# Effects of Syntactic and Semantic Structure on Production Planning

**Monica Do** {*monicado@sas.upenn.edu*} **Elsi Kaiser** {*emkaiser@usc.edu*}
Department of Linguistics, University of Southern California, Los Angeles, USA

## 1. Introduction

- **Language production, like comprehension, is incremental**[1]
  - **When describing an image, speakers:** (1) Apprehend Scene → **(2) Formulate Message** → **(3) Linguistically Encode Message** → (4) Phonologically Encode Message → (5) Begin Articulation
- **Griffin and Bock (2000):** Used visual-world eye-tracking paradigm to investigate whether linguistic encoding is semantically or syntactically driven
  **Actives:** The mailman is chasing the dog.
  **Passives:** The mailman is being chased by the dog.
  - **Found encoding driven by syntactic prominence:** Speakers encode the subject before the object, even when the subject is the patient
- **BUT,** other factors may complicate syntactic account
  - **Subjects were always more salient** human characters
  - **Planning of agent in passive by-phrases unknown**

## 2. Current Study

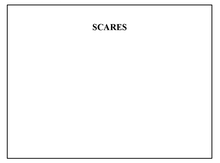
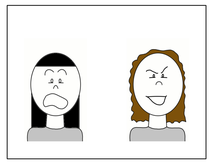
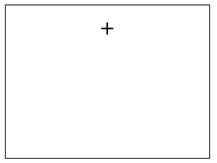
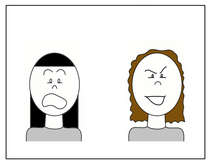
1. **Psych verbs separate syntactic from semantic structure**[2]
   **Agent-Patient:** 'blames', 'confronts', 'praises'
   **Experiencer-Stimulus:** 'fears', 'loves', 'hates'
   **Stimulus-Experiencer:** 'scares', 'amazes', 'confuses'
   **Question:** Does **linguistic encoding** start with the most **syntactically** (Subject) or **semantically** prominent argument (Agt >> Pat; Exp >> Stim)?
2. **Psych verbs considered distinct from action verbs**[3]
   **Morphologically:** Agt & Exp have different morphological case (e.g. Finnish)
   **Conceptually:**
   **Action verbs** → 'who **did** what to whom'
   **Psych verbs** → 'who **caused** what in whom'
   **Question:** Is **message formulation** sensitive to the theoretical differences between **action** and **psych** verbs?

## 3. Hypotheses & Predictions

| | Agt-Pat<br>Leslie blames Ann | Exp-Stim<br>Leslie fears Ann | Stim-Exp<br>Leslie scares Ann |
|---|---|---|---|
| **Message Formulation (200-400 ms)**[4] | | | |
| Action vs Psych verbs differ | Agt-Pat don't behave like Psych verbs | Exp-Stim & Stim-Exp verbs behave similarly | |
| **Linguistic Encoding (400-1000 ms)**[5] | | | |
| Syntactic | **Subject** | | **Subject** |
| Semantic | | | **Object** |

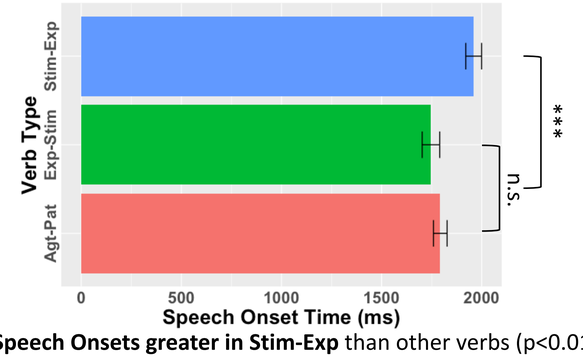
**REFERENCES: [1]** Levelt, 1989; Bock and Levelt, 1994 **[2]** Grimshaw, 1980; Jackendoff, 1987 **[3]** Brown and Fish, 1983 **[4-5]** Griffin & Bock, 2000 **[6]** Ferreira, 1994; Thompson and Lee, 2009
**THANKS TO:** Russell Endowed Fellowship (USC), A. Besserman (USC) for images

## 4. Experiment Designs

| Experiment 1: Sentence Production | Experiment 2: Picture Inspection |
|---|---|
| 24 targets, 36 fillers | |
| **See-and-describe task (n=34):** (1) See verb cue   (2) Produce a sentence using verb that describes image  | **No linguistic task (n=18):** (1) See fixation cross   (1) Inspect the "content" and "characteristics" of each image  (2) Intermittently rate aesthetic quality (e.g. 'ugliness', 'naturalness') of images using 5-point scale |
| Post-Experiment Questionnaires | |
| **(1) Image Interpretability** Identify images where it is 'unclear' who did what to who **(2) Salience** Rate emotiveness of each expression on a 5-point scale **(3) Autism spectrum quotient** | **(1) Salience** Rate emotiveness of each expression on a 5-point scale **(2) Autism spectrum quotient** |

## 5. Exp 1: Speech Onsets

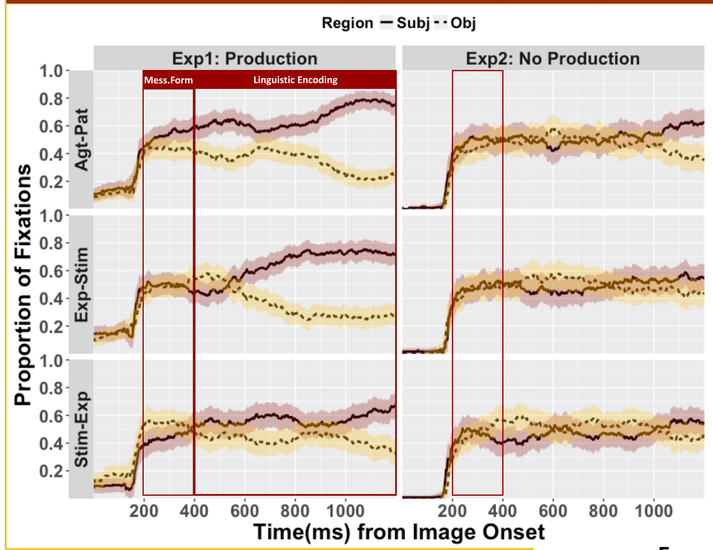
**Speech Onset Times by Verb Type**

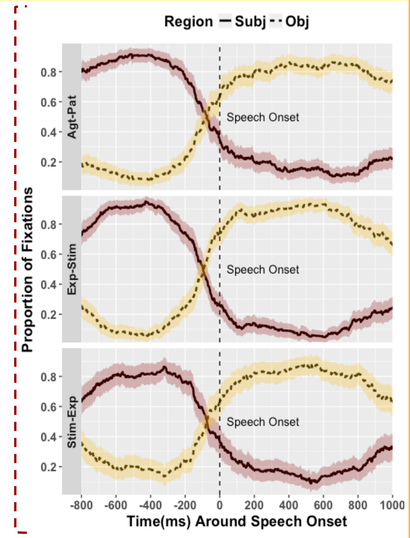



- **Speech Onsets greater in Stim-Exp** than other verbs (p<0.01)
- Onsets for **Agt-Pat & Exp-Stim don't differ** (p=0.481)

**Take away:** Speakers slower to start Stim-Exp, where syntactic and semantic prominence not aligned; this can't be due to 'surface' syntax.[6]

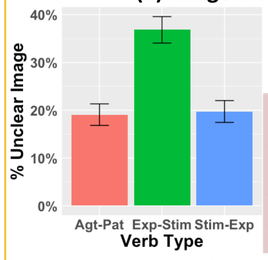
## 6. Exp 1 & Exp 2: Eye-Movements




## 7. Exp 1: Questionnaires

**(1) Image Interpretability**




- Significantly more unclear Exp-Stim images (p<.01)

**Take Away:** Slower Speech Onsets & Eye-movements in Stim-Exp verbs not due to Image Clarity

**(2) Salience**

- **No salience differences** between Agt vs Pat (p=0.126) or Exp vs Stim (p=0.895)

**Take Away:** No evidence eye-movements at Message Formulation due to imbalance in images

**(3) Autism spectrum quotient**

- **No correlations** between speech onset times and overall ASQ scores & ASQ subscales

**Experiment 1: Sentence Production**

- **Start of Message Formulation: (1)** More Subj-looks in Apt-Pat than other verbs (by-subj: p<.05, by-item: p=.18) **(2)** Fewer Subj-looks in Stim-Exp than Exp-Stim verbs (by-subj: p<.001, by-item: p=.08)
- **During Message Formulation:** Verbs don't differ in rate at which Subj preference emerges (all p>.07)
- **Start of Linguistic Encoding:** Looks to Subj for Stim-Exp do not differ from Agt-Pat or Exp-Stim verbs (p's>.33)
- **During Linguistic Encoding:** Subj preference emerges slower in Stim-Exp (by-subj: p<.01, by-item: p=.09)

**Take Away: (1)** Psych verbs do not behave as a class at message formulation **(2)** Linguistic encoding harder if syntactic and semantic prominence misaligned

**Experiment 2: Picture Inspection**

- **Picture Inspection:** No difference among verbs (p's>.2)

**Exp 1 & Exp 2 Compared**

- **Start of Mess.Form/Pic.Insp.: (1)** No clear differences between Agt-Pat versus other verbs across experiments (p's>.2) **(2)** Differences between Exp-Stim and Stim-Exp verbs vary across experiments (p's < .05)

## 8. Discussion & Conclusion

- **Stim-Exp verbs show linguistic encoding is not strictly syntactically control (contra Griffin and Bock, 2000):**
  (1) When syntactic and semantic prominence ***misaligned***, speakers are slower to begin their sentences
  (2) Eye-movements show relatively ***prolonged competition*** between syntactically prominent subject versus semantically prominent object
  (3) Competition is due to ***syntactic and semantic misalignment***, not difficulty interpreting Stim-Exp images
- **Message formulation and linguistic encoding are distinct processes:** In Exp-Stim and Stim-Exp verbs, difficulty formulating message-level representations did not predict difficulty linguistically encoding
- **Action and Psych events don't appear to behave as distinct classes at message formulation**: Instead, some evidence suggests message formulation guided by semantically most prominent argument regardless of event type, but evidence complicated by (un)interpretability of Exp-Stim images