The Linking Problem

LSCI 151C/251C

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Linking and the Problem

WHAT IS "LINKING PROBLEM"?

Linking is syntactic knowledge of **verb-arguement interpretation**.

The linking problem is that children *somehow* learn how to **map thematic roles** (like AGENT, PATIENT) to **syntactic positions** (like subject, object).

OKAY, WHY IS IT A PROBLEM?

Children can generalize this knowledge to new verbs even though the **same role** can appear in **different positions** depending on the verb, subject, and object.

Syntatic Frames and Thematic Roles

Linking theories link the **thematic roles** specified by a verb's **lexical semantics** (to the syntactic **argument positions** specified by that verb's **syntactic frame (**Subject, object, etc.).

Agent: the *initiator*, the *causer* or *doer* of the action.

Patient: the entity that undergoes, the action, moved, experienced, or perceived

FOR EXAMPLE:

The Penguin — breaks — the ice

The penguin is in the **subject position** → the child realizes that the penguin is the agent

break = the verb that **"links"** the **agent** and **patient**

The ice is in the **object position** → the child realizes that the ice is the patient

The Power of Linking Patterns

Once a **child identifies linking patterns**, children can group similar verbs, enabling generalizations about their properties. This helps predict their syntactic profile (word order and arguments) and interpretation profile (meaning with arguments).

FOR EXAMPLE:

The girl  blicked  the kitten

We can associate new words, like “blick,” with actions, such as the girl “blicking” the kitten. It appears that children are learning linking patterns at a more abstract level, as they can generalize these patterns from one verb to another (Pearl & Sprouse 2019).

Challenges

A verb class can involve many linking behaviors.

SUBJECT-RAISING VERBS

Example: 'Lindy seemed/appeared to hug the kitten,.'

verbs with “**subject-raising**” behavior like appear and seem allow their **subject** to **not** have a **thematic role.**

Lindy is not a “seemer” or an “appearer”, but rather a kitten-hugger.

PASSIVIZABLE

Example: 'The toy kitten **was** hugged/broken by Lindy.'

Verbs with **passivizable** behavior allow their **subject** to be a **PATIENT** in the passive construction

Hugging or breaking is happening to the toy kitten not Lindy.

UNACCUSATIVE

Example: ‘The toy kitten fell/broke’

Verbs with “**unaccusative**” behavior like fall and break have a **PATIENT** in the **subject** position

Falling or breaking is happening to the toy kitten

Conceptual & Syntactic cues

Examples: ‘The toy kitten broke’ vs. ‘The toy kitten was broken by Lindy’

ANIMACY

Inanimate subjects + non-finite complement tend to be grouped as a subject-raising verb.

Children would realize that **the toy kitten is is innanimate**. It is not the thing doing the breaking but rather the thing that broke.

CONTEXT

Break appears in an **unaccusative context** of the form Noun-Phrase Verb

Break appears in the **passive context** ‘Noun-Phrase “*was*” Verb Preposition Noun-Phrase.‘

DISTRIBUTION

A child would observe that both utterances include **two instances of PATIENT** in the subject position (The toy kitten) and **one instance of AGENT** in the prepositional phrase (Lindy in the passive utterance).

Two Theories of Linking

Pearl and Sprouse (2019) examined how children **learn verb classes** using conceptual and syntaxtic cues through a computational cognitive model. They examined two key theories: the **Uniformity of Theta Assignment Hypothesis (UTAH**) and the **relativized UTAH (rUTAH**).

Uniformity of Theta Assignment

The mapping is **invariant** across all verb classes.

Simple **fixed mapping**:
Agent = subject
Object = patient

Toy kitten = agent, assumes toy kitten is breaking Lindy

relativized UTAH (rUTAH).

Proposes that maping roles are linked to syntactic positions **relative** to the thematic roles.

Mappped based on **ordering**:
e.g. AGENT > PATIENT

Toy kitten → patient after thematic roles are assigned even though it appears in the subject position

Immplimenting the Theory

Pearl and Sprouse (2021) test whether the linking patterns children observe in their input are best explained by: UTAH (simple, fixed mapping) or rUTAH (more complex, verb-class-sensitive mapping). They did this by comparing behavioral data to modeled outputs trained on both distributional and contextual cues.

INTEGRATION

The model integrates three types of information:
Animacy (non-linguistic cue)
Syntactic contexts (syntactic cue)
Links semantic-syntactic mapping)

These are combined using a Bayesian inference learning mechanism modeled child was using (UTAH vs rUTAH, not having linking knowledge vs. having it already).

MODEL INPUT

Realistic sample of speech directed at three-, four-, and five-year-old children.

Acquisitional Intake: Thematic categories for syntactic positions (e.g., PATIENT-ish → subject for UTAH; HIGHEST → subject for rUTAH)

OUTPUT

The child learns verb classes at various ages, with successful learning aligning with observed knowledge in real children.

The Tolerance Principle is used to evaluate which links are strong enough to generalize and which complex linking patterns are effective based on children's acquisition.

FINDINGS

Thematic representation use changes with age:
3-year-olds: best matched by rUTAH
4-year-olds: best matched by UTAH
5-year-olds: matched by either

Only 5-year-olds' verb classes matched by children with linking knowledge.

Interpretation

Key Findings: Advantage of rUTAH

Advantage 1: Children learning rUTAH can more easily generate complex linking patterns from simpler individual links.

Advantage 2: Only rUTAH, not UTAH, can be successfully generalized from child-directed input using the Tolerance Principle.

Conclusion:

- A child exposed to realistic English input and applying the Tolerance Principle is more likely to adopt rUTAH.
- By around age five, children may have developed a relativized linking theory like rUTAH to solve the linking problem.

Thanks guys