Evidence for subunit structure when gesturers communicate in/transitive actions

Chuck Bradley • bradley4@purdue.edu
Linguistics Program, Purdue University

BACKGROUND

CLAIM:

- Pantomime (*silent gesture*) is 'holistic'; represents an event globally without internal structure [1,2]

COUNTERCLAIM:

- Pantomime is 'language-like,' 'spontaneous sign'; may contain subunits amenable to linguistic analysis [3,4]
  a. Accounts for similarities between pantomimes
  b. 'Holistic' approach not useful in describing 'soft' constraints on possible representations

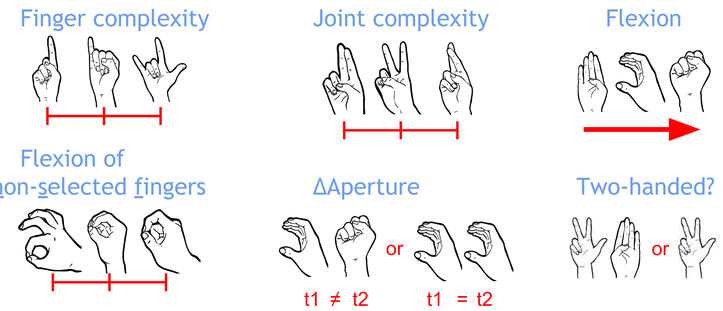
PREVIOUS WORK:

- Agents, themes represented via iconic handshapes in sign languages [5]
- Gesturers also manipulate handshape in non/agentive events (e.g., *put-at* vs. *be-at*) [6,7], but this may not generalize. Authors:
  a. Only looked at two handshape parameters (Finger & Joint complexity; see below)
  b. Only looked at two predicates (i.e., *put-at* and *be-at*)
  c. Only looked at *proportion* of parameters in each class of predicate
  d. THUS: total information available in the signal **underestimated**, the importance of a select few features **overestimated**

CURRENT STUDY

EXPANSION:

- 72 unique events (e.g., *hitting, breaking, dropping; deflating, moving, walking*)
- Six handshape parameters



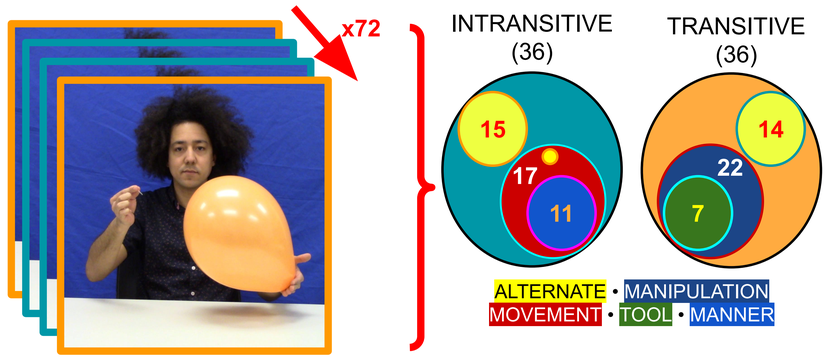
- Moves beyond averages
- Novel algorithm produces item-by-item transitivity predictions; more faithfully emulates sender's task in communicating transitivity

HYPOTHESES:

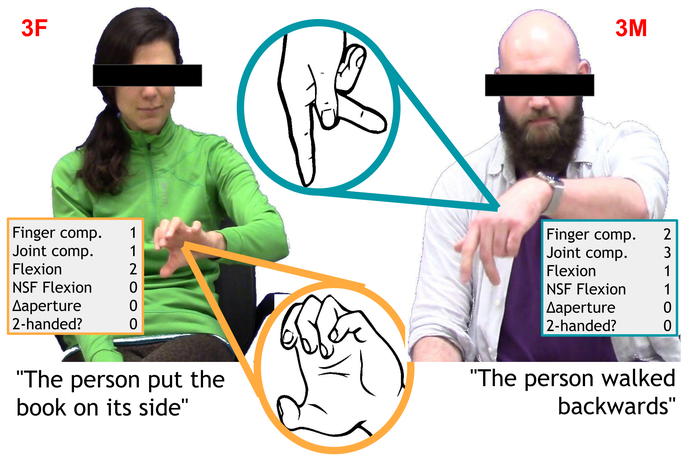
- Transitivity distinctions are manifest in pantomime
- Such are predicted (encoded) by discrete handshape parameters
  a. Argues for compositionality of pantomime w.r.t. transitivity coding
- Distinctions manifest more strongly in certain semantic classes
  a. +++ Events of tool-use and manner
  b. ++ Events of manipulation and movement
  c. + Causative/ inchoative alternation events (*Alternating events*)

METHOD

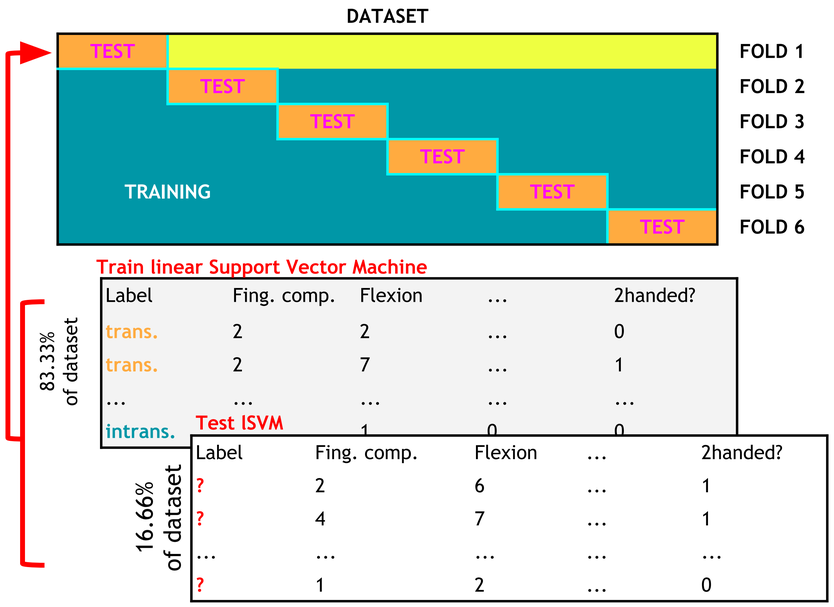
1. 72 videos of in/transitive actions, broken into subclasses



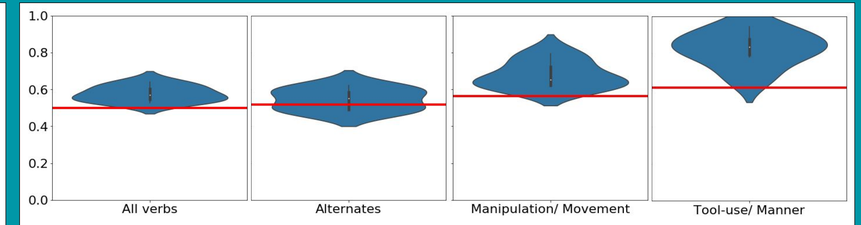
2. 6 participants (3F) pantomimed actions; productions annotated for 6 visual features; total (6 x 72 =) 432 pantomimes.



3. Data split into 6 partitions randomly; equal proportion of in/transitive items
4. Each fold, train linear support vector machine on 5/6 partitions, test on 6th
5. lSVM predicts transitivity class of each unseen pantomime, item-by-item
6. Generates a prediction accuracy score; repeat 6 times, s.t. every partition serves as test set once; report average accuracy



RESULTS



Analysis	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Fold 6	Mean	MCC
All	54.17	59.72	**63.89***	56.94	54.17	**65.28****	**59.03*****	0.1808
Alternates	51.72	62.07	48.28	58.62	55.17	48.28	54.02	0.0902
Manip/Mvmt	**76.92****	64.10	**71.79***	53.85	69.23	66.67	**67.09*****	0.3831
Tool/Manner	**94.44****	**88.89***	77.78	**83.33***	66.67	**83.33***	**82.41*****	0.6316

Fig. 1: Per-Fold classifier accuracies (in %) for analyses of alternating verbs, verbs of manipulation and movement, and verbs of tool use and manner of motion. Mean accuracy is reported in the penultimate column. Overall quality of each analysis is reported in the final column, via the Matthew's Correlation Coefficient (MCC). MCC is interpreted like other correlation coefficients. * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

	ΔAperture	2-handed?	Fing. comp.	Flexion	NSF flexion
All verbs		1.0961 (±0.61)	0.1872 (±0.12)	0.4188 (± 0.27)	
Alternates	0.4448 (±0.31)	1.3052 (±0.49)			-0.3632(±0.17)
Manip/Mvmt		0.7356 (±0.31)	0.3203 (±0.14)	0.8030 (±0.14)	0.1803 (±0.11)
Tool/Manner		0.4959 (±0.30)	0.477 (±0.26)	1.1129 (±0.16)	0.1217 (±0.16)

Tab. 1: Average model coefficients for the 3 - 4 best predictors. Positive values (green) correspond with 'transitive' labels; negative (blue) with 'intransitive' labels. Numbers in brackets are 95% CIs. Coefs interpreted relative to other coefs w/in an analysis.

INTERPRETATION, NEXT STEPS

FINDINGS:

- Transitivity information is available in pantomimed signal
- Information available more faithfully in *certain* semantic categories: Manipulation/ movement and Tool-use/ Manner events.
- Four features (2-handed?, Flexion, NSF Flexion and Finger Complexity) accurately predict transitivity class
  a. BUT: Flexion and 2-handed? most reliable

INTERPRETATIONS:

- Indicates that pantomime has internal structure, and that this structure manifests in transitivity distinctions
  a. Counter 'holistic' accounts of pantomime's structure
  b. May generalize to co-speech gesture
- For all significant analyses, transitives were more marked than intransitives
  a. Suggests that their internal structure is similarly more complex (e.g., involve more projections)
  b. Consistent with theoretical and typological accounts of encoding of causation.

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[7] Brentari, D., Coppola, M., Cho, P. W., & A. Senghas. 2017. Handshape complexity as a precursor to phonology: variation, emergence, and acquisition. Language Acquisition, 24(4)

NICE TO MEET YOU: