

THE BASIC ISSUES OF MODELACT PROJECT

ALESSANDRO PANUNZI

LABLITA - UNIVERSITY OF FLORENCE

MODELACT Project



Focus on human action categorization

- Starting point: linguistic categorization of action → action verbs

Multidisciplinary approach

- Semantics, language acquisition, sign languages, computational linguistics, robotics

Linguistic and cognitive categorization are not equivalent

- Many verbs can refer to different types of action
- The same action can be predicated by different verbs

Lexical encoding of action verbs differ across languages

- Translation of action verbs is problematic

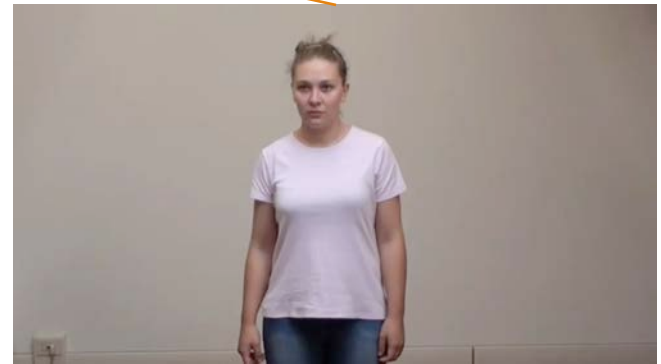
Similarity judgment

Do these scenes represent the same action?

EN: to cross



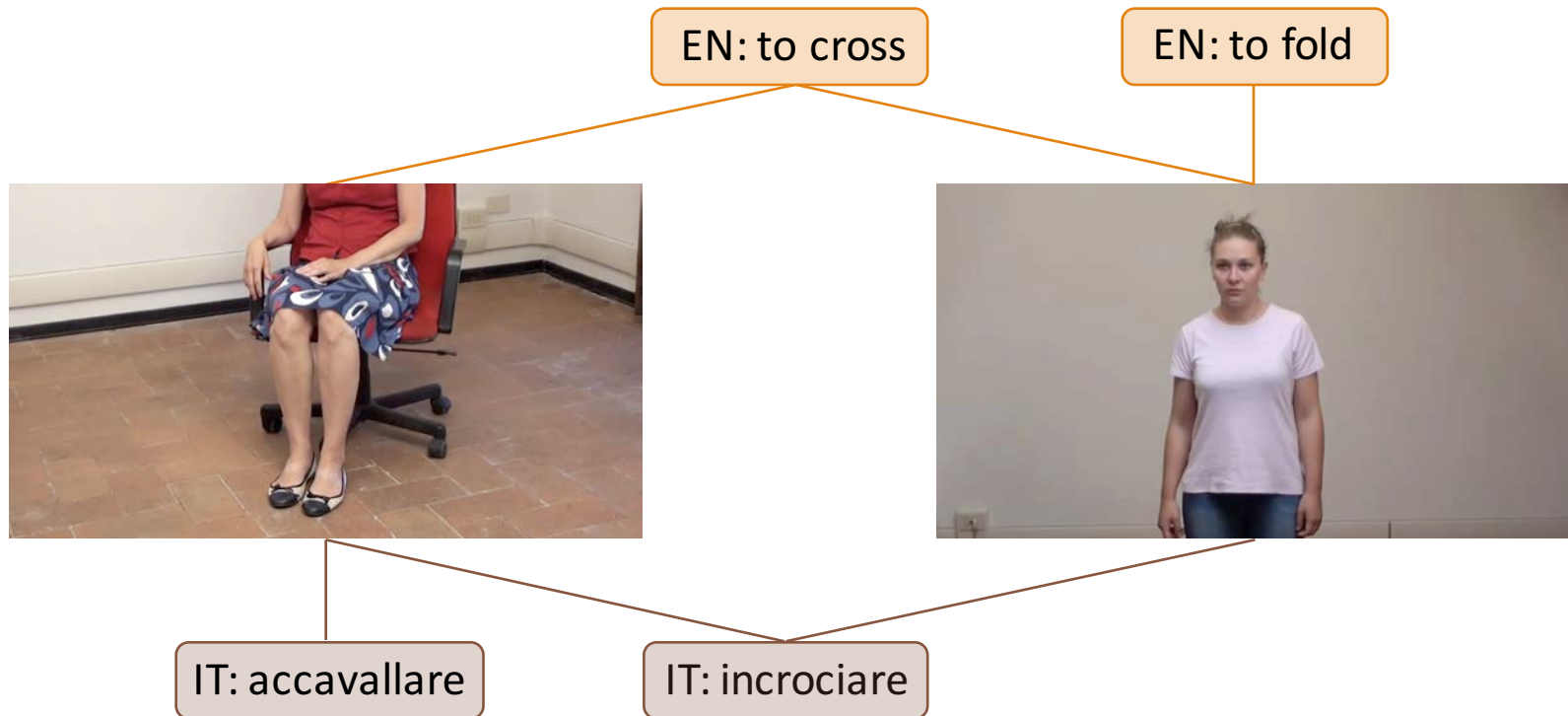
IT: attraversare



IT: incrociare

Similarity judgment

Do these scenes represent the same action?



IMAGACT Project



This is not a special case, but rather the most common case when we deal with high-frequency action verbs

- General action verbs

IMAGACT Ontology (www.imagact.it)

- Corpus-based language ontology covering the set of actions most frequently referred to in everyday language
- 1010 distinct action concepts identified through the analysis of English and Italian spoken corpora (more than 500 verbs for each language)
- Each concept has been represented by means of a prototypical scene, either animated (3D) or filmed
- The action concepts in IMAGACT have already been extended to Chinese and Spanish (1st release)
- It can be easily extended to any language: more than 15 languages currently in IMAGACT4ALL → **afternoon panel!**

MODELACT Consortium: University of Florence



Coordinator: Alessandro Panunzi

- LABLITA – Italian Linguistic Laboratory

Definition of a model for action categorization that is able to

- Adequately represent the linguistic vs. cognitive mismatches
- Adequately represent the different categorization across languages
- Translation relations

Relations between scenes and action types

From the identification of action concepts to their definition

- Features that allow action categorization within the pragmatic continuum
- Semantic properties that allow a single verb to refer to different action types

ISTC-CNR (Rome)



Coordinator: Elena Tomasuolo

- LACAM – Language and Communication Across Modality

Acquisition (comprehension and production) of action verbs, with respect to the different action types of each lemma

Comparison between Italian and LIS (Italian Sign Language)

- Hearing and deaf children
- Different ages

Order of acquisition for action verbs

Comparing the acquisition of action vs. non-action verbs

Frequency of action verbs in adult input to children

ILC-CNR (Pisa)



Coordinator: Irene Russo

Automatic disambiguation of action verbs

- Different action types in IMAGACT Ontology
- Cf. Word Sense Disambiguation tasks with WordNet(s)
- Role of the object (and affordances)
- Multimodal and distributional approaches

Testing in human-robot interaction

- Giving orders to robots in natural language
- Collaboration with Sant'Anna School of Advanced Studies - Pisa

University of Siena



Coordinator: Monica Malvezzi

- SIRSLab – Siena Robotics and Systems Lab

Analyze the actions in the IMAGACT Ontology from the robotic point of view

- Actions involving a hand and an arm
- Active interaction with object (moving, rotating, transforming it)
- Actions with a smooth and controllable dynamics (no impulsive actions)
- E.g. *to take, to turn*

Hand tracking: tools and systems to capture hand and arm motion

Mechanical and mathematical representation of hand/arm system involved in these actions

Basic concepts

Extensional variation of general action verbs

- Primary variation
- Marked (secondary) variation

Different levels of action categorization

- Linguistic categorization through the verb lexicon
- Cognitive categorization through similarity (non linguistic) judgments

Local equivalence

- Co-extensionality of two predicates to the same action type

Dimensions of (primary) variation

- Vertical variation
- Horizontal variation

Primary variation

Focus on the primary variation of action verbs

- Physical actions representative of the semantic core of the verb

Marked (secondary) variation

- Action verbs are widely used in metaphors and phraseology
- About 40-50% of occurrences in IMAGACT corpora
- E.g. *a thought crossed John's mind*

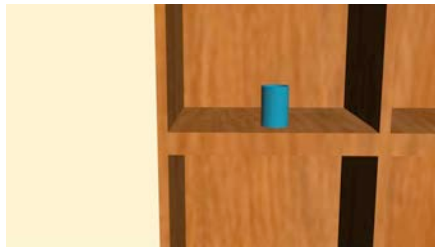
Judgment (semantic competence): a use is primary if

- It refers to a physical action
- It can be pointed out to give an ostensive definition of a verb

look at that: this action and similar events are what we intend with V

→ cf. *Gianni prende l'autobus / John takes the bus*

Prendere



Local equivalence

Local equivalence is NOT synonymy

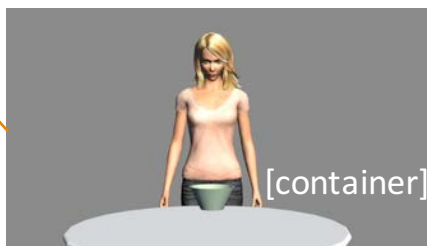
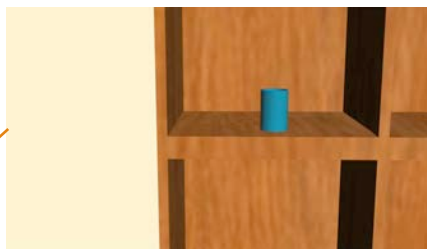
- Equivalence in reference, co-extensionality
- Meaning vs. reference

Two (or more) verbs with different meaning can refer to the same action

- Different ways to refer to the same event
- May involve different points of view (e.g. intentions or goals) on an action

In the IMAGACT Ontology the local equivalence of two verbs is represented by their linking to the same prototypical scene

prendere

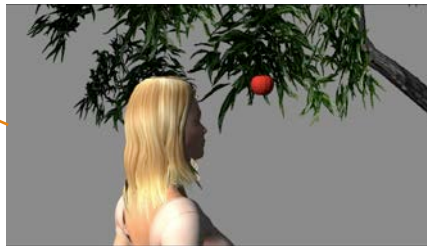
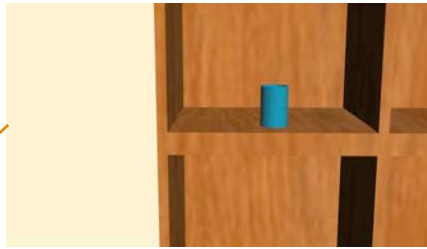


raccogliere

cogliere

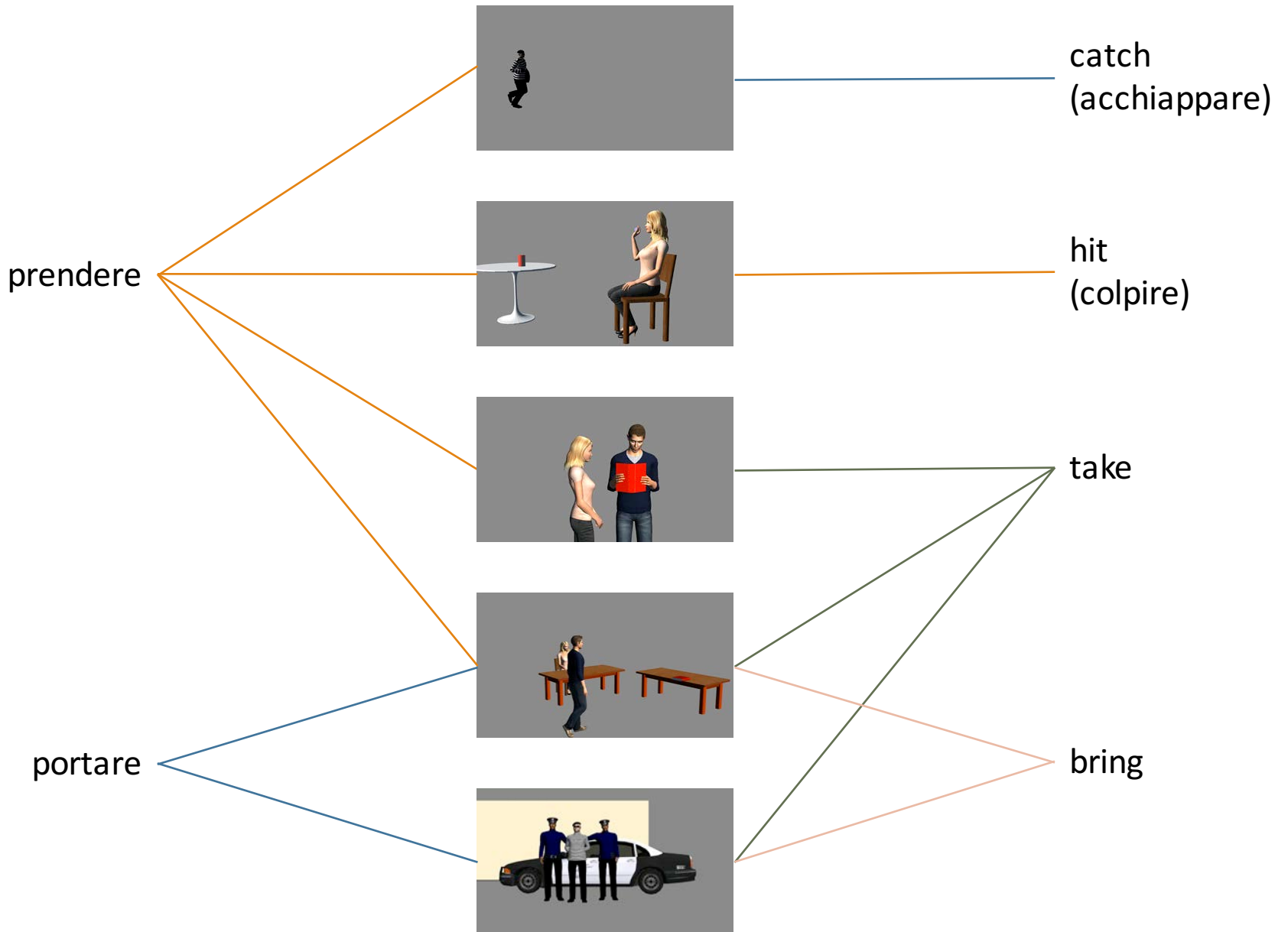
estrarre

prendere



take



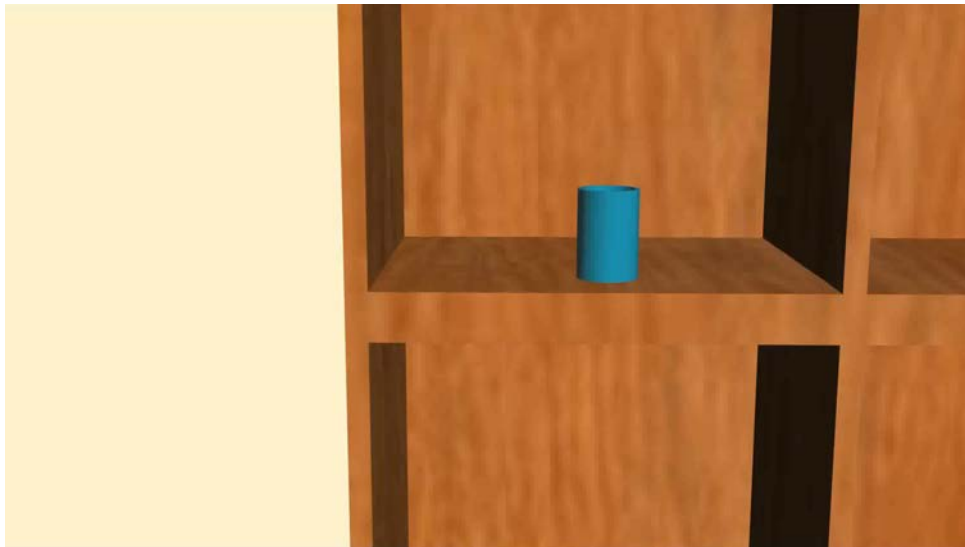


Local equivalence and conceptualizations

Local equivalence is NOT synonymy

Differences in event conceptualization

- In term of spatial configuration, relation with the agent, goal of the action



prendere

- Location \rightarrow agent
- Taking possession of theme
- The object becomes “available” to the agent

togliere

- Location \rightarrow removal
- Relation between the figure and the ground
- The object “disappears”

Dimensions of variation

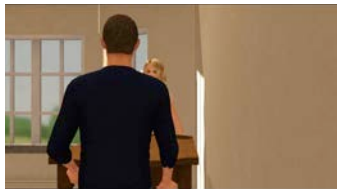
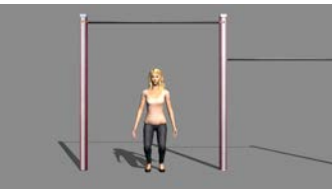
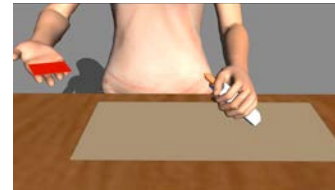
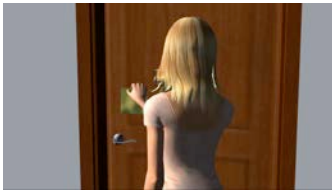
Vertical variation of a verb

- Identifies the action categories to which a verb can refer to
- Different action schemas, different conceptualizations

Horizontal variation of a concept (action type)

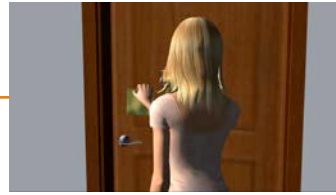
- **Motivated by local equivalences with more specific verbs**
- An action type is a productive category
- It extends on different singular events
- Creation of “prototype families”

Attaccare

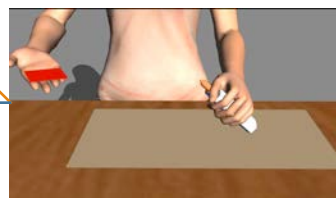


[instrument]

appiccicare



incollare
glue



appuntare
pin
tack



inchiodare
nail



attaccare
[constraint] related to a ground

stick

appendere



suspend



affiggere



appoggiare
lay

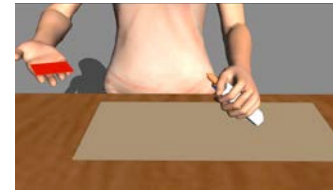


attaccare
[constraint] related to gravity

hang



Type 1



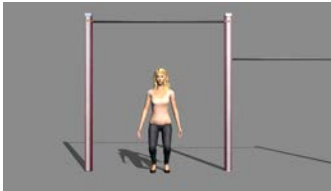
Type 2



Type 3



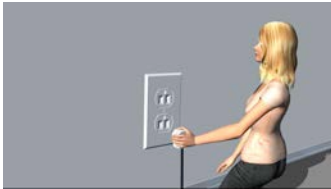
Type 4



Type 5



Type 6



Conclusions...

... in the form of an introduction

Action verbs are able to extend to actions with different cognitive schemas and prominences

- It varies across languages and across lemmas

Different verbs categorize actions starting from different perspectives

We know from dozens of studies that the representation of action verbs is activated in the premotor and motor system in the brain

- Hauk, Johnsrude, & Pulvermüller 2004, Tettamanti *et al.* 2005; Aziz-Zadeh, Wilson, Rizzolatti, & Iacoboni 2006, Rueschemeyer, Brass & Friederici 2007 (among many others)

... and some questions

Is there a common ground in the neural representations of the different actions to which a general verb can refer to, or different representations are activated case by case, with respect to the specific referred action?

- *crossing the street vs. crossing the arms vs. crossing the legs*
- *prendere il bicchiere vs. prendere la palla al volo vs. prendere il bersaglio*

How similar are the neural representations of two different conceptualizations of the same action?

- E.g. two sentences with different verbs (which have different meanings and different perspectives) to refer to the same event
- *prendere la tazza vs. togliere la tazza*

Neural correlates of the concepts of primary variation and local equivalence

... and some questions

How this vary cross-linguistically?

- *prendere* vs. *take* (vs. *catch* and *hit*)
- Cases from Chinese → IMAGACT panel

Typological variation of action verbs with respect to the neural functions related to action categorization

- Biological vs. cultural variation in the brain processing of action sentences

Neural correlates of the cross-linguistic variation of action categorization

IMAGACT Ontology and MODELACT Project provide an extensive test set that can be exploited for answering these questions