

CMAP LINKING PHRASE CONSTRAINT FOR THE STRUCTURAL NARROWING OF CONSTRUCTIVIST SECOND LANGUAGE TASKS

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Abstract. In constructivist second language (L2) learning environments¹, particularly in relatively teacher-remote situations such as those involving Learning Management Systems (LMS), task performance freedom can be an obstacle to the achievement of specific educational objectives. This paper presents an example of task narrowing achieved by Cmap² interface related task design.

The relations represented by Cmap links are defined by linking phrases, so in L2 task involving mapping, by constraining the content of the linking phrases it is possible to constrain learner behavior towards more articulate expression, while still retaining a beneficial degree of task performance freedom. Such constraint can push the learner to very specific language structure behaviors, e.g. forced articulation at the argument level of discourse.

This purposeful constraining of task is illustrated by the author's work with the informal technical academic English register (used for example in science magazines and presentation scripts). This paper presents the process of the author's adaptation of Cmaps and CmapTools for L2 learner analysis of technical text and for the subsequent writing of technical text, using Cmaps for the framing of argument analysis. The approach described here provides the technical academic writing (TAW) learner with a graphical, text-reduced mapping that constitutes a view of how the technical academic genres are constructed, and how they function as carriers of meaning. In conclusion, questions are framed for the development and consolidation of this approach.

1 Introduction

The entry level second language writer of technical academic English is performing a number of cognitive activities simultaneously: recalling lexical units, remembering appropriate register, attending to sentence word order, and orchestrating rhetorical structure and readability. Compounded by lack of confidence in decoding the wording of problems, this imposes considerable cognitive load (Chandler & Sweller, 1992). Maps can support and/or confirm the learner's comprehension of task input language, and can motivate problem solving, thus backgrounding language concerns (Dansereau, 2005). Argument maps serve to clarify the line of argument. Knowledge structure maps (following Mohan, 1986) keep learner attention on the information aspect (rather than the rhetorical) of task, even during learner composition.

The following is an outline of the design process used by the author to arrive at a constrained concept mapping tool for learner use in text analysis and composition. The process consists of three main decisions:

1. choice of map type;
2. choice of text genre for writing analysis samples; and
3. choice of the set of text labels for map links.

The aim of this design process is to create tasks and devices³ that aid the TAW (technical academic writing³) learner in perceiving information structures: argument structure, knowledge structure (following Mohan (1986) and Hunter (2002)) and message type (central message, background information).

	Central message	Background information
Argument layer	target content	discard
Knowledge structure layer	avoid	discard

Figure 1. Target structure for text analysis by TAW learners.

¹ Constructivist theory prescribes learning environments that afford learners the freedom to make inferences, discoveries and conclusions, and assume that this will lead to optimal learning outcomes (Jonassen et al., 2006).

² Cmaps are node-link maps whose link relations are indicated by linking phrases (text labels). Cañas, A. J., & Novak, J.D. (2006)

³ Technical academic writing (TAW) is defined here as the science and engineering subset of English for Academic Purposes (EAP), which is the study of the learning of academic writing by second language users of the target language (usually English).

2 Instructional design

The objective of the design process reported here is to clarify the layers of text structure for the technical academic writing (TAW) learner. TAW, the writing of technical academic papers by second language writers, is formulaic: the rhetorical schema is prescribed by academic journals and by the research community. It is also formulaic in that although a logical argument underlies the discourse of the paper, the fashion in recent decades is to leave the argument in technical academic writing implicit. In order to lead the TAW learner to successful mastery of the analytical and composition skills, it is necessary to clarify for the learner that technical academic text success is governed by a number of non-grammar issues, primarily:

1. rhetorical moves vs information units,
2. rhetorical distance (cf. register) (Moffett, 1992),
3. degree of abstraction (cf. argument-information-lexical unit) and
4. readability (Gopen & Swan, 1990).

2.1 Design decision 1: map type

A cursory survey of the concept mapping methods now in general use reveals three main types of text mapping which may be used to reduce such cognitive load:

1. association type dyadic,
2. branching type, and
3. textured-link dyadic type.

Association type dyadic maps consist of nodes joined by lines which indicate the existence of some (unspecified) association in the mapper's mind. Such 'mind maps' are used primarily for brainstorming, but they do not lend themselves to articulate representation of structured discourse such as argument, debate or scientific description.

Branching maps are similar to dyadic mind maps in structure and degree of articulation of concept-concept relations, but the tendency to cluster concepts around a central concept gives the impression of symbolizing only lists and classification (attribute groups) and not the broader range including either argumentation moves (e.g. evidence, background, support, antithesis) or knowledge structures (Mohan, 1986) (e.g. classification, comparison, sequence, cause-effect) or both.

Textured-link dyadic maps specify relations between concepts (nodes), and as such represent can represent information structures at two levels of abstraction: argument structure and knowledge structures, as shown in Figure 2.

Structure	Node content	Link type
Argument structure	Independent clauses	Rhetorical (e.g. argument) relations
Knowledge structures	Nouns/noun phrases	Attribute, compare, classify
	Independent clauses	Sequence, cause-effect

Figure 2. Two levels of abstraction represented in node-link maps.

Cmaps are type 3 maps, having textured link dyadic elements. Cañas & Novak (2006) define the rules of operation for Cmaps:

- Rectangles (nodes) contain concepts.
- Rectangles are joined by labeled lines called propositions.
- Propositions are usually uni-directional.
- The label in the middle of a proposition is called a linking phrase.

Given CmapTools' (Cañas *et al.* 2004) ease of use, zero cost, sharability in multiple formats and web readiness, the author's design choice was to have the TAW learners analyze text and compose text structure with Cmaps.

2.2 Design decision 2: text genre for analysis samples

The most appropriate choices of text sample sources for learner analysis are published technical research papers and articles from popular science magazines and newspapers. Magazine articles were chosen for the following reasons.

- a. As well as information report genre (impersonal, rhetorically distant, highly formulaic) language, they also contain persuasive and motivating language, while technical research papers by convention contain only report genre. It is essential for this task array that the learners confront mixed genre text.
- b. The somewhat loose structure of popular science articles, where knowledge structure information is often mixed with argument structure information, is more similar to the structure of L2 TAW learners' assemblages of ideas than to that of research papers.
- c. The register of popular science writing shares many lexical and discourse features with that used in the spoken language of technical academic conference presentations.

2.3 Design decision 3: the array of linking phrases

In the guidance of learner analysis of text with Cmaps, the following rules force the learners to separate persuasion from essential content, and to construct dyads whose English equivalents are concise, logical argument utterances. Based on informal, exploratory observation of learner behavior over a one-year period, the following rules appear sufficient.

1. Nodes must not contain rhetorical devices; those reside in the linking phrases.
2. Nodes must contain nouns/noun phrases/knowledge structures.
3. Relations between nodes must be in the task creator's defined list of allowable TAW relations.

To determine the list of TAW-allowable 'relations' for Cmap linking phrases, it is necessary to examine numerous samples of TAW argument. This work is under way now, and the following are tentative observations.

The relations used in Horn's (2001) argument mapping are claims, rebuttals and counterrebuttals; these were found to be inadequate for representing the detailed unilateral arguments commonly found in popular science articles. On the other hand, Mann's (1999) RST relations are extensive, being designed to meet the needs of representation of humanities advocative-adversarial discourse, and are too rich to (a) represent elegantly the controlled argument format of the research paper genre or (b) serve as low cognitive load tools for second language TAW writers.

A trial and error approach was taken: over a period of one year, instructor-learner negotiation of summary completeness and quality yielded the following list of linking phrases necessary for the mapping of the unilateral argument in technical research papers. The resulting array of necessary and allowable linking phrases is shown in Figure 3.

Citation as subject	Results as subject	Claim as subject
claims (that) proposes (that) implies (that) suggests (that) infers (that) observes (that)	reveals (that) demonstrates (that) indicates (that) disproves disproves proves (that) implies (that)	is supported by is contradicted by is in agreement with is in opposition to assumes (that)

Figure 3. Allowable linking phrases for the argument mapping task

2.4 Negotiating map contents

Instructional design deliberations led to the selection of the constructivist approach (Jonassen *et al.* 2006) for map-based TAW instruction. In this constructivist approach, the learners analyze sample texts and reflect collaboratively to arrive at consensus. By presenting various frameworks for analysis, the instructor can direct the learners' analytical process towards a focus on argument relations and register characterizations.

3 Instructional process

The following is an example of the constructivist process in the instruction of doctoral engineering students (second language users of English) using the text, "Traditional pest control worse than useless," from *The Daily Yomiuri*, March 27, 2008 (see Appendix). The text was chosen for the reasons given in section 2.2 of this paper.

3.1 Phase 1: unconstrained associative mapping

The learners were given the text and instructed to make association type concept maps of the content of the text. To force summarization, a limit of 10 nodes was imposed. Performance was strongly uniform in terms of node content. Generally the learners used the patterns (e.g. subject-verb) of discourse found in the text. The learners reported (and demonstrated) difficulties with associational mapping in terms of

1. Orientation: do relative vertical and horizontal position have an agreed meaning?
2. Centrality: only 3 out of 12 subjects used graphical elements to signal the central node.
3. Over-structure: all 12 subjects placed the topic node in the center of the array.

See Figure 4 for an example.

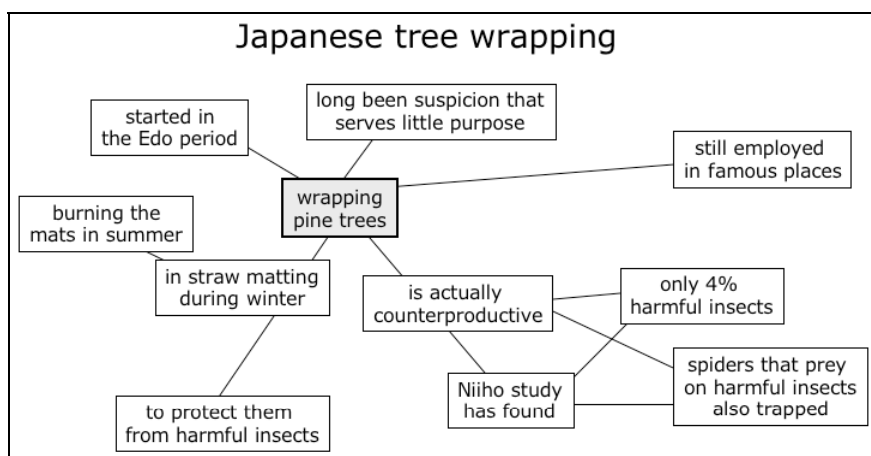


Figure 4. Typical TAW learner association type concept map, constrained to 10 nodes [sic].

3.2 Phase 2: unconstrained Cmap task

The learners were then asked to map the same text again, using CmapTools software, and to "try to represent the argument in the Niiho paper." Figure 5 shows a typical student product. Maps were still highly varied in node content and in link type.

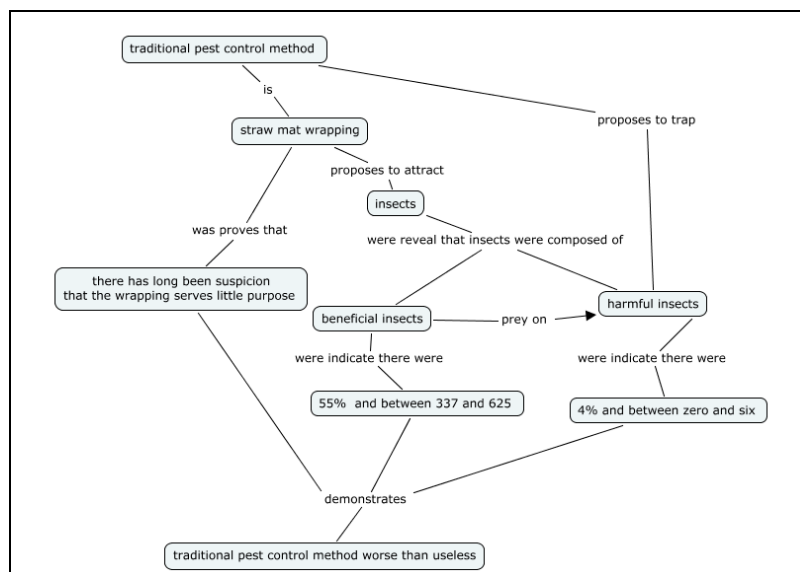


Figure 5. Typical TAW learner lines-of-rhetoric map

3.3 Phase 3: constrained Cmap task

The learners were asked to map the text a third time, again using CmapTools software, but with only the argumentation links listed in section 2.3. Task performance was rather uniform in choice of links from the array above, and map structure and content varied relatively little. The following difficulties were observed in the learners' argument mapping:

1. Some learners ignored the constraint on link content.
2. Some learners added link types (25 occurrences, 5 of 12 subjects)
3. Some learners varied the language in the constrained links (4 of 12 subjects)
4. Some learners added information not contained in the original text (2 occurrences).

See Figure 6 for an example of student mapping in this scenario.

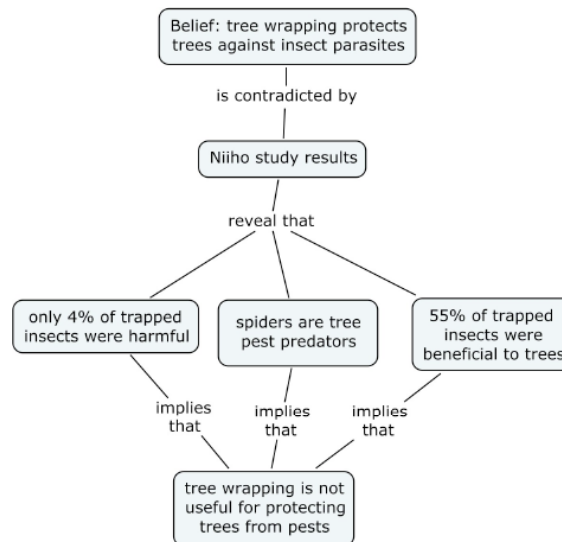


Figure 6. Map with links constrained to argument moves.

4 Conclusion

In the label-constrained mapping approach described here, most subjects did successfully separate persuasive and information-bearing text without specific instructions to do so, and without instruction in how to do so. Of course the mapping approach is not essential to the acquisition of that skill: the value of this mapping approach lies in the visual accessibility of the representation of structured text information, and in the forced low-verbal articulation of relations between argument elements.

Informal observation of learner behavior in constrained-link scenarios suggests that constraining link content can lead TAW learners to accurate, minimal summarization of the arguments in TAW text. The following questions have been identified for future study by the author.

1. Constrained-link maps afford valuable support to TAW learner analysis of text. Do they also afford valuable support to TAW learner composition processes?
2. What is the optimal size and content of the array of linking phrases for the representation of TAW argumentation?
3. Does the *ad hoc* representation technique developed here have implications for a multi-level model of the representation of text-based presentation of information structures?
4. Does the chart in figure 2 present a valid, revealing framework for the classification of argument analysis error?

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Appendix

Text of the article used for analytical tasks.

Traditional pest control worse than useless
The Daily Yomiuri, March 27, 2008.

OSAKA--The traditional method of wrapping pine trees in straw matting during winter to protect them from harmful insects is actually counterproductive, a recent study has found.

Komo-maki, or straw mat wrapping, is a traditional pest control method used to trap harmful insects in the straw wrapped around the trunk. In early winter, straw mats are wrapped around the trunks to attract insects. During winter, the insects multiply in the warm mats, which are then removed from the trees and burned together with the insects inside in early spring.

But a study led by Chikako Niiho, an associate professor of insect ecology at Hyogo University, found that 55 percent of insects caught in straw mats used to wrap pine trees at Himeji Castle in Himeji, Hyogo Prefecture, for four years, were beneficial to trees, while only 4 percent were harmful.

An examination of about 350 straw mats used to wrap pine trees at the castle found between zero and six egger moth caterpillars, a tree pest, each year from 2002-04, and only 44 even in the worst year, 2005. The team found no long-horned beetles--not itself a pest, but a carrier of pinewood nematodes. Together with egger moths, pinewood nematodes are the main cause of pine wilt, a disease fatal to pine trees.

On the other hand, the researchers found between 337 and 625 spiders of various species that prey on harmful insects. Also found in the mats were between 90 and 486 beneficial assassin bugs, which also prey on pests.

According to researchers, egger moth caterpillars live under bark and are found in cracks in the trunk after the removal of mats, with a lot of egger moth pupae found in the same places in summer. Nematodes also inhabit trunks, meaning the straw mat wrapping is useless as a way of getting rid of them.

It is thought that the wrapping of pine trees in winter started in the Edo period (1603-1867), when it was common practice in the gardens of feudal lords. The wrapping has been an annual event at Himeji Castle since the 1960s. But there has long been suspicion that the wrapping serves little purpose.

For this reason, while wrapping is still employed in famous places such as Miho no Matsubara (Miho Pine Grove) in Shizuoka and Okayama Korakuen garden in Okayama, the method was abandoned 20 years ago in the Outer Garden of the Imperial Palace in Tokyo and Kyoto Imperial Palace Garden in Kyoto. Hamamatsu, Shizuoka Prefecture, did not employ the method this year and Hiratsuka, Kanagawa Prefecture, is considering dropping it.

Niiho said straw mats provide places for beneficial insects to pass the winter. Places that want to continue the wrapping should only burn the mats after giving the beneficial insects time to get away, she advised.

A spokesman for Himeji Castle Office said: "It's true we found many spiders in the mats, but as we never knew they were good for the trees we burned them anyway. We want to figure out a better way."