Intonational Marking of Information Structure in L2 English

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Prosodic marking of information structure

▶ **English uses prosody to (probabilistically) mark information structure** (Hirschberg & Pierrehumbert, 1986; Pierrehumbert & Hirshberg, 1990)

1. **Given information typically bears no pitch accent ($\emptyset$)**
   (especially when the given target and its antecedent share the same grammatical role and appear in the same surface position)

   A: Mariana did what?
   *B: **Mariana**$_\emptyset$ made the marmalade.*

2. **New information is generally marked with H***

   A: Who made the marmalade?
   *B: **Mariana**$_{H*}$ made the marmalade.*

3. **Contrastive information is most commonly marked with L+H***

   *A: Did **John** make the marmalade?*
   *B: **Mariana**$_{L+H*}$ made the marmalade.*

Japanese intonational system

- **Tokyo Japanese uses word-level accentuation to differentiate lexical items** (Venditti & Jun, 2005; Venditti, Maekawa & Beckman, 2008)

  - Accented words: H*+L

  - Unaccented words: no accent

→ No discourse/pragmatic meaning associated with presence or absence of pitch accent

Accented word

u e' r u m o n o
the ones who are starved

Unaccented word

u e r u m o n o
something to plant
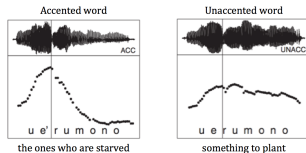
- Syntactic (scrambling) and morphological (topic marker *–wa*) choices are used to indicate information status

Japanese intonational system

► **However, Tokyo Japanese uses prosody for marking contrast**
(Venditti & Jun, 2005; Venditti, Maekawa & Beckman, 2008)
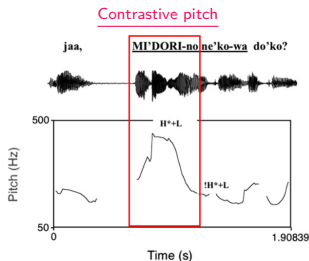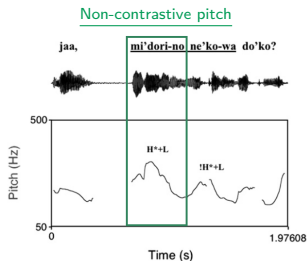
► Contrastive information is expressed by locally expanded pitch range. This realization is acoustically similar to realizations of L+H* in English

English & Japanese intonational systems

- **Accentuation vs. deaccentuation**
  - English new vs. given information is generally indicated by accentuation (H*) vs. deaccentuation (∅)
  - Presence or absence of pitch accent in Japanese indicates two different lexical items

- **Prosodic contrast**
  - English contrastive focus is marked with L+H*
  - Japanese contrastive focus is marked with expanded pitch range

Prosody and information structure in L2

- **L2-English production studies**

    - **Wennerstrom (1994, 1998)**
      Lectures by intermediate learners whose L1 is Spanish, Japanese, and Thai
    - **Verdugo (2003, 2006)**
      Scripted dialogues by upper-intermediate L1-Spanish learners
    - **Nava (2008)**
      Q & A dialogues and narrations by L1-Spanish learners at various levels
    - **O'Brien & Gut (2010)**
      Picture Q & A and narratives by intermediate-advanced L1-German learners
    - **Swerts & Zerbian (2010)**
      Picture description by L1-Zulu learners at various levels
    - **Gut, Pillai & Mohd Don (2013)**
      Card game by L1-Malay learners at various levels

$\rightarrow$ These production studies support L1 prosodic transfer and the effect of proficiency on the acquisition of L2 discourse prosody

Prosody and information structure in L2

▶ **Comprehension studies**

  ▶ **Akker & Cutler (2003): Phoneme detection task**
    → Less efficient processing by L2 learners even at the advanced level

  ▶ **Braun & Tagliapietra (2011): Lexical decision task**
    → Divergence between L1 speakers and advanced L2 learners in the priming effect

  ▶ **Chen & Lai (2011): Eye-tracking listening comprehension**
    → More native-like performance in the intermediate group than the advanced group

  ▶ **Takeda, Anderson, Schafer, & Schwartz (2015): Intonation naturalness rating task**
    → More native-like performance in the advanced group than the intermediate group

→ The acquisition of L2 discourse prosody is challenging even for advanced learners

Predictions

If L1-Japanese L2-English learners rely on their L1 knowledge of prosody-discourse mapping…

- **L+H*-contrastive association should be the easiest**
- **H*-new and null accent-given associations should be more challenging**

Production

- Given vs. new information – If same lexical items, mark with the same prosodic patterns (at least initially)
- Contrastive information – Mark with a steep rise in pitch

Comprehension

- Null accent vs. H* – No effect on discourse processing
- L+H* – Facilitates the processing of contrastive information

Research questions & participants

▶ **Research questions**

1. **Can L2 learners employ target language (TL) pitch accents in production to indicate given, new, contrastive status of discourse entities?**

   → Exp.1. Computer-based, semi-spontaneous production task

2. **Can L2 learners incorporate TL accentual information into online processing of discourse entities?**

   → Exp.2. Eye-tracking listening comprehension task

▶ **Participants**

   ▶ **70 L1 English speakers**
   ▶ **64 L1-Japanese L2 learners of English**
   -34 lower-level, 30 upper-level learners grouped by a median split
   (Proficiency measures: c-test & read-aloud task)

Exp.1: Production task

▶ **Purpose**
To examine whether L2 learners use prosody to indicate information status in a semi-spontaneous interactive task

▶ **Task: Computer-based animal-coloring speaking task**
1. Saw a slide that featured 2 pairs of a colored drawing tool with an animal
2. Gave instructions to the confederate

e.g. *Use the green paintbrush to color the cow. Now, use the blue paintbrush to color the dolphin.*
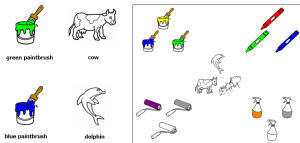

green paintbrush   cow

blue paintbrush   dolphin
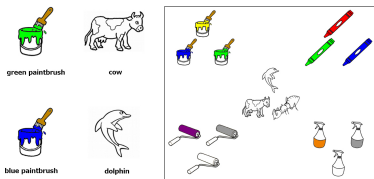
Production task

Instruction 1
Use the green paintbrush to color the cow.

Instruction 2
Now, use the blue paintbrush to color the dolphin.

- ▶ **Conditions: 3 context types**

	Context type	Instruction 1	Instruction 2
1.	Both new	green crayon	blue paintbrush
2.	Adjective contrastive	green paintbrush	blue paintbrush
3.	Both given	blue paintbrush	blue paintbrush

- ▶ **3 context conditions x 8 tokens = 24 items**
- ▶ **Critical region: Color adjective in Instruction 2**

Production data analysis

- **Word segmentation**
  1. Segmented word-by-word using the Prosodylab-Aligner (Gorman, Howell, & Wagner, 2011)
  2. Word boundaries readjusted by a native speaker of English who had training in phonetics and phonology

- **Acoustic analysis**
  - **Mean F0 across the entire adjective (focus of today's talk), F0 max, F0 min, F0 excursion & duration were analyzed using mixed effects regression models**
    lmer(pitch $\sim$ context + (1 + context | subject) + (1 + context | item))
  - **Context Helmert coded**
    -Both given vs. Both new/Adjective contrastive
      (unaccented preference vs. accented preference)
    -Both new vs. Adjective contrastive
      (H* preference vs. L+H* preference)
  - **Tukey's post-hoc tests comparing 3 context conditions**

- **Phonological analysis**
  - ToBI annotation in progress...

Predictions: Mean pitch in adjective region

1. **L1 group**
   - Adjective contrastive - High
   - Both new - Mid
   - Both given -Low

2. **L2 group**
   - **L2 lower level group**
     - Adjective contrastive - High
     - Both new & Both given - No difference in pitch for the same lexical items
   - **L2 upper level group**
     - Adjective contrastive - High
     - Both new & Both given - Difference in pitch starts to emerge

Pitch results

Mean pitch in adjective region (adjusted for speaker variability)
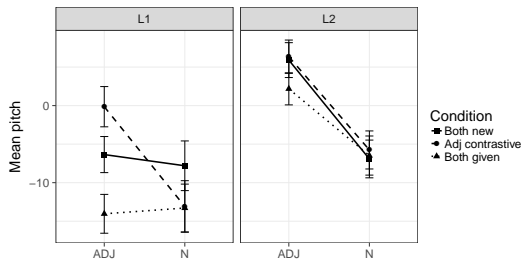
Figure 1: Mean pitch

- **L1 group**
  - Adj. cont. > Both new
    ($b = 5.90$, $p < .01$)
  - Adj. cont./Both new > Both given
    ($b = 10.82$, $p < .001$)
  - Post-hoc test
    Adj. cont. > Both new > Both given

  Cont   New   Given

- **L2 group**
  - Adj. cont. = Both new
  - Adj. cont./Both new > Both given
    ($b = 3.78$, $p < .05$)
  - Post-hoc test
    Adj. cont. = Both new = Both given

  Cont   New   Given

- L1 speakers make a 3-way distinction among Adjective contrastive, Both new, and Both given
- L2 learners make a binary distinction between Adjective contrastive/Both new and Both given, although this was not confirmed in the post-hoc analysis

Pitch results by proficiency

Mean pitch in adjective region (adjusted for speaker variability)
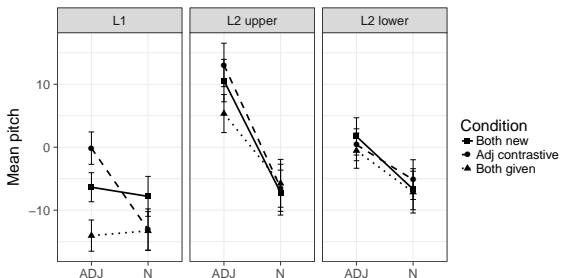
Figure 2: Mean pitch by proficiency

- **L2 upper group**
  - Adj. cont. = Both new
  - **Adj. cont./Both new** > **Both given**
    ($b = 5.90$, $p < .05$)
  - Post-hoc test
    - **Adj. cont.** > **Both given**
    - Adj. cont. = Both new
    - Both new = Both given

  Cont   New   Given

- **L2 lower group**
  - Adj. cont. = Both new
  - Adj. cont./Both new = Both given
  - Post-hoc test
    - Adj. cont. = Both new = Both given

  Cont   New   Given

- Upper level learners distinguish Adjective contrastive from Both given
- Lower level learners do not differentiate Adjective contrastive, Both new, and Both given

Production task: Summary

- **L1 speakers**
  - **Increasing mean pitch in the following order:**
    - **Both given** < **Both new** < **Adjective contrastive**
  - → L1 speakers utilize pitch cues to mark given, new, contrastive referents

- **L2 lower level learners**
  - **No difference among Both given, Both new, and Adjective contrastive**
    - → Unexpectedly, lower level learners did not use pitch to signal contrastive referents as they do in their L1 Japanese
    - → Instead, they often emphasized every single word
  - → The L1 prosody-discourse mapping (expanded pitch-contrastive) seems not to transfer to L2 prosodic marking of discourse referents (L+H*-contrastive) at the beginning level

- **L2 upper level learners**
  - **Significant difference between Adjective contrastive and Both given**
    - → Is this acoustic difference due to a successful mapping of expanded pitch-to-contrastive, or null accent-to-given, or some of each?
  - → The results nevertheless imply that advanced L2 learners are able to acquire new prosody-discourse mappings (null accent-given; L+H*-contrast(?)) in TL

Exp.2: Eye-tracking listening experiment

▶ **Purpose**
To examine whether L2 listeners can quickly interpret and integrate prosodic cues for the processing of discourse referents

▶ **Task (based on Ito & Speer, 2008; Ito et al., 2012)**

1. Saw a display with drawing tools and animals

2. Listened to pre-recorded instructions

   Use the green paintbrush to color the dolphin.
   Now, use the blue paintbrush to color the cow.

3. Clicked on the specified drawing tool and animal
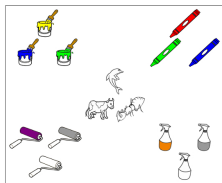
▶ **2 smaller experiments**

   ▶ **New vs. Given experiment**
   25 L1-English & 26 L2-English (13 lower-level, 13 upper-level) participants

   ▶ **New vs. Contrastive experiment**
   45 L1-English & 38 L2-English (21 lower-level, 17 upper-level) participants

Exp.2A: New-given eye-tracking experiment

Instruction 1
Use the (green crayon / blue paintbrush) to color the dolphin.

Instruction 2
Now, use the blue$_{(H* / \emptyset)}$ paintbrush to color the cow.
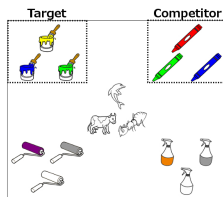
▶ **Conditions:**

2 context types (New vs. Given) x 2 pitch accent types (H* vs. $\emptyset$)

	Context–Accent (Adj.)	Instruction 1	Instruction 2
a.	New–H*	green crayon `Play`	blue$_{H*}$ paintbrush `Play`
b.	New–$\emptyset$	green crayon	blue$_{\emptyset}$ paintbrush `Play`
c.	Given–H*	blue paintbrush `Play`	blue$_{H*}$ paintbrush
d.	Given–$\emptyset$	blue paintbrush	blue$_{\emptyset}$ paintbrush

▶ **Only one other drawing implement had the same color as the Target implement → Competitor (e.g. blue crayon)**

Sound stimuli & experimental items

Instruction 2

Now, use the <u>blue</u> (H / ∅) paintbrush to color the cow.*
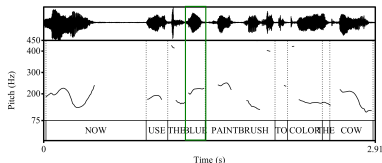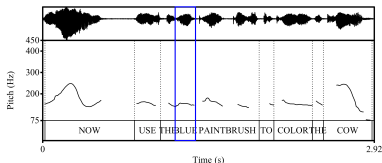
H* pitch contour

Null accent pitch contour

▶ 5 practice items

▶ 24 experimental items (4 conditions × 6 tokens) + 24 fillers = 48 items

▶ 48 items divided into 2 blocks of 24 trials each

▶ Items presented in pseudo-randomized order

Predictions

	Context–Accent (Adj.)	Instruction 1	Instruction 2
a.	New–H*	green crayon	blue$_{H*}$ paintbrush
b.	New–∅	green crayon	blue$_{∅}$ paintbrush
c.	Given–H*	blue paintbrush	blue$_{H*}$ paintbrush
d.	Given–∅	blue paintbrush	blue$_{∅}$ paintbrush

▶ **L1 group**
  - ▶ More looks to Target in New–H* than in New–∅
  - ▶ More looks to Target in Given–∅ than in Given–H*

▶ **L2 group: If the presence or absence of accentuation is perceived as a discourse marker as in English...**
  - ▶ Same as L1 group

▶ **L2 group: If the presence or absence of accentuation is perceived for lexical recognition as in L1...**
  - ▶ No difference between New–H* and New–∅
  - ▶ No difference between Given–∅ and Given–H*

Results

- **Mouse click accuracy**
  - L1 group – 99.66% (97.92-100%)
  - L2 group – 99.18 % (95.34-100%)
  - Trials with incorrect mouse clicks excluded in further analyses

- **Eye-gaze data analysis**
  - Separate empirical logit analyses by subject and by item (Barr, 2008)
    lmer(Target ~ Pitch * Context + (1 + Pitch + Context | Subject))
    [Reference condition-New, H* (contrast coded as 2 x 2)]
  - Time aligned from the noun onset (disambiguation point)
  - Critical time window: -100ms – 900ms
    Based on grand mean logit function by collapsing data across the four conditions
    (Ito et al., 2012)
  - Tukey's post-hoc pairwise comparison tests
  - Fixation graphs: $\frac{FixationsToTarget}{AllPossibleFixations}$

L1 results – Looks to Target

(green crayon / blue paintbrush) $\rightarrow$ blue$_{(H^* / \emptyset)}$ paintbrush
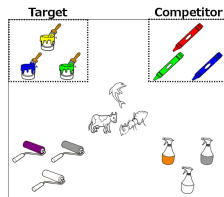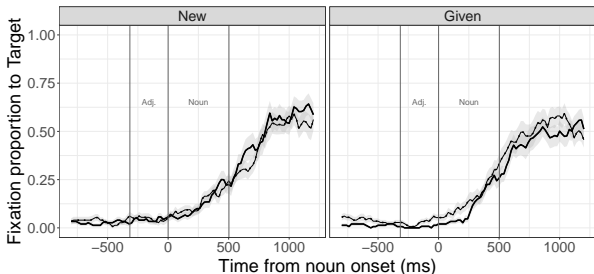
- ▶ No main effect of Context or Accent
- ▶ **(Marginally) significant Context x Accent interaction effect by subject and item analyses** [$b = .41$, $p < .05$; $b = .34$, $p = .06$]
- ▶ **However, post-hoc test shows no significant difference among the four conditions**

  $\rightarrow$ **Visual inspection of the graph indicates some facilitative effect of null accent in the Given context, but this effect may be small**

L2 results – Looks to Target

(green crayon / blue paintbrush) → blue$_{(\text{H}^* / \emptyset)}$ paintbrush
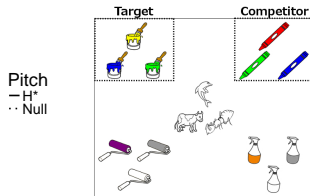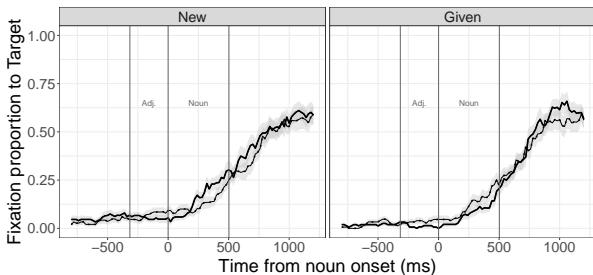
▶ **No main or interaction effects**

New-given eye-tracking experiment: Summary

▶ **L1 speakers**
(Based on the main analysis and the visual inspection of the graph)
  - ▶ More looks to Target in Given–∅ than in Given–H*
  - ▶ No difference in looks to Target in New–H* and New–∅

→ Null accent seems to facilitate L1-English processing of given referents

▶ **L2 lower & upper level learners**
  - ▶ No difference in looks to Target in Given–∅ and in Given–H*
  - ▶ No difference in looks to Target in New–H* and New–∅

→ L2 learners, regardless of proficiency, do not seem to utilize null accent when processing given referents

Exp.2B: New-contrastive eye-tracking task

Instruction 1
Use the (green crayon / green paintbrush) to color the dolphin.

Instruction 2
Now, use the blue$_{(H* / L+H*)}$ paintbrush to color the cow.
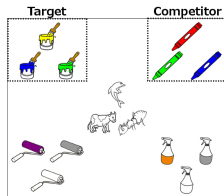
▶ **Conditions:**

2 context types (New vs. Contrastive) x 2 pitch accent types (H* vs. L+H*)

	Context–Accent (Adj.)	Instruction 1	Instruction 2
a.	New–H*	green crayon `Play`	blue$_{H*}$ paintbrush `Play`
b.	New–L+H*	green crayon	blue$_{L+H*}$ paintbrush `Play`
c.	Cont–H*	green paintbrush `Play`	blue$_{H*}$ paintbrush
d.	Cont–L+H*	green paintbrush	blue$_{L+H*}$ paintbrush

Note: (b) is a garden-path condition where the contrastive interpretation of L+H* triggers looks to the incorrect target (blue crayon)

Sound stimuli & experimental items

Instruction 2

Now, use the <u>blue</u> (H / L+H*) paintbrush to color the cow.*
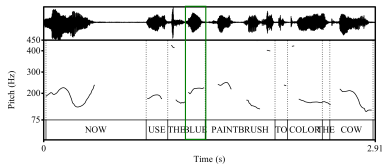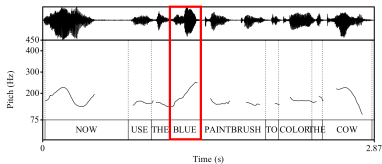
H* pitch contour

L+H* pitch contour

▶ 24 experimental items (4 conditions x 6 tokens) + 24 fillers = 48 items, divided into 2 blocks of 24 trials each

Predictions

	Context–Accent (Adj.)	Instruction 1	Instruction 2
a.	New–H*	green crayon	blue$_{H*}$ paintbrush
b.	New–L+H*	green crayon	blue$_{L+H*}$ paintbrush
c.	Cont–H*	green paintbrush	blue$_{H*}$ paintbrush$_{H*}$
d.	Cont–L+H*	green paintbrush	blue$_{L+H*}$ paintbrush

- **L1 group**
  - More looks to Target in New–H* than in New–L+H*
    (More looks to Competitor in New–L+H* than in New–H*)
  - More looks to Target in Contrastive–L+H* than in Contrastive–H*
- **L2 group: If H* vs. L+H* are perceived as new vs. contrastive markers as in English...**
  - Same as L1 group
- **L2 group: If H* vs. L+H* are not perceived as new vs. contrastive markers...**
  - No difference between New–H* and New–L+H*
  - No difference between Contrastive–L+H* and Contrastive–H*

Results

- **Mouse click accuracy**
  - L1 group – 99.51% (95.56-100%)
  - L2 group – 98.64 % (92.71-100%)
  - Trials with incorrect mouse clicks excluded in further analyses
- **Eye-gaze data analysis**
 - Same as new-given experiment

L1 results – Looks to Target

(green crayon / green paintbrush) → blue(H* / L+H*) paintbrush
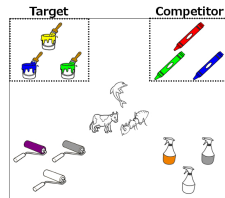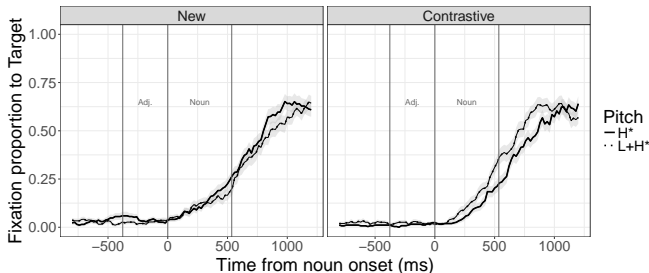
- No main effect of Context or Accent
- **Interaction effect of Context x Accent by subject & item analyses** [b = 0.46, p < .001; b = 0.44, p = .01]
- Post-hoc analysis
  -**More fixations for L+H* than for H* in Contrastive context** [p < .05]
  -**No difference between L+H* and H* in New context**

→ **L+H* in the Contrastive context increases fixations to Target**

L2 results – Looks to Target

(green crayon / green paintbrush) → blue$_{(H*\ /\ L+H*)}$ paintbrush
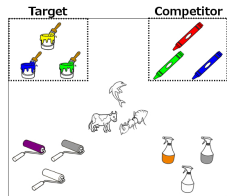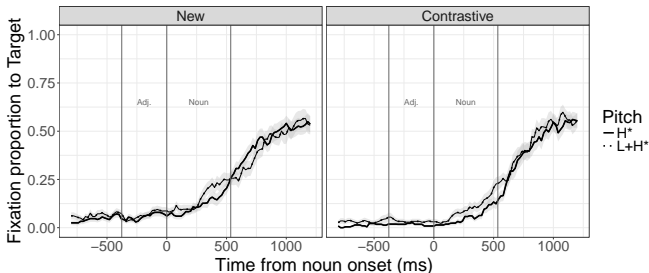
- **Main effect of Context by subject & item analyses** [b = -0.29, p < .01; b = -0.29, p < .01]
- No interaction effect

→ **L2 learners tend to look at a new referent regardless of pitch type**

New-contrastive eye-tracking experiment: Summary

► **L1 speakers**
  ► More looks to Target in Contrastive–L+H* than in Contrastive–H*
  ► No difference in looks to Target in New–H* and New–L+H*

  → L+H* facilitates looks to contrastive referents for L1 speakers

► **L2 lower & upper level learners**
  ► No difference in looks to Target in Contrastive–L+H* and Contrastive–H*
  ► No difference in looks to Target in New–H* and New–L+H*

  → L2 learners, regardless of proficiency, do not use L+H* to facilitate the processing of contrastive referents

Discussion: L1 English

- **Production**
  - Given, new, contrastive referents are signaled with increasing mean pitch
    → L1 English speakers reliably mark information structure using pitch cues (Breen, Fedorenko, Wagner & Gibson, 2010)

- **Eye-tracking comprehension**
  - Null accent may facilitate the processing of given referents
    → In the present study, the effect of null accent was weak possibly due to the relatively small number of participants (n=25)

  - L+H* speeds up the processing of contrastive referents
    → L+H* creates a bias toward contrastive referents (Ito & Speer, 2008; Watson, Tanenhaus & Gunlogson, 2008)

Discussion: L2 English

► **Production**

   ► Lower level learners do not utilize pitch cues to distinguish given, new, and contrastive referents

   → Lower level learners do not seem to transfer the L1 prosody-discourse mapping (expanded pitch-contrastive) to the prosodic marking of discourse referents (L+H*-contrastive)

   → Emphasis on each word overrides prosodic marking of discourse information?

   ► Upper level learners appear to use pitch to differentiate contrastive vs. given referents

   → This provides a hint that L1-Japanese L2-English learners can acquire new prosody-discourse mappings (null accent-given; L+H*-contrastive(?)) as their proficiency increases

Discussion: L2 English

- **Eye-tracking comprehension**
  - Neither the null accent-given association nor the L+H*-contrastive association emerged in this task

  → Contrary to the results from the intonation naturalness rating task in Takeda, Anderson, Schafer & Schwartz (2015)

- **For future investigation....**
  - Analyze the data with a smaller window size
  - More participants to increase statistical power
  - Reduce the speed of sound stimuli & usse longer interstimulus interval for more processing time & less time pressure for L2 learners

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Duration results
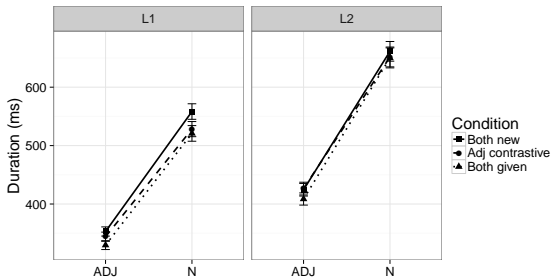
Duration of adjectve region

Figure x:Duration

- ▶ **L1 group**
  - ▶ **Both new > Adj. cont.**
    (b = -9.82, $p < .01$)
  - ▶ **Adj. cont./Both new > Both given**
    (b = 21.87, $p < .001$)
  - ▶ Post-hoc test
    Both new > Adj. cont. (marginal)
    Adj. cont. > Both given
    Both new > Both given

- ▶ **L2 group**
  - ▶ Adj. cont. = Both new
  - ▶ **Adj. cont./Both new > Both given**
    (b = 17.41, $p < .01$)
  - ▶ Post-hoc test
    Adj. cont. = Both new
    Both new > Both given
    Adj. cont. = Both given

- ▶ For L1 group, lengthening of the critical region was most prominent in Both new, followed by Adjective contrastive, then Both given
- ▶ L2 learners use durational cues to mark Both new. vs. Both given

Duration results by proficiency

Duration of adjective region
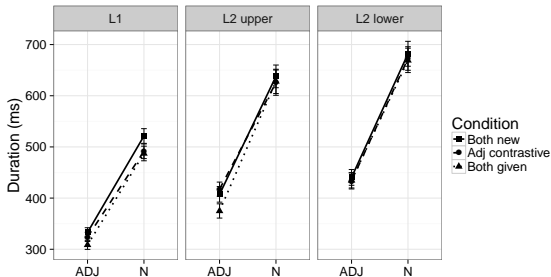
Figure x: Duration by proficiency

▶ **L2 upper group**

  ▶ Adj. cont. = Both new
  ▶ **Adj. cont./Both new > Both given**
     ($b = 20.49$, $p < .05$)
  ▶ Post-hoc test
     Adj. cont. = Both new
   **Both new > Both given**
     Adj. cont. = Both given

▶ **L2 lower group**

  ▶ Both new = Adj. cont.
  ▶ Adj. cont./Both new = Both given
  ▶ Post-hoc test
     Adj. cont. = Both new = Both given

▶ Lower level learners do not distinguish the three types of discourse referents with duration
▶ Upper level learners are able to use durational cues to indicate Both new vs. Both given

L2 results – Looks to Target (by Block)

(green crayon / blue paintbrush) → blue$_{(H* / \emptyset)}$ paintbrush
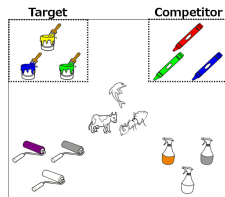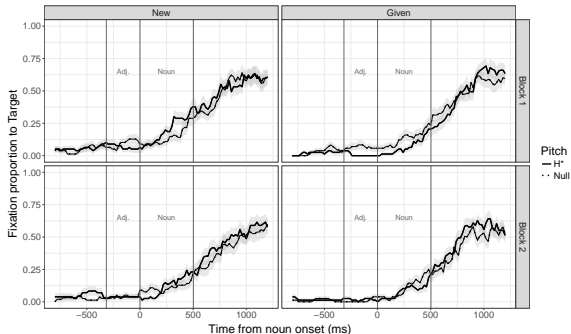
- **Block 1**
  - (Marginally) significant Context effect by subject and item analyses [b = -0.23, p = .08; b = -0.28, $p < .05$]
  - **Marginally significant Context x Accent interaction effect by subject analysis [b = 0.42, p = .08]**

→ L2 learners tend to look at a new object regardless of pitch types
→ **Null accent tends to increase fixations to Target in the Given context in earlier trials**

L2 results – Looks to Target (Block 1 by Proficiency)

(green crayon / blue paintbrush) → blue$_{(H^* / \emptyset)}$ paintbrush
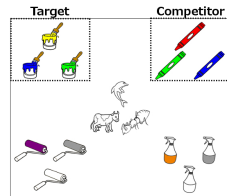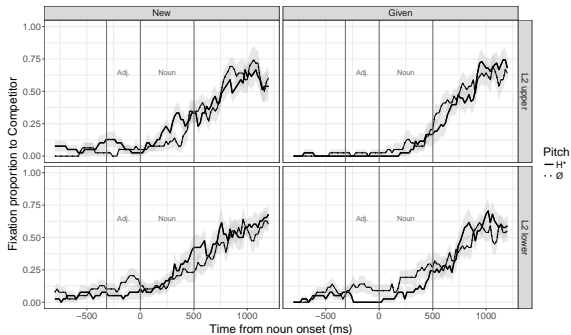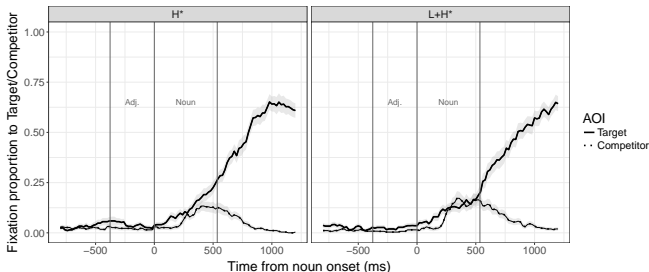

- ▶ **L2 upper group**
  - ▶ Marginally significant Conrexr effect by item analysis [$b = -0.30$, $p = .06$]
- ▶ **No main or interaction effects for L2 lower group**
  - → Context × Pitch interaction disappears due to the small number of data points?

L1 results – Looks to Competitor in New context
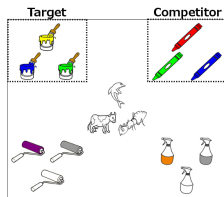
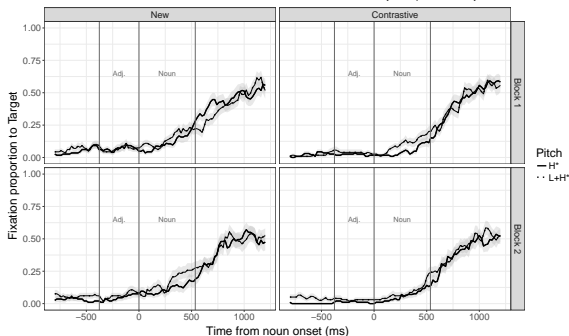green crayon → blue$_{(\text{H* / L+H*})}$ paintbrush
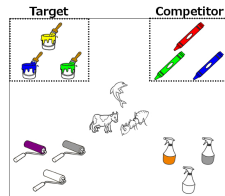
▶ Post-hoc analysis
  -Marginally significant difference between L+H* and H* in Block 1 for New context, by subject analysis [$p = .07$]

  → **L+H* tends to evoke fixations to the incorrect target in the New context especially in earlier trials**

L2 results – Looks to Target (by Block)

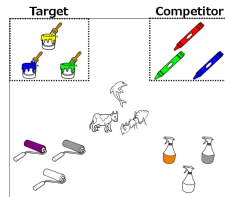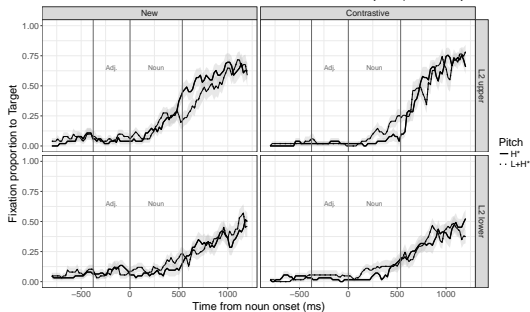(green crayon / green paintbrush) → blue(H* / L+H*) paintbrush

- **Block 1**
  - Main effect of Context by subject & item analyses [$b = -0.22$, $p = .06$; $b = -0.24$, $p < .05$]

→ **Again, L2 learners' preference for a new object**

L2 results – Looks to Target (Block 1 by Proficiency)

(green crayon / green paintbrush) → blue$_{(H* / L+H*)}$ paintbrush

- (Marginally) significant context effect by subject & item analysis for L2 upper group [$b =$ 0.31, $p = .07$; $b = -0.29$, $p < .05$]
- No main or interaction effects for L2 lower group

→ **L2 learners' preference for a new object comes from the upper group**

L2 results – Looks to Competitor in New context

(green crayon / green paintbrush) → blue$_{(H* / L+H*)}$ paintbrush
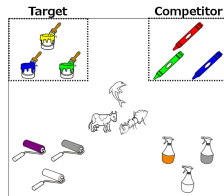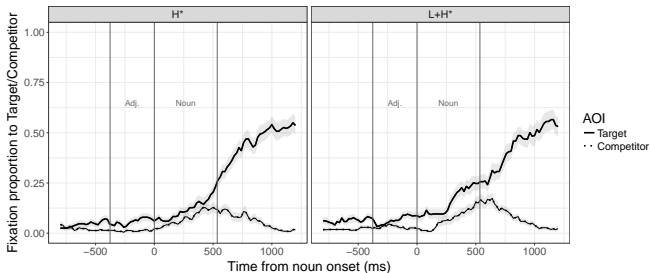
► Post-hoc analysis
-No difference in looks to Competitor between L+H* and H* in the New context

→ L+H* does not trigger garden-path for L2 learners