The Nature and Interaction of Word-Learning Mechanisms Determine How Meanings are Represented

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Word-Learning Mechanisms in Interaction

1) Adults use information from the visual context, the linguistic context, and their world knowledge for sentence comprehension (Altman & Kamide, 1999) & word learning (*learning based on sentence-level constraints*, ***SLCL***, Köhne & Crocker, 2010).

2) Language novices track co-occurring visual referents and spoken words to learn their meanings (*cross-situational word learning,* ***CSWL***, Yu & Smith, 2007).

3) SLCL and CSWL are used **jointly** when they provide **complementary** information (Köhne & Crocker, 2010).

The Nature of Word-Learning Mechanisms

1) CSWL works **bottom-up**, SLCL **top-down**.

2) CSWL: **parallel, probabilistic, incremental** (Vouloumanos, 2008; Yurovsky, Fricker, Yu, & Smith, 2010).

3) SLCL: more **deterministic** (Köhne & Crocker, 2010) - verb cues are directly (and even predictively) used to identify referents.

When SLCL and CSWL provide redundant information (i.e., are independently applicable)…

… Are still both mechanisms applied? Does SLCL block CSWL (or vice versa)?
… How is that related to the nature of SLCL and CSWL?
… How are word meanings based on CSWL and SLCL mentally represented?

Experimental Paradigm & Procedure

German adults learn a mini semi-natural language (based on Indonesian) in four basic phases:

1. **Verb learning**: Participants are familiarized with four restrictive verbs (e.g., eat) and two non-restrictive verbs (e.g. take).

2. **Noun learning**: Visual static scenes & auditory SVO-sentences are presented. Adults are asked to understand the sentences & learn the 16 nouns (96 trials).

Si gadis bermamema/tambamema si zelan.
'The woman will eat/take the ZELAN.'

Each object noun (e.g. *zelan*) has two potential **meanings**
- Low frequency meaning (co-occurrence noun and object across trials: **50%**) - hat
- High frequency meaning (co-occurrence noun and object across trials: **83%**) - carrot

+ each noun is in one of 2 **conditions**
- **R**(estrictive): Noun occurs with restrictive verbs (in some trials): e.g., eat
- **N**(on-restrictive): Noun always occurs with non-restrictive verbs: e.g., take

= Condition R: 83% meaning (carrot) favored by CSWL **AND** SLCL, 50% (hat) *dis*favored by SLCL and *less* favored by CSWL
= Condition N: 83% meaning (carrot) favored by CSWL, 50% (hat) *less* favored

3. **Vocabulary test** ('Click on the object matching the spoken noun.') & confidence rating ('How sure are you about your choice?', 1(not sure)-9(sure)).
Type 1) Depicted: 83% object (carrot), 50% object (hat), 2 distractors (pizza and shirt, each 17%) (16 trials)
Type 2) Depicted: 50% object (hat), associate of the 83% object's category (apple), 2 distractors (jeans, skirt, each 17%) (16 trials)

4. **Vocabulary-test repetition one day later**

Results

Learnings rates (choosing the 83% referent in Type 1): Day1-N 60%, Day1-R 84%, Day2-N 49%, Day2-R 78%

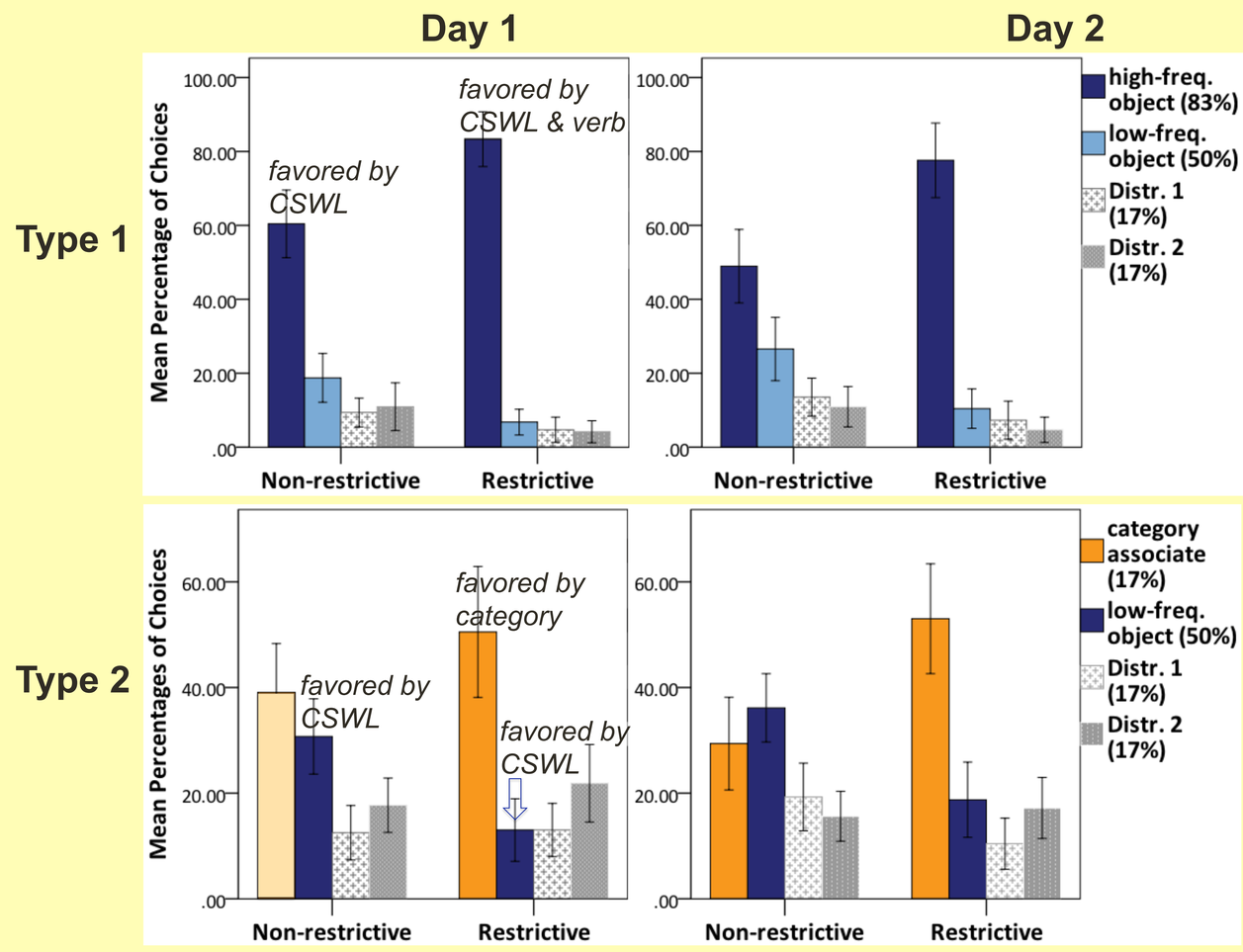
Type 1: In R, learners preferred the 83% referent on both days. In N, the 50% referent got a secondary preference on Day 2.

Type 2: In R, only the category associate was favored, on both days. In N, the associate was favored over the distractors on Day 1 but not Day 2. The 50% referent was favored over the distractors on both days.

> N: fine-grained sensitivity for differences in frequency of co-occurrence (83% vs. 50% vs. 17%) - **CSWL is parallel**

> R: **SLCL** blocked this statistical sensitivity (> **determinism**!) & increases sensitivity for category associations

> **Effect of Day**: While the likelihood of choosing the category associate (Type 2) was stable in R, it decreased in N: mental representation of R-meanings more based on categories



CONCLUSIONS

- CSWL offers a parallel way of learning & initiates probabilistic mental representations of word meanings.
- SLCL works in a more deterministic manner & initiates category-based mental representations of word meanings.
- When CSWL and SLCL are redundantly applicable, learners rely on SLCL while completely ignoring CSWL > economic word-learning strategy.

References
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