Contextual Vocabulary Acquisition: Learning the Meaning of "Sedative"

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Abstract

This project involved representing a context for the word "Sedative" in SNePS and studying the inference of it's meaning using the noun algorithm. In light of Contextual Vocabulary Acquisition (CVA) research, this project includes experiments to understand how humans interpret the meaning of "Sedative" from the given context.

Contextual Vocabulary Acquisition [1] is a research project that studies computational theories related to automatic acquisition of new vocabulary by determining the meaning of unknown words from their context. The goal of this research is to apply these learning methods and create a new curriculum to enhance the vocabulary learning skills of classroom students.

"Semantic Network Processing System" (SNePS) [2] is the knowledge representation and reasoning platform used to model and verify computational theories developed in this project. A passage is provided with an unknown word, sometimes replacing the word with a non-existent term, and subjects are requested to speak out their thoughts, as they try to infer a meaning for the word from it's context. The thoughts, called think-aloud protocols, are analyzed to study how a meaning was inferred. Armed with such analysis, researchers at UB develop algorithms to infer the meaning of adjectives, nouns and verbs.

Experiments in the CVA seminar involve representing the context of a neologism in SNePS and using either the adjective, noun, or verb algorithm to infer it's meaning. The computerized cognitive agent of SNePS is called CASSIE. Based on human protocols and results from the algorithms, either the SNePS representation of context or the inference algorithms are modified to arrive at a refined meaning. This report provides an overview of prior work carried out in CVA for the word "Sedative", the methodology used to obtain human interpretations of the word, studies conducted on SNePS, results and future ideas.

1 Context and Inferences

The project started with an analysis of prior work done by Chiechih Chi[1] in CVA related work. The context used in this project is a news article about a medication called Versed (Appendix B).

In his analysis, Chi suggests the meaning "Sedative is food or drug, but is likely to be a drug. Sedative can relieve anxiety and cause sedation". The project goal is to represent the context and background knowledge used by Chi, and study the suggested inference. This is accompanied with analysis of meanings inferred by human subjects. The passage is pruned to select relevant sentences as context for CASSIE and suitable background knowledge is selected for unknown elements.

1.1 Selected Context:

- Relief is available for the anxiety children suffer when undergoing difficult medical procedures or facing surgery.
- Versed can be used to calm and sedate children who must undergo procedures such as bone-marrow aspiration or spinal tap.
- The U.S. Food and Drug Administration (FDA) granted marketing

[1] Project Report, http://www.cse.buffalo.edu/ rapaport/CVA/sedative.html

clearance today to a sedative for use in children.

- Versed allows the child to forget what happened during the period of sedation.
- Versed is a drug.
- Versed is a sedative.
- Versed causes a deeper state of sedation.
- It can be used as a light sedative to help alleviate a child's anxiety.

1.2 Background Knowledge:

- If FDA grants that people use something x, then x must be either food or drug.
- Child is a subclass of human being.
- Alleviate is equivalent to relieve.

2 Results

A web-site[2] is used to identify human interpretations of the context for *sedative*. To eliminate the possibility of subjects knowing the word, *sedative* is

[2] URL: http://www.cse.buffalo.edu/ kompalli/page.html

replaced with a non-existent term *trymodine*. The subjects are instructed to identify the context that gave them maximum information about *trymodine*, and asked to suggest a meaning for *trymodine*.

To achieve the first goal of the project, which was to identify the actual context needed for Chi's solution, three sentences were represented in SNePS:

- Versed is a drug.
- Versed is a sedative.
- Versed causes a deeper state of sedation.

From this minimal information, CASSIE inferred the result:

Possible Class Inclusions: Drug,

Possible Actions: Causes Sedation, Alleviate anxiety,

However, this information has not been used by human subjects (Appendix C) to determine meaning of the neologism. The meaning offered by subjects too, is different from the one suggested by Chi. In an effort to estimate the validity of results from the subjects, the entire context (Section 1.1) has been encoded into CASSIE, and a new meaning inferred:

Possible Class Inclusions: Drug,

Possible Actions: Allows m47, Calm b5, Relieve b3, Alleviate Anxiety, gets

FDA clearance m40,

m47 == Child (to) Forget Sedation

b5 == A child who must undergo procedures such as bone-marrow aspiration or spinal tap.

b3 == The anxiety children suffer when undergoing difficult medical procedures or facing surgery.

m40 == Children may use Versed.

3 Discussion of Results

In collected protocols, null responses to "Background Knowledge Used" may be indications of the ineffectiveness of web-based techniques in capturing thoughts: subjects may not necessarily type their ideas. The protocol results mention "tranquilizer, anaesthetic, anesthesia" in the definitions of some subjects, sure indications that more background knowledge than indicated is used by humans during meaning inference. Background knowledge used in the current project is not an effective match for the background used by humans. Building a continuously updated repository of knowledge may be expensive, but a plausible solution to the lack of background information.

Equivalence relations were handled by using a "&ant-cq" case frame. An ideal fix is to code equivalence relations into the noun definition algorithm, and create an equiv case frame. A large amount of context selected by the users as well as present in the passage includes references to temporal information "during the period of sedation". Also, there are references to a sedative carrying out different actions based on dosage/quantity. A suitable case frame needs to be used to represent such information. None of the subjects used contexts like "*Without sedation*, such restraint is often necessary, and parents may even participate in restraining their child, which can be very distressing". It might be interesting to explore the representation of such phrases e.g. "Darkness is the phenomena of having no light". Representing the concept of "many children" has been ignored from the current project. It does not seem to be an easy issue to resolve, given that "many" is a relative clause and may not be represented as simple set relation. Another example would be "few".

A Other Files

Description of files included with the project report.

page.html	The HTML page used to collect protocol information.
funform.cgi	The CGI file used to collect protocol information.
sedative.demo	Demo file used to represent Chi's context.
sedative.demo.run	Transcript of execting sedative.demo.
sedative2.demo	Demo file used to represent entire context.
sedative2.demo.run	Transcript of execting sedative.demo.

B Context

Context used for the CVA project on "sedative"[3]:

> NUTLEY, N.J., March 19, 1997 – Relief is now available for the anxiety many children suffer when undergoing difficult medical procedures or facing surgery. The U.S. Food and Drug Administration (FDA) granted marketing clearance today to a trymodine for use in children.
>
> The medication, Versed(R) (midazolam HCl), can be used to calm and sedate children who must undergo procedures such as bone-marrow aspiration or spinal tap. Sedating a child also may

[3]Source: http://www.pslgroup.com/dg/216e2.htm

spare parents the trauma of watching their child being physically restrained during procedures. Without sedation, such restraint is often necessary, and parents may even participate in restraining their child, which can be very distressing.

Versed also can be used to help calm children facing surgery, who might otherwise be terrified by the mask used to administer anesthesia, or by separation from their parents.

Versed now is also available for use in infants and children of all ages in critical care settings. This is the first time a trymodine has been approved for use of any kind in newborns. Without sedation, babies and children may have a difficult time tolerating a breathing tube or ventilator – and "fighting" a ventilator can be life-threatening.

"FDA clearance of Versed reflects the increasing recognition that children feel as much pain and anxiety as adults, and should be offered the same level of relief," said Maureen Strafford, M.D., director of pediatric cardiac anesthesiology at the New England Medical Center in Boston. "Unfortunately, the trymodine currently relied on most often for kids is the phrase 'almost done.'"

After sedation with Versed, a child usually has little or no memory of undergoing the procedure. This "amnestic" quality of Versed is particularly advantageous because without it, children sometimes suffer from nightmares or other psychological traumas after undergoing medical procedures.

Versed, marketed by Hoffmann-La Roche, has already been used safely in 24 million children worldwide, but today's marketing clearance of Versed for use in pediatrics now gives doctors specific dosing recommendations for administering the medication to children.

"Versed is a very important drug for children," said Charles Cote, M.D., professor of anesthesia at Northwestern University Medical School in Chicago. "I'm hoping that other pharmaceutical companies will follow Roche's lead in clarifying prescribing information for a drug widely used in children."

A variety of uses Versed is an injectable trymodine that has a variety of uses, depending on its dosage and administration. It can be used as a light trymodine to help alleviate a child's anxiety before a therapeutic or diagnostic procedure, as well as to allow the child to forget what happened during the period of sedation; as a mild to moderate trymodine to cause a deeper state of sedation; and as a part of general anesthesia during surgery. Intravenous Versed also can be administered by continuous infusion to children in critical care settings.

Safety Versed was introduced for adult use in 1986. The medication works rapidly, providing sedation within five minutes, and is eliminated from the body quickly. Its availability for use in children was based on clinical experience with the drug in more than 24 million children worldwide.

C Human Protocols

This section lists protocols collected from an web form used for the CVA project. Instructions from the site are included to enable readers to understand the responses. These are followed by responses from each subject.

C.1 Site Instructions

- Please read the passage given below: it is an extract from a medical report.
- There are three goals in this project.

Identify sentences that give you most information about the word "trymodine", and paste them in the "Context" text box at the bottom.

Try to think of a meaning for the word "trymodine", and write it in the "Meaning" text box.

While coming up with the definition, If you used some extra information, please enter it in the "Background" text box. Typically this information would include thoughts not present in the passage: maybe background knowledge of medicines or surgery that you used to arrive at the meaning.

- Filling in your initials and/or TOEFL scores is optional.

C.2 Subject 1:

Context Selected: Relief is now available for the anxiety many children suffer when undergoing difficult medical procedures or facing surgery. The U.S. Food and Drug Administration (FDA) granted marketing clearance today to a trymodine for use in children. The medication, Versed(R) (midazolam HCl), can be used to calm and sedate children who must undergo procedures such as bone-marrow aspiration or spinal tap.

Meaning: kind of medical treatment

Background:

Initials: K

TOEFL: 263

C.3 Subject 2:

Context: The U.S. Food and Drug Administration (FDA) granted marketing clearance today to a trymodine for use in children. The medication, Versed(R) (midazolam HCl), can be used to calm and sedate children who must undergo procedures such as bone-marrow aspiration or spinal tap. “Unfortunately, the trymodine currently relied on most often for kids is the phrase ‘almost done.‘” It can be used as a light trymodine to help alleviate a child’s anxiety before a therapeutic or diagnostic procedure, as well as to allow the child to forget what happened during the period of sedation; as a mild to moderate trymodine to cause a deeper state of sedation; and as a part of general anesthesia during surgery.

Meaning: tranquilizer

Background: None.

Initials: SJ

TOEFL:

C.4 Subject 3:

Context: "Unfortunately, the trymodine currently relied on most often for kids is the phrase 'almost done.'"

It can be used as a light trymodine to help alleviate a child's anxiety before a therapeutic or diagnostic procedure, as well as to allow the child to forget what happened during the period of sedation; as a mild to moderate trymodine to cause a deeper state of sedation; and as a part of general anesthesia during surgery.

Meaning: Something used to relieve pain sounds more like a pain relieving drug used for sedation and pain relief

Background: Dentist by profession

Initials: KBJ

TOEFL: 280

C.5 Subject 4:

Context: The medication, Versed(R) (midazolam HCl), can be used to calm and sedate children who must undergo procedures such as bone-marrow aspiration or spinal tap.

Meaning: sort of a sedative drug used as a anesthetic

Background:

Initials: vsc

TOEFL: 290

C.6 Subject 5:

Context: A variety of uses Versed is an injectable trymodine that has a variety of uses, depending on its dosage and administration. It can be used as a light trymodine to help alleviate a child's anxiety before a therapeutic or diagnostic procedure, as well as to allow the child to forget what happened during the period of sedation;

Meaning: Sedative, some kind of anesthesia

Background:

Initials: ARU

TOEFL: 250

References

[1] William J. Rapaport and Michael W. Kibby. Contextual vocabulary acquisition: A computational theory and educational curriculum. *Proceedings of the 6th World Multiconference on Systemics, Cybernetics and Informatics*, 2:261–266, 2001.

[2] Stuart C. Shapiro and William J. Rapaport. Sneps considered as a fully intensional propositional semantic network. *The Knowledge Frontier: Essays in the Representation of Knowledge*, pages 262–315, 1987.