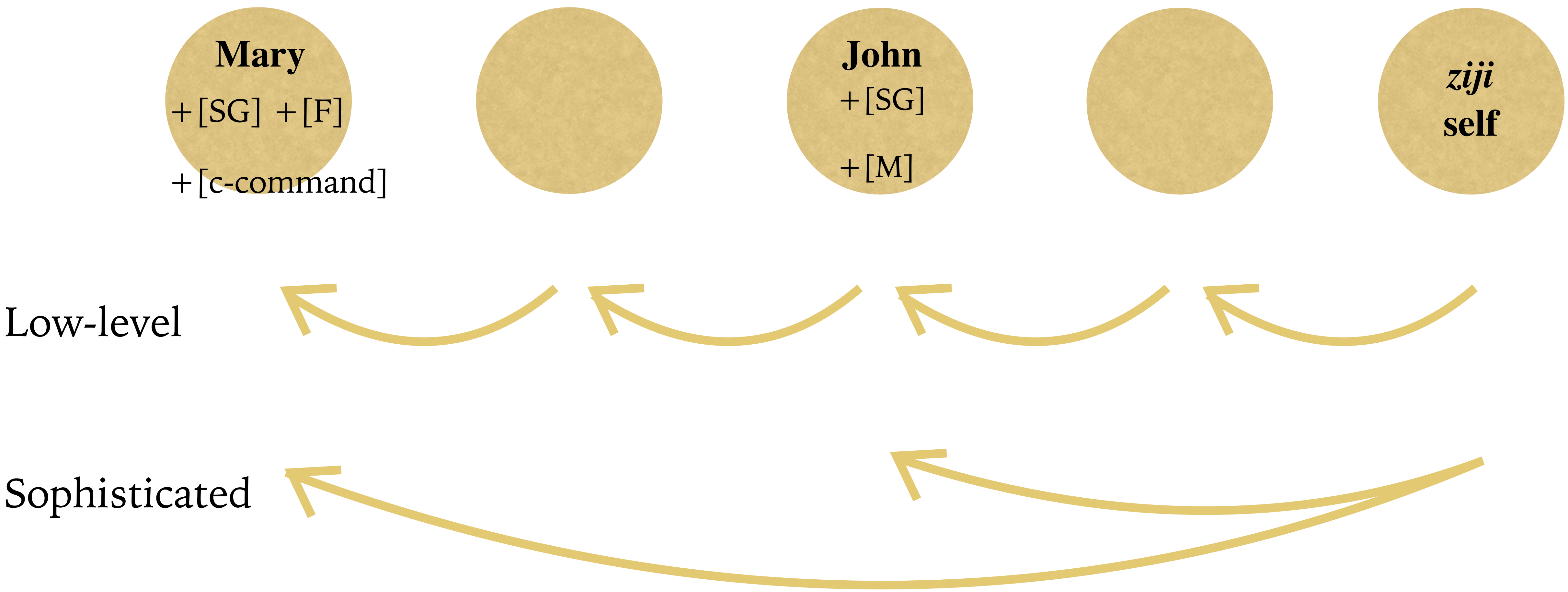
Decayed quality



MEMORY RETRIEVAL MECHANISMS: TWO HYPOTHESES

- **Serial search** mechanism: multiple representations are inspected; irrelevant intermediate contents are necessarily accessed before finding the target representation (Dillon et al, 2014).
  - Perhaps not possible to immediately identify the target representation.
  - Structural properties of an antecedent may be relevant for determining which representation is the target.

Set of representations being inspected: {Mary, John}



- Intermediate contents might be unsuitable as antecedents, but very relevant for determining whether the dependency is legitimate.
  - e.g. c-commanding relations can be easily checked via a serial walk through the structure

MEMORY RETRIEVAL PROCESS OF TOO?

(2a) The memory retrieval process of many anaphoric dependencies is via **direct access**.

- Pronoun resolution (Foraker & McElree, 2007)
- VP ellipsis (Martin & McElree, 2008)
- Sluicing (Martin & McElree, 2011)

- We may expect to see that a direct access memory retrieval mechanism also underlies the processing of an anaphoric trigger, such as *too*.

PROCESSING SIGNATURE OF ANAPHORIC EXPRESSIONS

(2b) A direct access model is **cue-based**.

- Cues are hypothesised to be information such as "grammatical constraints": e.g. morpho-syntactic cues.

METHODOLOGICAL CONCERNS

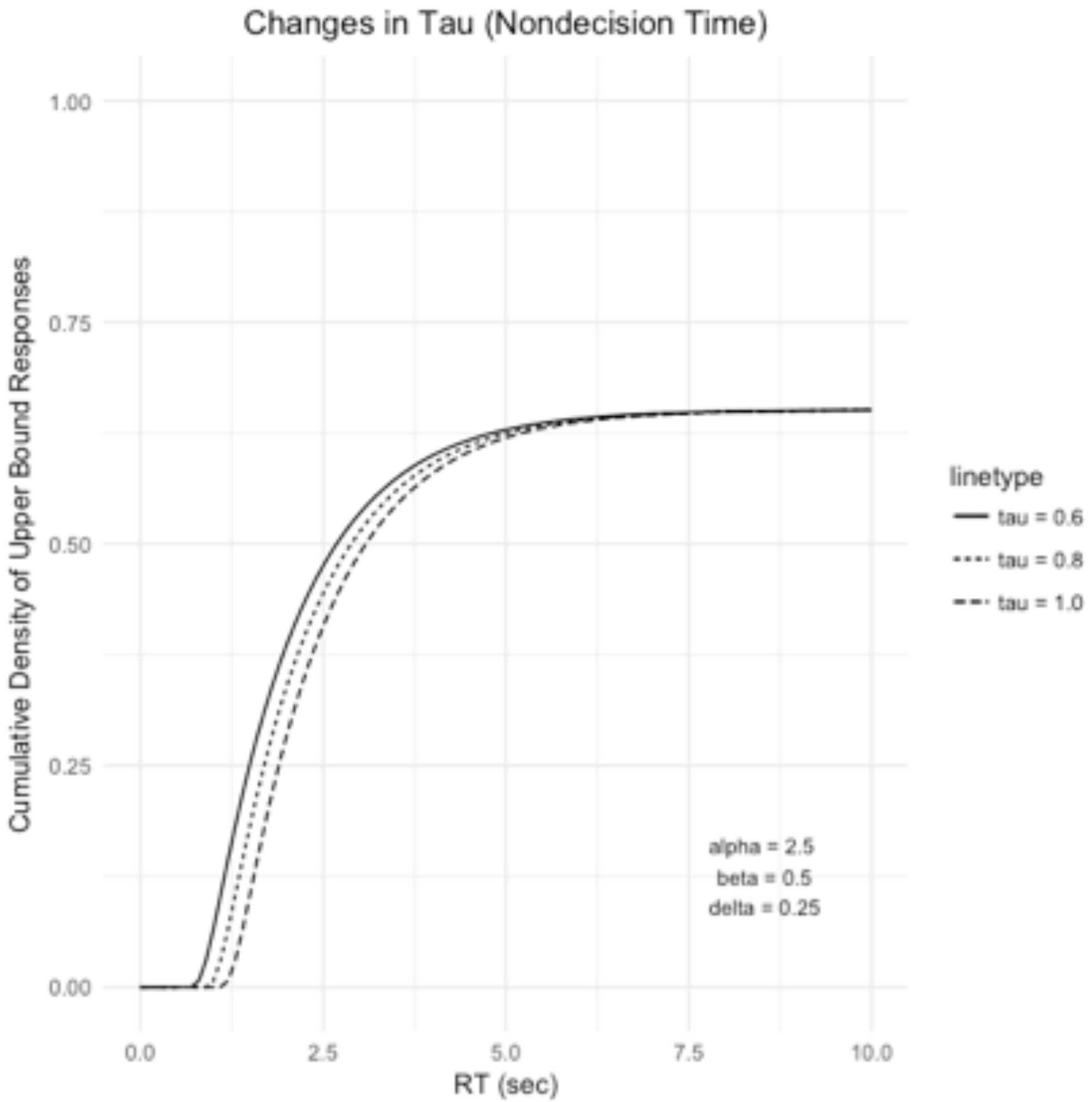
- To distinguish **serial search** from **direct access**, we need to tease apart retrieval speed and accuracy……
- But they are confounded in simple reaction time measures:
  - Longer reaction times may be due to the time it takes to access a more remote antecedent (i.e. extra processing steps are required).
  - Or it may simply reflect the decayed quality of the representation of a more remote antecedent (but retrieval speed is not necessarily slowed!).

DRIFT DIFFUSION MODELLING

- DDM jointly models accuracy and response time distributions, with parameters that reflect distinct underlying memory retrieval processes (Ratcliff 1978; Ratcliff, et al., 2016; McElree & Dosher 1989)
- From these measurements, a retrieval function is estimated that relates accuracy to elapsed processing time.
- End product: A best-fit model with several key parameters

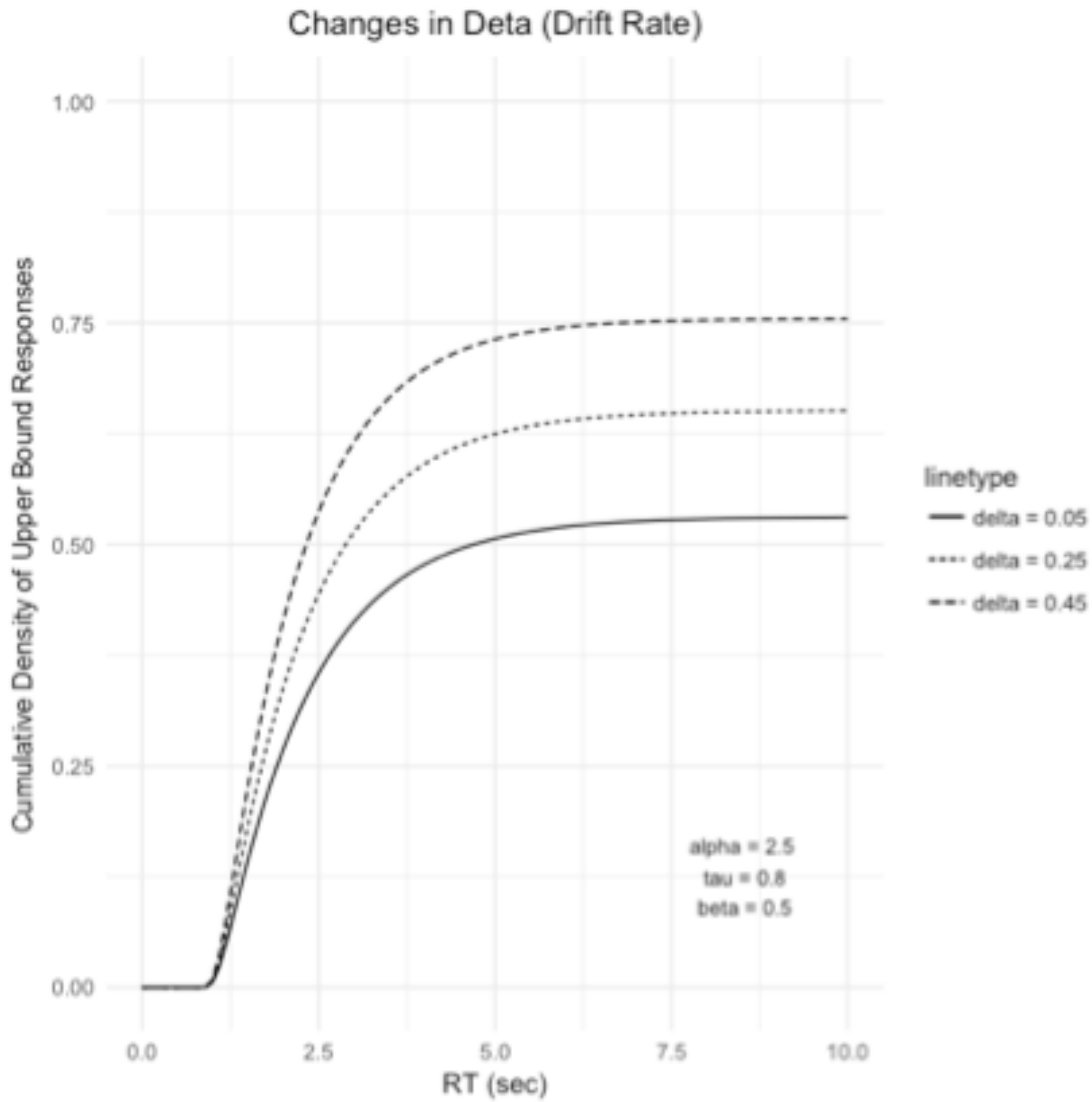
DRIFT DIFFUSION MODELLING

- τ, *nondecision time*: the time required for memory access



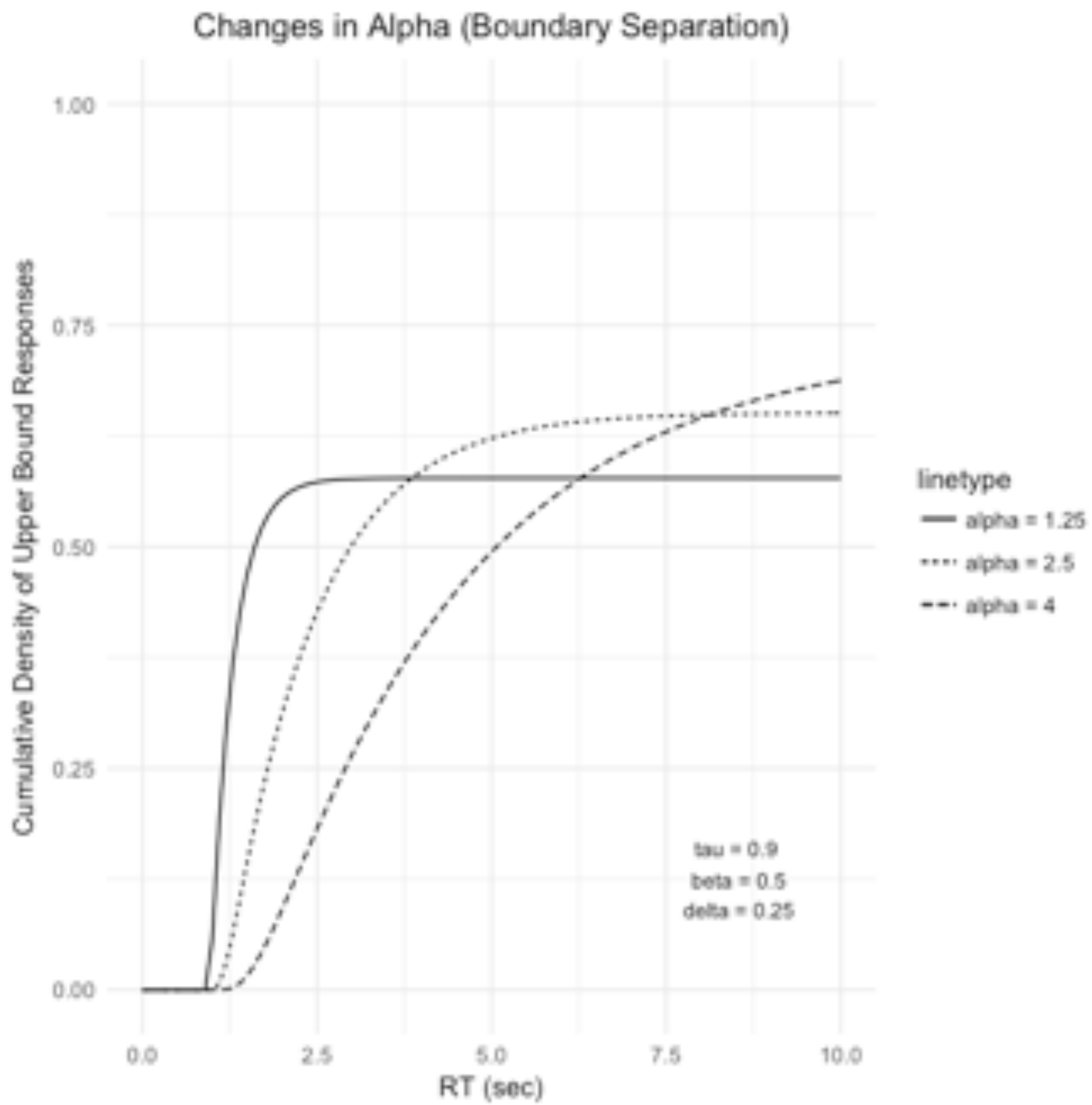
DRIFT DIFFUSION MODELLING

- δ, *drift rate*: the asymptotic accuracy



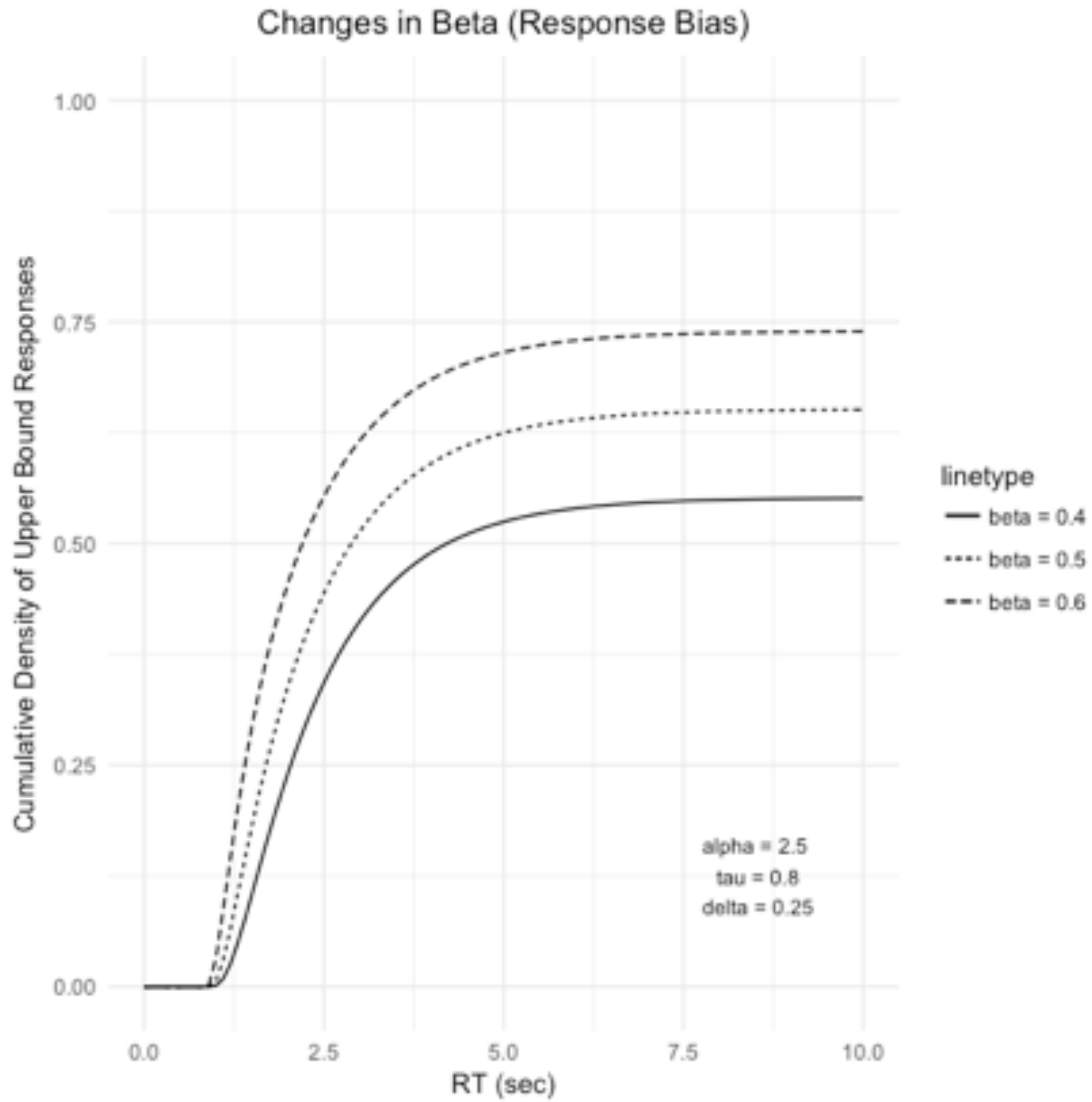
DRIFT DIFFUSION MODELLING

- α, *boundary separation*: the retrieval speed & the asymptote



DRIFT DIFFUSION MODELLING

- β, *response bias*



THE TAKE-HOME MESSAGE

- A difference in **τ** or **α** can be used to infer that a serial search retrieval process is at play.
- The lack of this difference indicates a direct access retrieval process.

EXPERIMENTAL DESIGN

- Speeded acceptability judgement study (N = 64):
  - An experimenter-paced sentence reading task
  - Phrase-by-phrase with RSVP presentation (400 msec/phrase)
  - Followed by an end-of-sentence acceptability judgment with binary choices.

EXPERIMENTAL DESIGN

- Distance was manipulated as **Near** or **Far**.
- Context (the VP) was **Same** or **Different**, satisfying or failing to satisfy the presuppositions respectively

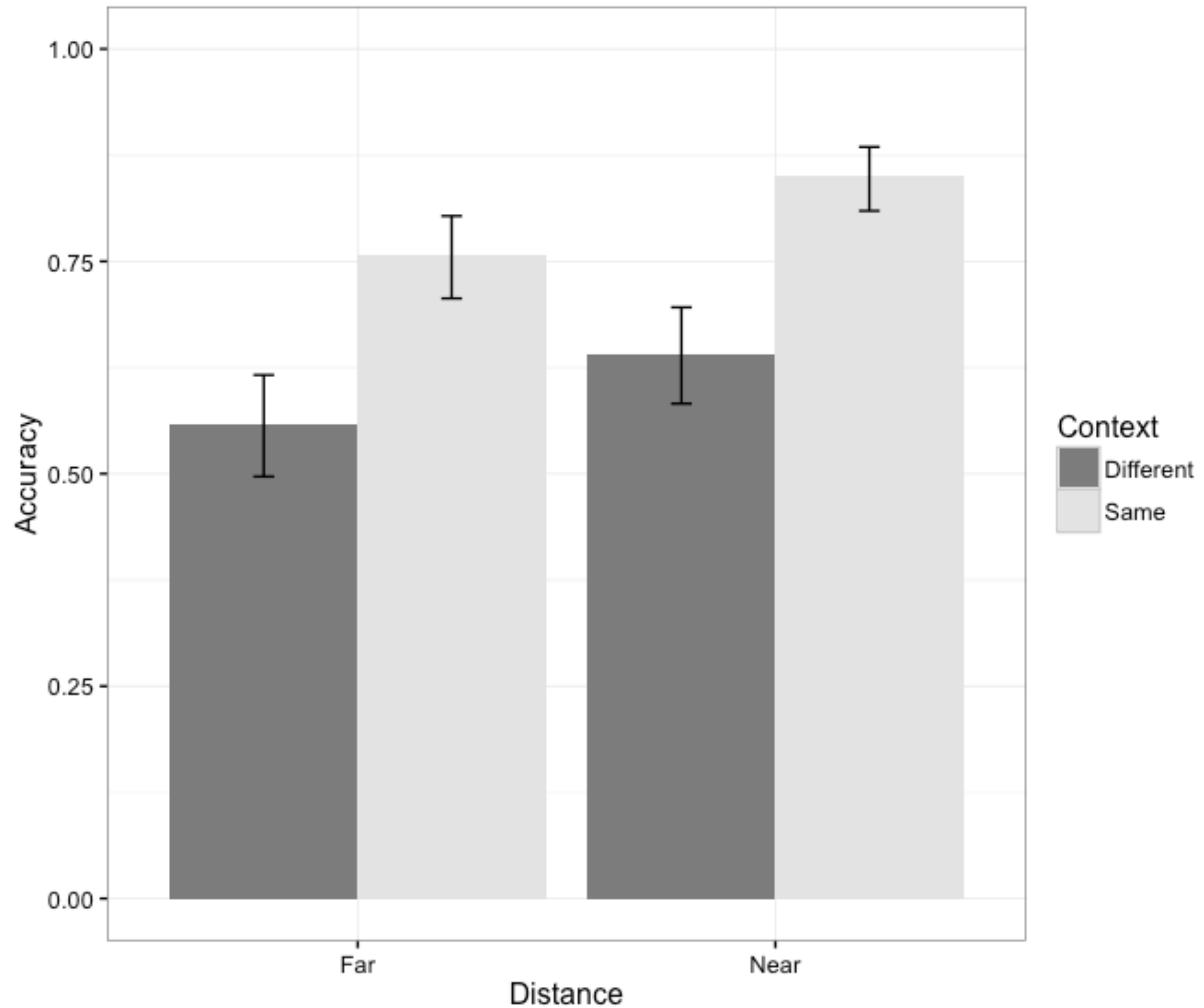
	Same	Different
Near	If the editor resigned, then the critics resigned too.	# If the editor plagiarized, then the critics resigned too.
Far	If the editor resigned, then everyone from the publishing house would be shocked to hear that the critics resigned too.	# If the editor plagiarized, then everyone from the publishing house would be shocked to hear that the critics resigned too.

PREDICTIONS

- Accuracy:
  - A distance effect, with higher accuracy in the **Near** condition.
- Response time:
  - No distance effect is expected.
  - If there are (hints of) distance effects, DDM is useful to check whether it's due to a difference in retrieval speed or just the quality of memory representation.

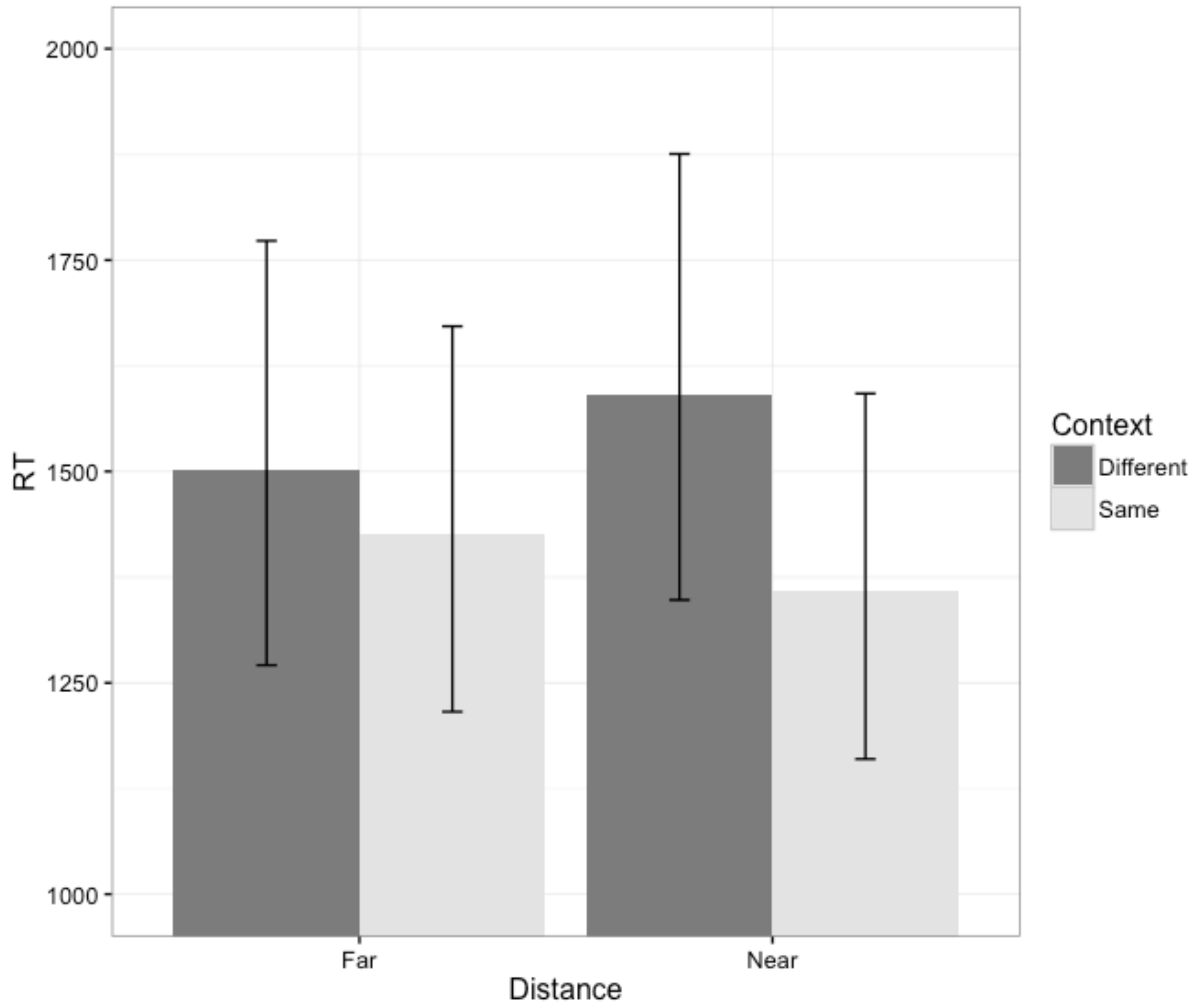
RESULTS: ACCURACY

- Participants were more accurate in the **Near** condition, suggesting **accuracy** differences.
  - A main effect of Distance ($t = 4.769$, $p < .001$) and Context ($t = 3.604$, $p < .001$).
  - Their interaction was non-significant ($t = 0.671$, $p = .502$).

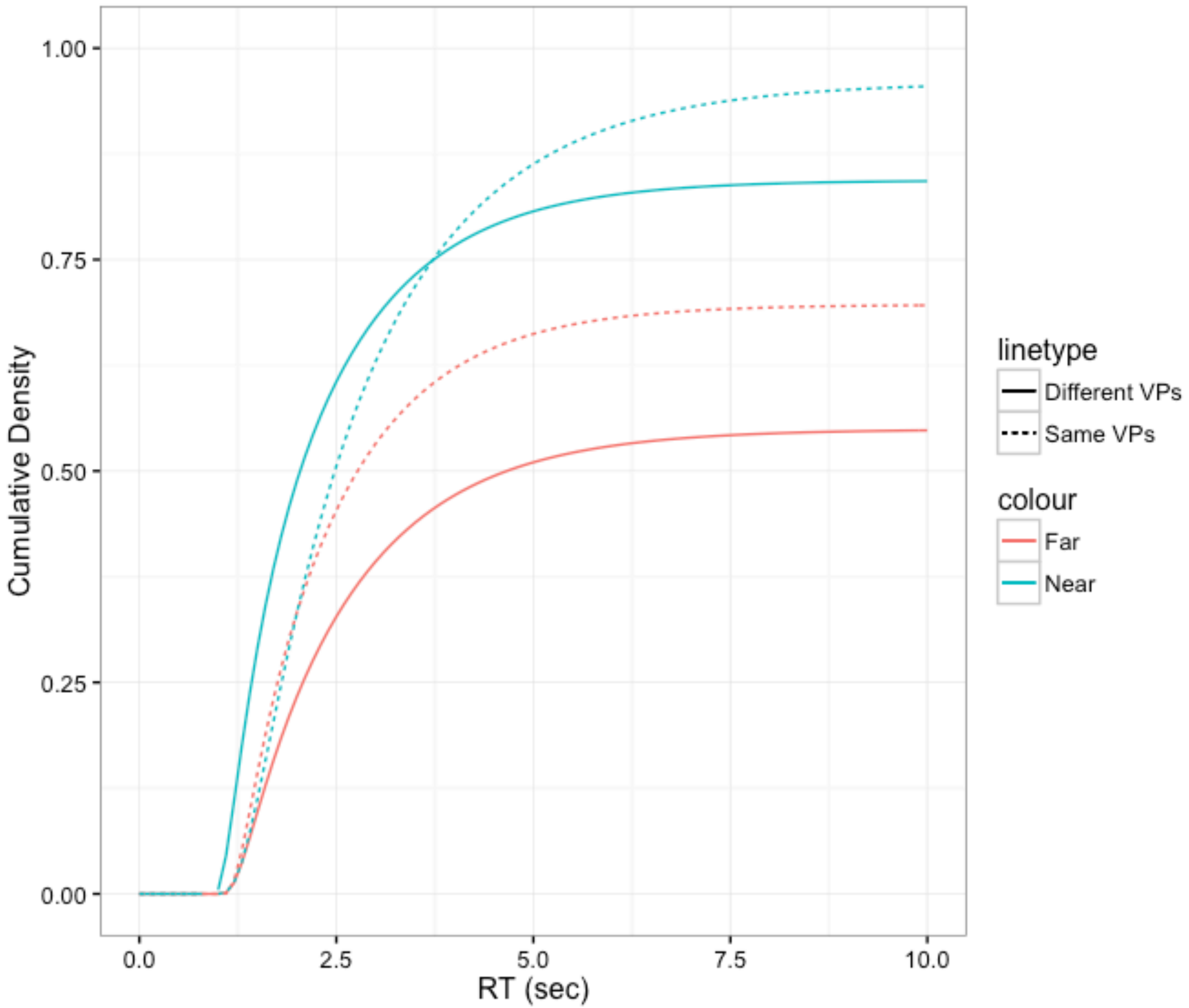


RESULTS: RESPONSE TIME (FOR ACCURATE RESPONSES)

- A marginally significant interaction between Distance and Context ($t = 1.799$, $p = .079$), and a main effect of Context ($t = -2.755$, $p = .007$)
- Planned comparison revealed no effects of Distance within the Context types.



RESULTS: DDM ANALYSIS



RESULTS: DDM ANALYSIS

	τ (retrieval speed)	α (rate)	δ (accuracy)
Distance	1.691	0.863	-1.725
Context	2.100*	0.821	4.261***
Interaction	0.941	-0.051	-0.310

- DDM revealed no effect of *Distance* on τ or α.
- No significant effects of *Distance* was found in terms of speed of retrieval.

CONCLUSIONS

- The memory retrieval process of the presupposition trigger *too* shares the processing signature of many anaphoric expressions:
  - (1) A memory retrieval process is initiated.
  - (2a) This process is via direct access.
  - (2b) What **cues** are being exploited for *too* to identify the target representation remains to be explored.

EVIDENCE OF ABSENCE? ABSENCE OF EVIDENCE?

- The conclusion for a direct access retrieval process is based on the *lack* of any difference in **τ** or **α**
  - Could it be due to the lack of statistical power?
  - A general concern for the studies on memory retrieval process
  - Being less resource-intensive and time consuming technique compared to Multiple-Response SAT paradigm, DDM offers more opportunities for replication

DISCUSSION (1): CUES

- One concern in our current design:
  - The same VP was used to satisfy the presupposition of *too*.
  - The same "form" may serve as a cue, making it possible to directly identify the target antecedent.
- Next step: using synonymous verbs to satisfy the presupposition (see also Göbel (2018)).
  - e.g. *If the editor resigned, then the critics quit too.*
  - This may shed light on what cues are actually available during the retrieval of the representation of a presupposed content.

DISCUSSION (2): ANTECEDENTS

- What is a possible antecedent for *too*?
  - We could need to add another propositional-level antecedent between the presupposed content and *too*.
  - e.g. *If the editor resigned and the writers went on a strike, then everyone from the publishing house would be shocked to hear that the critics quit too.*
- This will then help us fully consider the sophisticated version of the serial search model, and understand the extent to which the memory retrieval process of *too* is directly accessible.

DISCUSSION (3): DEPENDENCY & RETRIEVAL

- Three relevant dimensions for considering which memory retrieval mechanism is at play:
  - What is a suitable antecedent in a particular type of dependency?
  - How much information is available for identifying the target antecedent?
  - What are the structural properties of an antecedent that need to be taken into consideration?

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Website: *sherrychen.org*

Email: *sychen@mit.edu*

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