Towards authentic tasks and experiences: The example of parser-based CALL

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Authenticity of language learning tasks, authenticity of learning experiences and the use of authentic language are important characteristics of communicative language teaching and learning. In this article, ways of achieving productive use of authentic language in a computer-assisted language learning environment are discussed. This discussion concentrates on a particular area of CALL — parser-based CALL. The use and adaptation of two existing parsers for two CALL tools that support text production by encouraging learners to concentrate on the linguistic structure — mainly the grammar — of a text they have just produced in a communicative task are outlined to provide concrete evidence for the contribution language processing techniques can make to the field of Computer-Assisted Language Learning.

L'authenticité de la tâche langagière à effectuer, de l'expérience d'apprentissage et de l'utilisation de la langue sont des caractéristiques importantes dans l'apprentissage et l'enseignement des langues basés sur une approche communicative. Notre discussion porte sur une exploitation que nous croyons productive de cette langue authentique dans des environnements d'ELAO. Elle se concentre plus particulièrement sur un type d'ELAO, celui base sur le TAL. Nous décrivons l'utilisation et l'adaptation de deux parseurs dans deux systèmes d'ELAO différents mais dont la fonction commune est l'aide à la production de textes écrits où l'apprenant est amené à se concentrer sur certaines structures syntaxiques qu'il vient de produire. Nous voulons par le fait même démontrer l'apport indéniable des outils de TAL dans les systèmes d'ELAO.

Authentic Language in CALL programs?

Computer-assisted language learning could be described, in a very broad sense, as the creation, initiation, performance and/or evaluation of human-computer interactions which stimulate, facilitate and/or enable language learning. The term 'interaction' is here, strictly speaking, somewhat misleading since a genuine interaction would require actions by both participating partners — but do computers perform actions? Actions are normally understood to be intention led and they not only produce a result of some kind, but also affect the actor. In other words, we carry out actions in order to achieve something and in the

course of doing so we change — we learn, we experience, we gain or lose motivation, interest . . . Computers, on the other hand, are instruments and as such they are incarnations of (abstract) operations (Schmitz, 1992, p. 62). Schmitz continues by arguing:

> Insgesamt können also grundsätzlich alle geistigen Operationen Maschinen übertragen werden. Maschinen sind aber nicht in der Lage, Ziel und Sinn einer Handlung zu erkennen oder zu bestimmen. (*ibid*., p. 169)[1]

Intention, however, is the main feature that distinguishes actions from operations. Operations are former actions that in the process of automatization 'lost' their intention[2] (Rubinstein, 1984, p. 686ff). But is the distinction between operation and action in the world of computing as clear as Schmitz argues? Without trying to develop a philosophical argument, let us note that sophisticated computer programs not only change in the course of operating (or was it acting?) and can reason about intentions (e.g. inference engines). However, the programs we are talking about rely on the recognition of sometimes complex conditions which trigger the performance of more or less complex operations.

Consequently, we have an interaction between a human — who evaluates somebody else's action by reasoning about the likely intention and reacts to this assumed intention — and a machine which recognizes certain (preprogrammed) conditions and performs the related programmed operations. In the end, an interaction does take place because the computer user, in our case the language learner, interprets these computing operations as actions by assuming an underlying intention, e.g. a learner using a spell-checker (often) reacts as though the computer tool were trying to correct the spelling of a given text, but the operation carried out by the program is the complex attempt to match an input string against a particular record of a database. With Schmitz (1992, p. 175), we believe that learning only takes place in this interaction because the learners are willing to learn. They create a learning context and give sense to the algorithm of operations.

What consequences does this understanding of human-computer interaction have for our approach to language learning? What are the consequences for CALL? Current approaches to language learning and teaching emphasize the importance of authenticity.

> In both the literature and the CALL Survey, Communicative Language Teaching (CLT) emerged as the dominant contemporary approach, underpinned by the notion of 'communicative competence' . . . A descriptive vocabulary has come to be associated with communicative language teaching and this helps, to a certain extent, in clarifying the orientation of the communicative language teacher: the vocabulary includes such terms as language use, language functions, *authentic language*, discourse, fluency,

> interaction, negotiation, social context, appropriateness, coherence and cohesion. (Levy, 1997, p. 154; emphasis added)

Authenticity is a feature of learning tasks and experiences that can be achieved in many different ways. The aspect in which we are most interested is the use of *authentic language* by the learners. In other words, the two CALL components discussed here are not meant to set authentic tasks nor do they interfere during the main stage of the communicative process. This communicative process, in our case the production of a written text, can be initiated through any authentic task the teacher or the learners see fit. Our CALL components are called upon in the learning process at a much later stage. We would like to see learners who not only use the computer for typing and formatting their foreign language texts, but also learners who use computer tools to reflect upon the texts.

If such tools are to work successfully in a learning environment, then they need to have an enormous amount of information that enables them to recognize many different conditions and to perform the appropriate (complex) operations. Only then will learners have a chance to interpret these operations as actions and enter into a meaningful language-learning interaction with the machine. The learner is likely to be alienated when the computer operations are not interpretable as actions and this might result in a breakdown of the interaction because the learner cannot react meaningfully to the operation of the CALL tool. If we aim to make CALL tools more authentic, then what we are trying to achieve is to make the interaction look and feel more authentic. Therefore, we have to analyze the underlying conditions of this interaction and 'feed' the computer with this conditional structure and with a structure of operations that are triggered by these conditions. These CALL tools will perform appropriate operations which can be, without much difficulty, interpreted by the learner as meaningful actions and this enables the learner to react accordingly.

The particular CALL tools we would like to see are programs or components thereof that help learners to proofread and correct the form of foreign language texts. By form (Long, 1991) we mean the surface level of a text — in other words — the 'how' something is said and not so much the 'what' is being said. A number of such tools are already available: many word-processors include a spellcheck component, very often a thesaurus; monolingual and bilingual dictionaries are at the learner's disposal on-line. It would now be useful to extend this range of linguistic tools for foreign language learners. A possible next step is the development of grammar checkers that are written with language learners in mind. Juozulynas (1994) has shown that a grammar checker that relies on parsing techniques would be able to detect about 80% of the errors made by non-native text producers. His study of German essays written by American students concludes that grammar checkers which make use of the current advances in Natural Language Processing (NLP) will be effective

language learning tools. These empirical findings are confirmed by recent developments in Second Language Acquisition theory (SLA), many of which are directly applicable to CALL (Schulze, 1998).

Natural language parsers and the role they can play in computer-assisted language learning have been under scrutiny in the last decade, e.g. Matthews (1992), Holland *et al*. (1993), Nagata (1996). Parser-based CALL applications and components for a variety of learning tasks and for a number of languages have been developed over the years. Here we will take a closer look at two parser-based grammar checkers for language learners. For these two CALL tools, we would ideally like to have a parser that:

- covers as many morphological and syntactic phenomena of the target language as possible, in order to give the learner a genuine reason to be confident in the analysis of the parser;
- is able to recognize and analyze the overwhelming majority of linguistic constructions produced by learners, and so has some information about the acquisition order of a foreign language;
- and therefore has not only an adequate inventory of grammatical rules, but also a domain-independent dictionary so that a CALL component with this parser can be used for a wide variety of text types produced in many different learning tasks;
- is well documented so that the coverage, the restrictions and limitations of the parser can be clearly communicated to the learner so that no false expectations are raised (Holland et al., 1993);
- is not only capable of processing grammatically ill-formed input (Matthews, 1993), but can also reason about the well-formed construction intended by the learner, in order to guide the learner in an efficient manner through the post-editing, correcting and revision process;
- and provides sufficient information for the generation of adequate feedback to the learner so that learners not only benefit from the program during the text production task as such but also retain some knowledge in the longer term.

Generally speaking, parsing algorithms and syntactic parsers have reached a level of maturity that justifies their application in CALL. We will discuss in what way existing parsers can be adapted to meet the criteria outlined above. This discussion will be based on two parser-based CALL projects: both use an existing parser; one concentrates on processing the parser output to identify under-used and avoided syntactic structures; the other adapts the grammar by replacing hard constraints with weak constraints to give feedback on ill-formed

linguistic signs. However, before we turn to these examples, answers to two general questions will have to be discussed.

Firstly, why do we advocate parser-based CALL? And secondly, why do we rely on existing parsers? Holland *et al*. (1993) compare traditional and new technologies for CALL and answer their question "Why put parsers in language tutors?" as follows:

> The appeal lies in the power of the rules. The problem with evaluating students' language by computer is that there are so many things to say and so many ways to say them. To handle the unpredictable sentences students can produce requires a flexible rule set operating at an abstract level. (Holland *et al*., 1993, p. 30)

Thus, parsers are the backbone of CALL tools that return the control of the learning process to the learner. The text the learner puts in does not have to be restricted in any way. The students' answers are not limited to a well-defined set of pre-programmed answers (multiple choice) or to a restricted domain of anticipated answers (gap-filling). The text production task can form part of an authentic communicative task; learners are free to write whatever they assume to be appropriate. The evaluation of the input is then based on the analysis provided by the parser. This is possible because the parser relies on a finite set of linguistic rules, whereas using a traditional approach — pre-programming of anticipated correct and incorrect answers in order to provide feedback — would mean that an infinite number of possibilities would need to be fed to the program. Consequently, parsers are very versatile tools. They can be and they already are used as components in a wide variety of CALL programs, such as multi-media simulations of communicative situations, grammar and style checkers as independent programs or components of word processors, e-mail editors etc., and in traditional CALL packages. In all these programs they support the analysis of the textual input.

Parsers that guarantee a good coverage of a given language (i.e. parsers that are capable of handling a large number of different sentences in such a way that they succeed in giving a meaningful and useful structural analysis) have a complex system of morphological and syntactical rules as well as a comprehensive dictionary. Consequently, the development of such parser grammars is a lengthy and difficult process. Since we are much more interested in showing that parsing technology can make a useful contribution to the further progress of CALL and CALL tools in particular (and we are not so much interested in writing a parser grammar from scratch), we have made the pragmatic decision to use existing parsers and to attempt to adapt these so that they can function in a language learning context.

From a theoretical point of view, the use of parsers in CALL is beneficial and pragmatically possible, but how does parser-based CALL work in practice?

How do the two projects make use of the advantages of parser-based CALL? And how do they overcome the problems and limitations of this field? Let us first have a brief look at *Textana* — a parser that relies on weak constraints.

Adapting an existing parser grammar — the example of Textana

Normally, a successful parse indicates a well-formed sentence and an unsuccessful parse indicates an ill-formed one, judged on the basis of the grammar and lexicon, but for a variety of purposes it is necessary to have parsers that can deal with ill-formed linguistic constructions. Even if we were to assume that a given parser is only intended to parse texts produced by competent text producers in their own language, we cannot be certain that the text will be error free. Obviously, if it is clear right from the start that the parser will be used to evaluate sentences produced by foreign language learners, then this parser must be capable of producing meaningful structural analyses of such ill-formed sentences. This feature of a parser is often referred to as its robustness. Thus, parsers in a CALL environment have to achieve two conflicting goals: they have to parse correctly all well-formed constructions of the language and they have to parse sentences which are not formed according to the rules of the parser grammar (Dini and Malnati, 1993, p. 76). The latter sentences are constructed using linguistic rules of the language that are simply not implemented in the parser or rules that do not belong in the linguistic system of the language. In our case, the latter would be rules that describe the interlanguage (Selinker, 1972) of the learner, but not the target language.

Dini and Malnati (1993, p. 76ff) list four approaches to parsing ill-formed language input.

- the rule-based approach
- the metarule-based approach
- the preference-based approach
- the constraint-based approach.

They conclude that the fourth approach is the most efficient and a theoretically sound one and they argue as well that "weak constraint-based parsing has proven to be useful in increasing the robustness of an NLP system" (Dini and Malnati, 1993, p. 88). *Textana* uses these weak constraints in its grammar framework. The morphological rules of *Textana*'s parser grammar[3] are mainly based on a formalism taken from Categorial Grammar (CG) (Hoeksma, 1985), while most of the syntactic rules are based on Head-Driven Phrase Structure Grammar (HPSG) (Pollard and Sag, 1987, 1994). The parser grammar describes a substantial fragment of German: word formation, inflection, agreement, verb subcategorization. The composition rules used in categorial morphology and

the HPSG syntactic rules are such that they allow suitable smaller linguistic signs to combine to form a bigger linguistic sign. This happens mainly through two processes: unification and subcategorization. To be precise, when we talk about the creation of a sign then what we mean exactly is the creation of the structural representation of a sign. Of course, the signs are in the text produced by the learner and in our case it is a question of the parser recognizing the structure of these signs, e.g. what noun phrase contributes in what capacity to the formation of a larger unit — a sentence for instance.

Whenever (bigger) signs are created through a weak constraint, two outcomes are possible:

a) If no grammatical constraint has been violated then the merger of the two signs is possible and a new bigger sign is formed (e.g. Det + N). No additional remarks about the newly formed sign are recorded.

b) If a weak constraint has been violated, merger is still possible and the constraint violation will be recorded as the remarks feature of the sign (e.g. sing=plural) in the form of a predicate which normally would have caused the program to fail.

Textana is written in Prolog — a programming language well suited to unification-based grammars. For *Textana*, failing means that the parser would have returned no result at all. The only output would have been a simple 'no'.

The remarks, generally speaking, record the nature of the error found by the parser. They are inspected at appropriate times during the parsing process and are eventually used for generating the appropriate feedback for the learner. They provide information about the location as well as the type and the specific realization of the error. It is then not difficult to identify the actual rule which has been ignored and, if necessary, to explain it to the student.

Information that determines the appropriate level and form of feedback has to come from the student model — a part of the program which is responsible for eliciting, gathering, structuring and providing information about individual learners. *Textana*'s student model is a Prolog database that contains a record for each learner/user. The database holds information which has been elicited from the student (name, course and foreign-language learning experience). All other information comes directly from the parser. At this experimental stage only the number of errors per error type and the level of feedback given for each error type are recorded. However, it is possible to record every individual error, used, under-used and avoided constructions, and of course, all learner input, well-formed and ill-formed constructions alike. We have decided to opt for the recording of less information at the beginning in order to be able to evaluate *Textana* and its student model more thoroughly before expanding it.

Processing the output of an existing parser

The second project again works with an existing parser that was not written for CALL purposes originally. As we already indicated above, it can take years to develop an NLP tool that provides accurate grammaticality judgements and it therefore seems more efficient not to write a parser from scratch but rather to use an existing one. However, suitable parsers are not readily available and even more difficult to find when the language chosen is not English. FIPS (French Interactive Parser System) (Laenzlinger and Wehrli, 1991) is a principle-based parser (Chomsky, 1986). It was made available for this second CALL project. Firstly, its overall performance was measured against two corpora: a corpus of sentences extracted from a grammar textbook and a learner corpus (Hamel, 1996). From the first corpus, we were able to conclude that the parser proved to be suitable and reliable as its grammatical domain was large and it covered particularly well the intended domain — subordinate clauses. The construction of complex sentences was chosen as the grammatical phenomenon to be analyzed by FIPS in order to extend the parser in such a way that it could help intermediate learners to improve their grasp of complex sentential constructions in French. FIPS has the advantage that, faced with sentences it cannot analyze, it still produces a partial analysis. In other words, the parser just ignores grammatical constructions that it does not recognize and only provides a structural analysis of the sentences or parts of the sentence that it does recognize.

This enabled us to look at sentences produced by learners in our second corpus, sentences which for some were ill-formed but for which the parser still provided some partial analyzed output. What the learner corpus revealed to us was that most errors were of an orthographical (spelling), morphological (agreement), and lexical (choice) nature. The syntax (i.e. word order) seemed to be generally correct. So was there no use for FIPS as a tool for error diagnosis in our envisaged CALL environment? A more detailed analysis revealed that the high level of correctness was mainly due to the fact that learners overused constructions they were familiar with. So it was not the case that the syntax of complex sentences had been correct and hence no problems had been flagged by FIPS. It was that syntactically complex sentences simply were underused in the L2 corpus, i.e. their use had been avoided. These findings could be substantiated by elements of Second Language Acquisition (SLA) theory, particularly avoidance theory (Ellis, 1994) and competency analysis (Schachter, 1974). Thus, a different kind of grammar checking turned out to be relevant. In fact, recent research in CALLDash student modelling (Matthews, 1993) and parsers (Holland, 1994; Loritz, 1992) — has led us to believe that FIPS can be used as a tool for comprehensive diagnosis in CALL. This comprehensive diagnosis will rely on a post-parsing activity that will generate information about the number and types of clauses used and not used by L2 learners. In other

words, FIPS' output — the structural analyses of partial or complete parses of the sentences written by the learners — will be parsed again in order to gather data as to what types of constructions have been used in the learners' texts. This data will be compared to L1 data from the same discourse types (Bronckart, 1984). The frequency of certain types of complex sentences in an L2 text can now be compared to the expected frequency for this discourse type, i.e. to the frequency of this kind of construction in texts of the same type produced by French native speakers. The results of this diagnosis will trigger corresponding remedial activities on different clause types and on their function in relevant discourse types. Learners will thus be required to practise the sentence types which are relevant to the discourse type they were working on and which they tried to avoid because they were not competent or confident enough to use them.

Parser-based CALL — a way forward?

When we measure the two parsers used in the two CALL projects discussed here against our list of desiderata for the ideal CALL parser (see above), we can justifiably say that using existing parsers and adapting them has helped us to move closer to the ideal. Parsers are very powerful linguistic tools because they are based on a well-defined set of rules — a set of rules that, in its essence, is not that far away from the set of grammatical rules learners try to remember, understand and apply. Parsers can support and facilitate the learning of these grammatical rules. They produce an informative structural analysis of the textual input by the learner. In other words, they present grammatical knowledge which is highly relevant to the learners because it is contextualized knowledge, knowledge that will help them to improve and correct a text they have produced themselves. It is not just grammatical knowledge from a grammar textbook. This structural information can not only form the basis for adequate feedback to the learner, but it can also, and this is at least as important to us, form the basis for a better understanding of language learners, language learning processes, grammar acquisition, effective feedback mechanisms and text production in general. This is possible because the parser, which takes just the textual input as the information source, produces an elaborate information structure. Different aspects of this structure can easily be transferred to a student profile. The analysis of such student profiles will enable the fine-tuning of different parts of the grammar checker, but at the same time, the results will not only be relevant for the improvement of these CALL components themselves but they will also be linguistically interesting, since parsers provide a good opportunity to record data about text production processes and in our particular case about grammatical and text production aspects of second language acquisition.

However, the question was whether or not parser-based CALL can contribute in such a way as to move CALL applications closer to enabling, supporting and encouraging learners to produce authentic language at the computer. Not only the two examples briefly discussed here, but also numerous other examples have shown that parsers in CALL programs can be very valuable tools that help significantly to improve the overall quality of these programs. We have identified a number of features that such a parser must possess. Many more such features remain to be investigated. For example, how do learners work with parser-based CALL software? How do they react to interference in the text production process based just on a structural analysis of the text input? What exactly can structural analyses by the parser tell us about the learner, the learning process, grammar acquisition? But one outcome is apparent already: parsers return the (linguistic) control of the learning process to the learner. The learner has the chance to have any piece of text on any subject checked against the grammatical rules of a parser. The success of such an operation is merely dependent on an adequately sized dictionary. If the parser does not have all the grammatical rules that were necessary to create a complete structural analysis of the input text, it will simply comment on the missing rule (*Textana*) or ignore the part of the text or sentence that could not be analyzed using a rule known to the parser (FIPS). In other words, if we assume that no parser will ever cover a language in its entirety — even if we only consider the grammatical side — then this problem does not prevent us from using them in a CALL program. Indeed, we can do so as long as the feedback takes into consideration that judging a construction as morphologically and/or syntactically ill-formed on the basis of the parser grammar does not necessarily mean that the learner has made an error. It could just also mean that the parser simply did not recognize this structure. We can here at least hypothesize that the smallest parser grammar, e.g. one that only covers noun phrase internal agreement in German, does prove useful to learners as long as they know that it is only this set of operations that the parser-based CALL program can perform. Of course this hypothesis

Table 1: Overview of the two projects

	FIPS	Textana
Language	French	German
underlying grammar	GB/PPT	HPSG
main grammatical focus	Complex sentences	simple sentences
main purpose of parsing	Identify gaps	identify errors
feedback focus	Avoided/under-used structures	ill-formed structures
computational approach	post-parsing activity	weak constraints
learning approach	Remedial exercises	detailed feedback

needs to be validated in learning experiments, which will only be possible once parser-based CALL programs become more widely available.

Although the two projects use somewhat different approaches to parser-based CALL (see Table 1), they both demonstrate that using parsers for diagnosis and checking in language learning is practical and theoretically sound and promises to yield results in the future. They already allow learners now to produce authentic language and receive (and least some) meaningful feedback in order to progress in their language learning.

Notes

[1] Basically all cognitive operations can be performed by machines. However, machines are not capable of recognizing and determining the aim and the purpose of an action.

[2] The example used in Activity Theory, from which the distinction between action and operation was taken, is driving a car (Leontev, 1978). When one takes the first driving lessons, changing gear has to be learnt as an independent action. The intention of the learner-driver is to, let us say, change from second into third gear. Gradually over a period of time, this action becomes automated, becomes a skill. Now it might be the intention of the experienced driver to accelerate the car. One part of this complex action is the gear-changing operation, which as an operation does not have an independent intention.

[3] The parser and the English grammar were written by Allan Ramsay. For more details see `ubatuba.ccl.umist.ac.uk` and `www.ccl.umist.ac.uk/staff/allan`.

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