

Motivation for our Study: The Puzzle of Alternating Verbs

Alternating verbs in English such as the ones shown in (1) are the subject of some controversy in the theoretical literature.

- (1) a. The stick broke.
 b. John broke the stick

●According to Levin and Rappaport Hovav (1995), these are 'externally caused' verbs, which allow the systematic suppression of CAUSE in their lexical representation to create the intransitive from the transitive alternant.

●According to Ramchand (2008), they are unaccusatives that systematically undergo causativization constructionally to create a transitive from an intransitive.

Can we use other methodologies, such as psycholinguistic testing to resolve the representational and architectural questions surrounding these pairs?

Previous Work on the Processing Impact of Verbs of Different Classes

We assume that parsing is guided by general mechanisms, as well as by knowledge contributed by the comprehender concerning (i) discourse and contextual factors (ii) the frequencies of certain structures (iii) **semantic and syntactic restrictions imposed by specific lexical items**.

However, it is still an open question whether verbal subcategorization information influences the very earliest automatized stages of the initial parse (See Staub 2007 for overview).

●**Effects of Transitivity:** Even though there is a strong documented tendency for the parser to interpret a Noun Phrase following a verb as a direct object, Staub (2007) found that unambiguously intransitive verbs did not provoke this response, arguing that intransitivity information was guiding the initial parse. However, in tests with verbs with optional transitivity of various degrees, even verbs with low frequency transitive alternants behaved as if they were 'expecting' a following NP object, arguing that general mechanisms were overriding lexical information (van Gompel and Pickering 2001).

●**Event Structure Complexity?:** McKoon and Macfarland (2002) reported that 'externally caused' verbs like *break*, *melt* produced longer reading times than internally caused intransitives like *bloom*, *glow* on a lexical decision task, as well as timed grammaticality judgement tasks, arguing for a representational difference between the two types of verb, possibly in terms of event complexity. Thompson (2003) similarly found that unaccusatives are more difficult to access in verbal naming tasks than unergatives for agrammatical aphasics, and unaccusatives are rarely spontaneously produced.

Our Study: Lexical Properties Tested

- Transitivity vs. Intransitivity
- Flexibility vs. Rigidity
- Causative Alternations as opposed to transitive-intransitive optionality due to other factors

Importantly, verbs that alternate like melt have never really been tested for processing behaviours alongside either obligatorily transitive or obligatorily intransitive verbs respectively, because of the difficulty in constructing minimal pairs.

The Experiment

The experiment consisted of a 'go/no go' test, for testing integrating verbs of different types into different syntactic frames (G. Mauener and Carlson 1995).

Subjects were instructed that they would be reading a list of sentences, and told that some of them were possible sentences of English and some not.

They then read the sentences, self paced, word by word, having been instructed to press an 'abort' button when they decided that a sentence was bad/not possible.

The Core Test Sentences

The novelty of the experimental paradigm, and the reason we were able to compare verbs with different transitivity preferences against each other directly as exact minimal pairs in a structural integration task, was that the crucial test items consisted of the clausal complement frame where *all* the test verbs were ungrammatical.

- (2) The group bragged that Molly was the tallest. (CP-taking verb)
 *The team weakened that Martin was a student. (a-class)
 *The group sewed that Robert was a musician. (aa-class)
 *The committee thrived that Susan wrote the article. (i-class)
 *The company punished that Fiona was a teacher. (t-class)

Our Verb Classes

strictly transitive verbs (t),
 strictly intransitive verbs (i),
 verbs of unstable valency due to causative-inchoative alternation (break/melt type verbs) (a),
 verbs of unstable valency due to object drop (aa)

We had 9 verbs in each class, which were matched for frequency (log frequency from Baayen et al.) and word length.

The aa verb class and the a verb class were also matched for frequency of the transitive vs. the intransitive alternant, based on corpus counts for the first 200 relevant hits in the British National Corpus.

T (LogFreq)	I (LogFreq)	A (LogFreq)	Trans %	A2 (LogFreq)	Trans %
1. destroy (9.77)	compete (9.5)	expand (9.45)	.44	survive (9.51)	.36
2. punish (8.11)	vanish (7.24)	heal (8.37)	.58	recover (8.8)	.61
3. seduce (6.3)	grovel (6.31)	topple (5.57)	.20	shoplift (3.0)	.20
4. betray (6.65)	hover (6.59)	unfold (6.37)	.57	inhale (6.75)	.63
5. strangle (6.15)	linger (6.37)	widen (6.44)	.66	bathe (6.51)	.65
6. seize (7.56)	shudder (7.48)	shatter (7.78)	.53	sew (7.18)	.55
7. hinder (6.81)	stumble (7.03)	ferment (6.21)	.49	knit (7.01)	.76
8. injure (7.11)	thrive (7.25)	weaken (7.11)	.84	navigate (7.5)	.73
9. harass (7.88)	wander (7.83)	melt (7.93)	.45	relax (8.68)	.45

Experimental Design

Overall Design

-Three test sets were constructed, and each informant only did one test set. 3 Verbs from each verb class (12 in total, all ungrammatical) were included in each test set in the CP test frame, as well as 12 grammatical sentences with regular clause-taking verbs for balance.

-The test material also included all the test verbs placed in regular transitive, and intransitive frames as fillers.

-Each data set was balanced for frame type and proportion of grammatical sentences.

-No test set used the same actual verb more than once.

Choice of Grammatical Subject

The noun phrases in subject position were chosen from a set of just eight animate common nouns, which were chosen to be very boring, and technically ambiguous between an animate reading and a more abstract inanimate reading, like *the group*. This was because we did not want to bias the sentences in advance, and we wanted all of the verbs in our set to have possible grammatical continuations with one of these subjects.

In a separate off-line pre-test survey, we tested the relatedness scores of our chosen subjects our test verbs, and we discarded those with extreme scores.

Seventy-two English speaking undergraduates from Edinburgh University were tested, seven were discarded afterwards on the basis of their background information (late learners of English).

Verb Reading Time

Up to Word 3, the only difference between the test sentences and all the fillers is the choice of subject paired with the verb.

The team weakened that Martin was a student
 w1 w2 w3 w4 w5 w6 w7 w8

t aa i a
 625.54 659.52 660.03 683.15

A one-way analysis of means (not assuming equal variances), gives no significant overall effect of verb class:

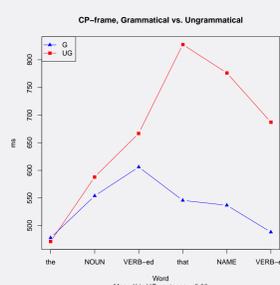
We also did not find any correlation between verb reading time and verb frequency, percentage transitivity, or length of the verb. We conclude that our materials were well balanced and that there is no effect of verb class up to this point.

Grammatical vs. Ungrammatical CP-Frame

Our basic methodology succeeded in producing an effect at the position of Word4 (the complementizer).

At Word 4 (the complementizer), *all* the ungrammatical sentences gave a significant spike in reading times, where the corresponding grammatical verb sentences showed a fall in reading time, showing that the presence of the *that* was causing problems of integration/processing for all of the non-CP taking verbs.

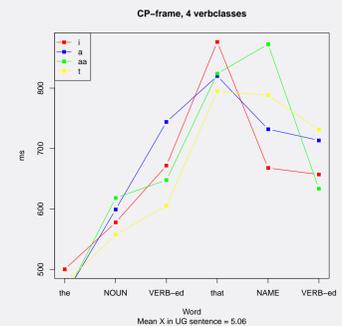
Figure : Time Course of Grammatical vs. Ungrammatical CP Sentences



Time Course by Verb Class

All the test verbs showed a spike in reading time at word4, but time to reject as dependent variable showed **no significant effects** between classes.

Figure : CP Frame Time Course: Ungrammatical t, aa, a and i sentences

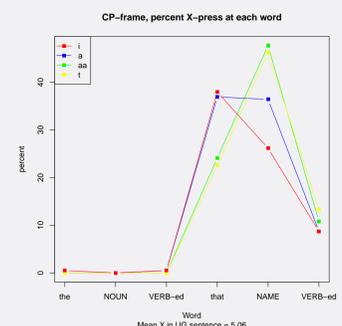


Average Word to Reject

The average word at which the sentence was rejected was significant by verb class: rejection in t, aa, conditions was 0.14 later than i, a conditions on average (t=2.04, mixed effects analysis). There were no significant differences between i and a, or between t and aa

The following visualization gives the percentage rejection rates for each word for the different verb classes. Our dependent variable of average word to reject showed that rejection was indeed significantly earlier for the i/a class than for the t/aa class.

Figure : Abort-X Press Percentage By Verb Class



Summary Box: Verb Class Matters!

●In a Go-NoGo reading experiment, *Transitive and Object Drop verbs* behaved alike with respect to their delay in rejecting ungrammatical CP frame sentences. *Intransitive and alternating Causative-inchoative verbs* showed no such delay and were non-distinct from each other.

●Even when controlled for frequency, and frequency of transitive alternant in a corpus (BNC), object drop verbs and causative-inchoative alternating verbs behaved statistically reliably differently, showing that probabilities in external distribution are not a stand-in for lexical representations.

●Causative-Inchoative Alternating verbs in English patterned like *intransitives* with respect to the effect of their lexical subcategorization information, contra lexicalist analyses like Levin and Rappaport Hovav (1995).

References

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