VISUAL GRAMMAR:
Multimedia for grammar and spelling instruction

Gerard Kempen
Experimental and Theoretical Psychology Unit
Leiden University

Abstract

Several European languages, in particular Dutch and French, employ orthographies with syntax-sensitive spelling rules that can be applied correctly only by writers who are able to produce explicit representations of sentence structure. Writing instruction in schools where these languages are taught, is impossible without a fair amount of grammatical terminology. This necessitates elementary grammar courses already in the higher grades of primary education. However, many students fail to attain the minimum level of grammatical understanding needed to spell correctly. In this chapter, I propose some ingredients of an improved grammar didactics that exploits the visualization and interaction opportunities offered by multimedia technology, and is based on a conception of sentence structure that takes so-called lexical frames (word frames) as elementary building blocks.

1. A case for grammar as a prerequisite for written language proficiency

Few foreign-language teachers and learners consider grammar their favorite subject matter. Whether or not explicit grammatical knowledge helps attaining *oral* proficiency in a second language , is controversial. Many learners become fluent speakers and smooth understanders simply by practicing these skills, without having paid much attention to the grammar rules of the target language. However, this observation does not justify downplaying the importance of grammar in the acquisition of *written* language skills, neither in the mother tongue nor in a foreign language. Striking examples are provided by languages with large numbers of homophonous wordforms whose orthography is dictated by syntactic context. Writers in these languages are likely to commit numerous errors if they ignore the grammar-sensitive spelling rules.

   Consider the spelling of verb forms in Dutch and French. The Dutch verb *vergroten* (Eng. *to enlarge*) has four conjugation forms that sound the same but are spelled differently: in addition to *vergroten* which serves as infinitive and present-tense plural, there are the past-tense singular *vergrootte*, the past-tense plural *vergrootten*, and the inflected past participle *vergrote* (I disregard some additional functions of these forms). Another example is the spelling of third-person present-tense singular verbs ending in the phoneme /t/. *Went*, *wend* and *wendt* are pronounced identically but *went* is derived from the infinitive *wennen* (*to get used to*) whereas *wend* and *wendt* are forms of *wenden* (*to turn*). *Wend* serves as imperative, as first-person singular and, in case of inversion (i.e., subject following the finite verb), as second-person singular. *Wendt* is third-person singular, and second-person singular in clauses without inversion (subject preceding the finite verb). Problematic cases like these are not restricted to rare verbs; e.g., the /t/-spelling rules force writers to choose between *word* and *wordt* —highly frequent forms of the copula and passive auxiliary verb *worden* (*to become, to be*). In French, the problem of homophonous wordforms with syntax-sensitive spelling differences is even more

widespread, witness inflectional forms such as *aimer, aimez, aimé, aimée, aimés* and *aimées* with identical pronunciation.

One might hope that, before long, solving such spelling problems can be delegated to sophisticated spelling and grammar checkers in powerful word processing systems. However, for many years to come, the sentence analysis components in these programs will have to rely on lexical, morphological and syntactic information alone, possibly enriched by statistical data; expecting them to come up with unambiguous semantic interpretations that reflect the author's intention, is too much to ask as long as they are supposed to deal with texts from unrestricted content domains. This rules out the feasibility of syntactic parsers that reliably reconstruct the sentence structure as intended by the author. Hence, grammar checkers for arbitrary texts in Dutch or French always run the risk of basing spelling advice on incorrect syntactic analyses. I rather expect the opposite trend, because sophisticated grammar checkers will have a hard time to communicate with linguistically naive users.

In actual practice, writers with insufficient parsing skill try to solve syntax-ridden spelling problems by invoking ad hoc heuristics such as the following:

"If you want to know how to spell *word(t)* in *Ik word* (*I am*), *Je wordt* (*You are*), *Word ik* (*Am I*) and *Word je*(*Are you*), then try a verb like *werken* (*to work*) where you do hear the inflectional ending /t/. Since you do not hear a /t/ in *Ik werk* (*I work*), you write *Ik word* without a *-t* ending. Similarly, one writes *Je wordt* and *Word je* in analogy with *Je werkt* and *Werk je*."

Analogical reasoning is indeed helpful but does not guarantee the correct solution. For instance, *je* is ambiguous between personal and possessive pronoun (*you* versus *your*). So, the writer has to realise that in *Word(t) je moeder geholpen?* (*Is your mother being helped?*) *je* belongs to *je moeder*, and that *Werkt je moeder* rather than *Werk je* is the correct analogy. This, of course, presupposes an explicit grammatical skill: the ability to divide a sentence into word groups—NPs in this example. In order to eradicate the need to train this elementary skill, teachers have come up with a trick:

"If one can change *je* to *jij* without making the sentence wrong, do not write the *-t*.; add a *-t* otherwise."

This heuristic appeals to the undeniable fact that the personal pronoun *jij* has nominative case only and therefore must be subject of the sentence. However, this heuristic is not foolproof. In *Besteed je tijd beter! (Spend your time better!),* *je* cannot be replaced by *jij,* implying that *besteedt* rather than *besteed* is correct. However, the singular imperative form of a verb is identical to the first-person singular, which never takes the *-t* suffix. It follows that students need to acquire grammatical terms such as "imperative form of a verb" or "imperative sentence mood"—unless their teachers invent additional heuristics circumventing such jargon, and so on and so forth.

Even experienced writers are seldom immune to homophonous verb form errors and typically report consciously applying 'official' rules or analogies. This observation is in

striking contrast with the virtually effortless way one acquires and uses the spoken forms of inflections. Native speakers of Dutch do not have to 'think' about whether or not the sentential context requires saying a /t/ after the stem /wɛrk/: they just do it on automatic pilot. But writing or not writing a -*t* after the stem *word* never stops presenting problems. This contrast has two possible causes: morphosyntactic rules for spoken and written language are acquired through different learning mechanisms, one reaching a higher level of proficiency than the other. Alternatively, if the same learning mechanism underlies the acquisition of spoken and written forms, it deals with the latter rather inefficiently. Both hypotheses may be true simultaneously. The language acquisition device enabling young children to learn the morphology of oral languages so effortlessly may deteriorate over time and have lost much of its effectiveness when these children start bothering about verb form spelling, that is, at the age of ten or eleven. Then, another learning mechanism takes over—one based on logical or analogical reasoning and explicit rules of some sort (cf. Kempen, 1992a).

The make-shift and flawed character of heuristic rules for verb form spelling and their apparent failure to fill the grammatical insight gap provide a strong case in favor of grammar as a necessary ingredient in written language instruction.

2. Refashioning the didactics of initial grammar instruction

The bottom line of the previous paragraph seems to present us with an insurmountable problem. Although grammar rules such as those underlying the syntax-sensitive aspects of verb form spelling may be indispensable, they are too abstract to be understood and applied correctly by the most primary and secondary schoolers. Consequently, the deplorable learning outcomes that epitomize the proverbial "tragedy of the verb forms", are unavoidable. This pessimistic conclusion, which is probably valid in the context of grammar instruction (if any) as practiced in many schools, has become a self-fulfilling prophecy. It has abated the interest of linguists and educationists in designing improved grammar didactics, with as a consequence that empirical investigations into effects of explicit grammatical knowledge upon the acquisition of written language skills tend to confirm the pessimistic picture (e.g., Schuurs, 1990; however, [NN] report moderately positive results for English students learning French).

Taught by age-old methods, many learners only have an inkling of the meaning of important grammatical terms. Grammar rules couched in vaguely familiar jargon are hard to apply correctly in writing, let alone in speaking. Factors such as the following must be held responsible for the low levels of success attained by current grammar didactics:

(1) the low level of motivation in students (and not seldom in teachers) due to the perception of grammar as a subject of little practical utility

(2) the poor quality of traditional paper-and-pencil parsing exercises:

- •little time for practicing
- •late and fragmented feedback
- •insufficient 'scaffolding' (gradual build-up of difficulty levels, guidance towards correct responses)

(3) the lack of a transparent visualization of grammatical structure; and

(4) little room for exploratory learning.

See Pijls, Daelemans & Kempen (1987) and Kempen & Jongen-Janner (1990) for appraisals of current grammar instruction methods.

In this chapter I propose some ingredients for an improved grammar didactics that may help learners to a gain a better understanding of the structure of words and sentences than is possible through current teaching methods, and thus may be expected to promote the acquisition of spelling and writing skills. The ingredients presuppose interactive multimedia techniques for visualizing and manipulating the structure of words and sentences. They enable the construction of rich and attractive CALL (computer-assisted language learning) environments with many opportunities for exploring and exercising grammatical notions.

An additional source of inspiration has been the computational-psycholinguistic model of grammar that I have developed in order to account for aspects of human grammatical performance (Kempen, 1997). In this model, lexical frames are taken to be the elementary building blocks of syntactic structures. This allows and integrated treatment of the various levels of sentence structure: word classes (parts of speech), word groups (constituents), and grammatical functions (syntactic relationships). Additional advantages are the terminology, which is relatively close to that of traditional school grammars, and structure diagrams that are easy to understand.

3. Lexical frames

As building blocks for sentence structures I propose *lexical frames* (or "word frames") as illustrated in Figure 1. The lexical frame of a word is a 'mobile' that specifies important properties of the word itself and of its sentential environment. The root nodes are labels of word groups ("phrasal categories": Sentence, Noun Phrase, Determiner Phrase, etc.). The row of labels below the root are grammatical functions (Head, Subject, Direct Object, Modifier, etc.). The third row consists of a lexical category (verb, personal pronoun, noun, etc.) that functions as the frame's head (hd) , with—optionally—additional phrasal categories. The latter designate word groups that populate the environment of the head word (*lost* takes Subject NP and Direct Object NPs, *puppy* takes a determiner and a modifier, etc.). The bottommost node of a frame is a word of the sentence.

The lexical frames get combined by an operation called *unification*. A root node may be merged with an identically labeled non-root node of another frame if their features

are compatible. For instance, The root of the lexical frame for personal pronoun *I* carries the feature "case = nominative". This is incompatible with the Direct Object NP of *lost*, which has the feature "case = accusative". It follows that the NP node dominating the personal pronoun *I* cannot unify with the Direct Object NP in the verb frame associated with *lost*. On the other hand, the NP node dominating *puppy* is eligible for unification with *lost*'s Direct Object because the value of its case feature is undecided ("case = nominative or accusative"). Figures 2 and 3 show how a more or less conventional syntactic tree is constructed from the unified lexical frames.
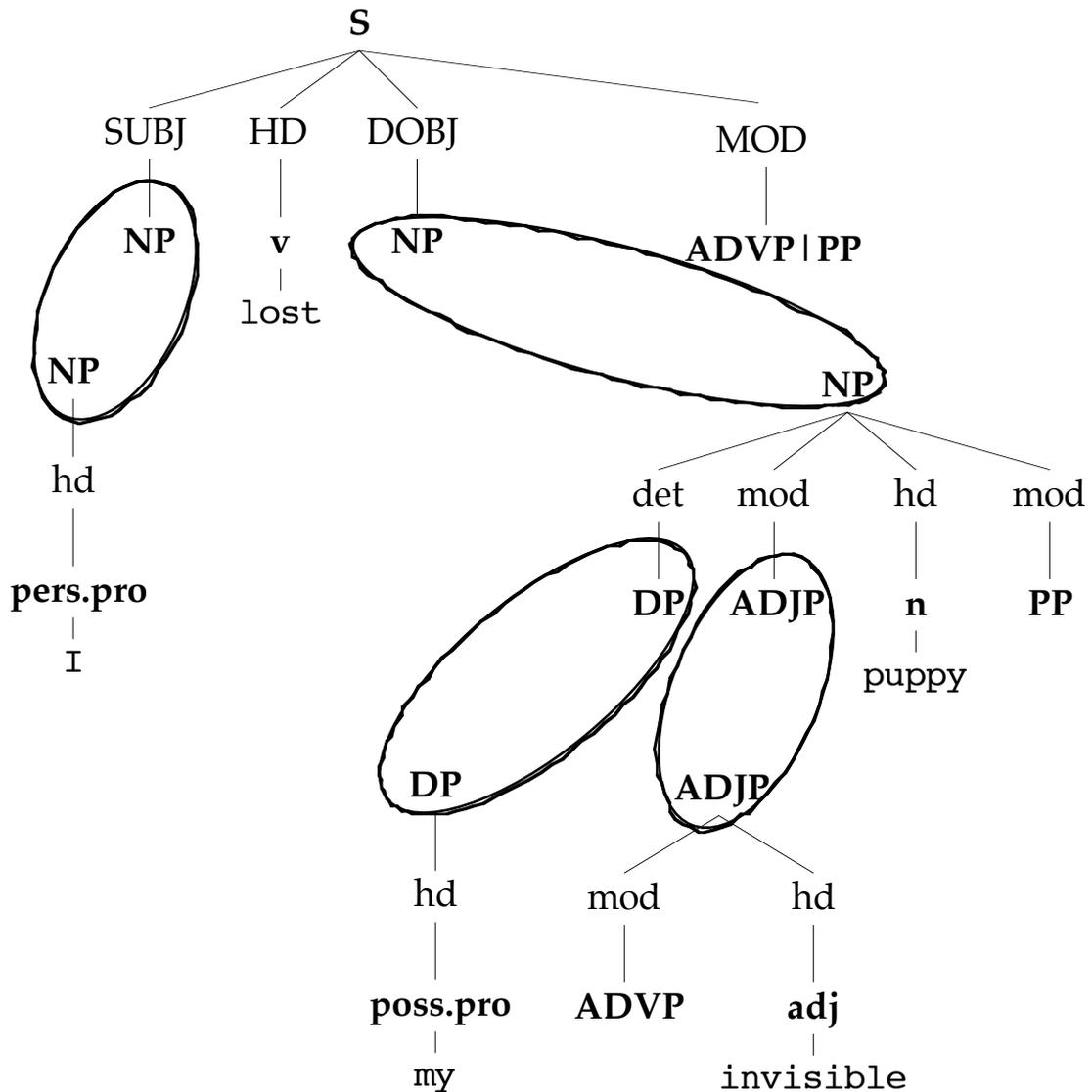

Figure 1. Lexical frames associated with the words in *I lost my invisible puppy* (title of a poem by Jack Prelutsky, 1990). The ellipses include two identically labeled nodes that are to be unified. Applying these unifications yields the tree diagram of Figure 2. Syntactic features (e.g. case values) are not shown.
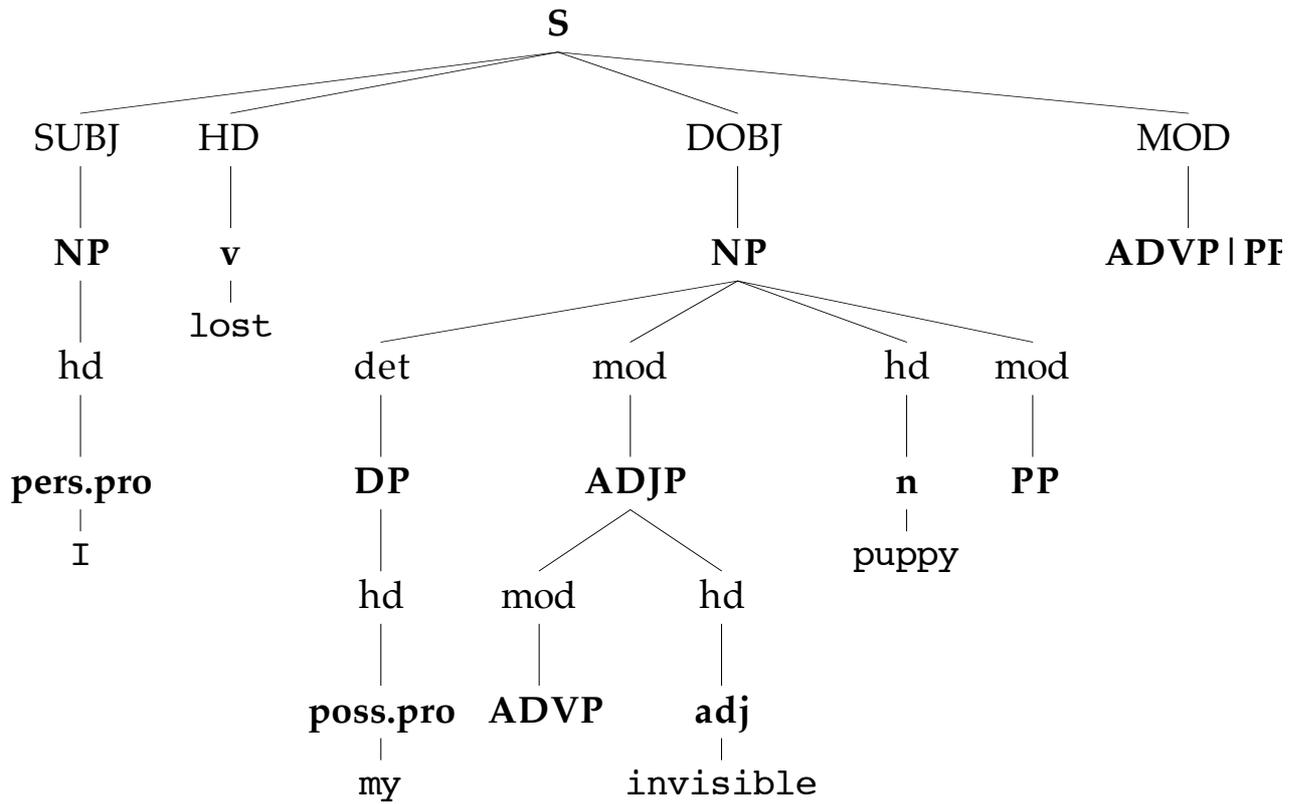
S
SUBJ   HD   DOBJ   MOD

NP   v   NP   ADVP|PP
        lost

hd

pers.pro   det   mod   hd   mod

I   DP   ADJP   n   PP
                                    puppy

                hd   mod   hd

                poss.pro ADVP adj

                my   invisible

Figure 2. Structure resulting from unification (merging) of the encircled node pairs in Figure 1.

S
SUBJ   HD   DOBJ

NP   NP

hd   det   mod   hd

                            DP   ADJP

                            hd   hd

pers.pro   v   poss.pro   adj   n

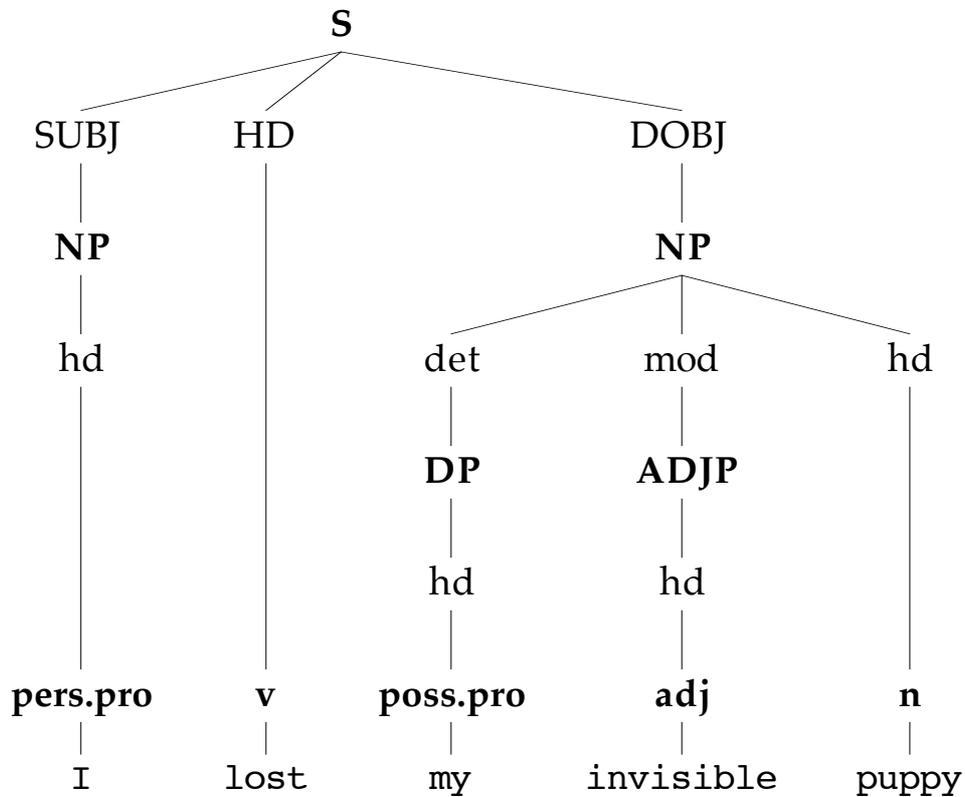I   lost   my   invisible   puppy

Figure 3. Syntactic tree resulting from Figure 2 after all branches that do not terminate in a lexical item have been pruned away and the terminal and preterminal nodes have been lined up.

4. Visualization: syntactic creatures and edifices

In order to convey the idea of lexical frames to fifth- and sixth-graders, I propose using the metaphor of family relationships: lexical frames become members of a family—depicted as some sort of phantasy creatures—, and the grammatical relations between frames in a sentence correspond to kinship relations, to be visualized as a kind of family portrait with the members holding each other. A possible elaboration of this idea for children who have no knowledge of grammatical jargon, is illustrated in Figure 4. The spookish creatures are named after words of the sentence. The different sizes and head shapes correspond to word classes and phrasal categories. Their limbs end in 'hands' whose size and shape match the size and shape of the heads of sought-after family members—the latter symbolizing a type of constituent that might or should belong to the same sentence (lock-and-key principle). The limbs have different shadings, corresponding to the different grammatical functions. (Color printing permits a wider range of possible mappings between grammatical concepts and graphical objects/properties.) In an interactive computer environment, children can be presented with animated versions of these creatures and invited to assemble a well-formed family portrait. The computer program checks the child's proposals and refuses any ill-formed ones ('scaffolding').

In order to enable talking about creatures of varying types, the teacher (with the graphical program following suit) gradually introduces the grammatical terms, e.g., as depicted in Figure 5. The operational definitions of these concepts—that is, directions for locating concept instances in a sentence—can be explained and tried out in terms of graphical properties and manipulations. For instance, after the pupils have learned to identify the finite verb of simple sentences, then the Subject and the Direct Object phrases can be located by following the tentacles of the verb creature. An important type of exploration and exercise consists of associating types of creatures with the words of a sentence ('part-of-speech tagging'), followed by constructing the family hierarchy ('parsing'). The constraints embodied by the creatures (and checked by the computer program) can provide all sorts of direct feedback and 'scaffolding'.
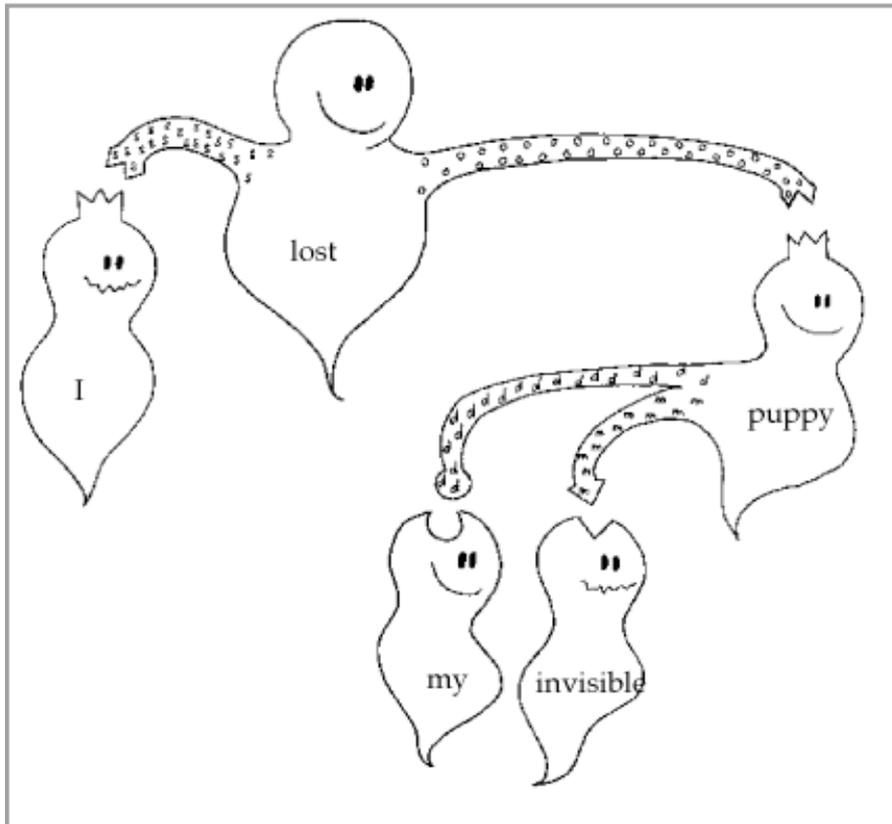
Figure 4. Possible visualization of lexical frames for elementary school children.
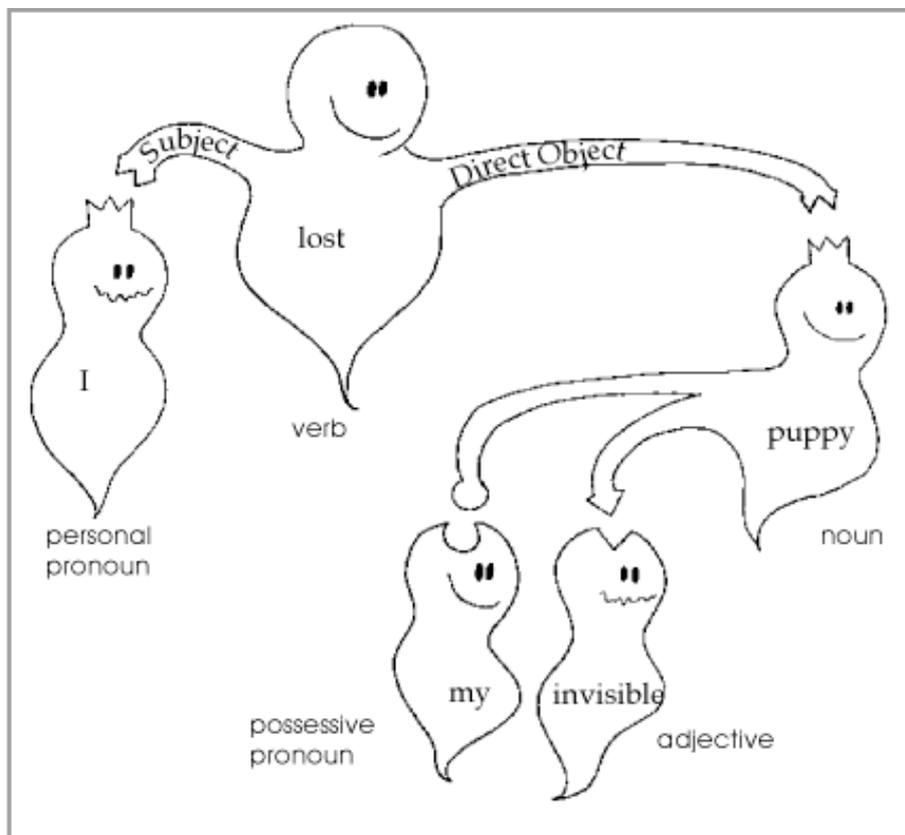

Figure 5. A family of lexical frames with some grammatical terms added.

An alternative, more schematic representation of sentence structure is illustrated by the multi-tiered quasi-Greek temple in Figure 6. The three types of nodes of a lexical frame—word groups or phrases, grammatical functions, and word classes—are inscribed on the tympanum, the frieze, and on the block at the foot of a column. The temple foundation displays the words of the sentence. The schematic temple-shaped visualization of syntactic structure drives home the idea that a sentence is more than a flat string of words, and can serve as a useful precursor to abstract trees.
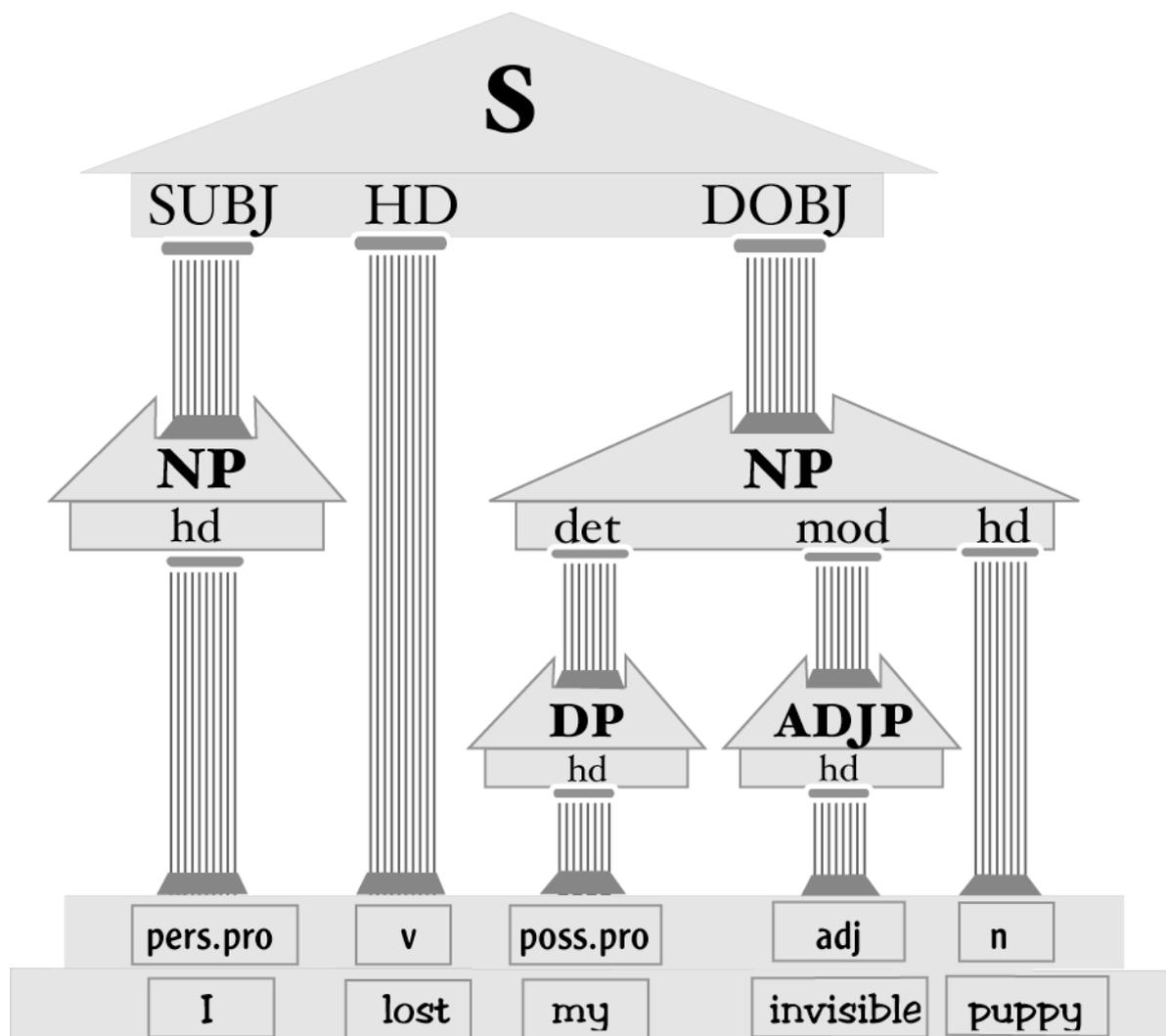
Figure 6. Syntactic structure visualized as a multi-tiered quasi-Greek temple.

5. Interaction: grammar games and exercises

Grammar instruction cannot restrict itself to conveying grammatical *insights* to the students. An equally important goal is *skill* acquisition: students should reach a sufficiently high level of proficiency in applying the operational definitions of the grammatical concepts, e.g. in locating parts-of-speech and syntactic constituents of various types, in recognizing their morpho-syntactic properties, and in constructing utterances that instantiate such concepts. Any grammar curriculum should therefore provide extensive and attractive materials to exercise these skills. The second didactic asset

offered by multimedia technology, in addition to visualization of knowledge domains, is interaction with objects in those domains. It opens up worlds of attractive games and exercises, whose motivating potential and exploratory and feedback opportunities have as yet hardly been exploited by grammar instruction methods.

Diesveld & Kempen (1993) have implemented a computer program, called Palladio, which lets children from age 10 onward practice parsing by completing temples from which certain pieces are missing. Scattered at the base of the temple are loose blocks representing various grammatical terms. The child picks up one of the blocks and drags it to a hole in the temple front; if the wrong hole is chosen, the block drops to the bottom again., etc. The program automatically constructs arbitrary temples when given a sentence in labeled brackets notation as input.
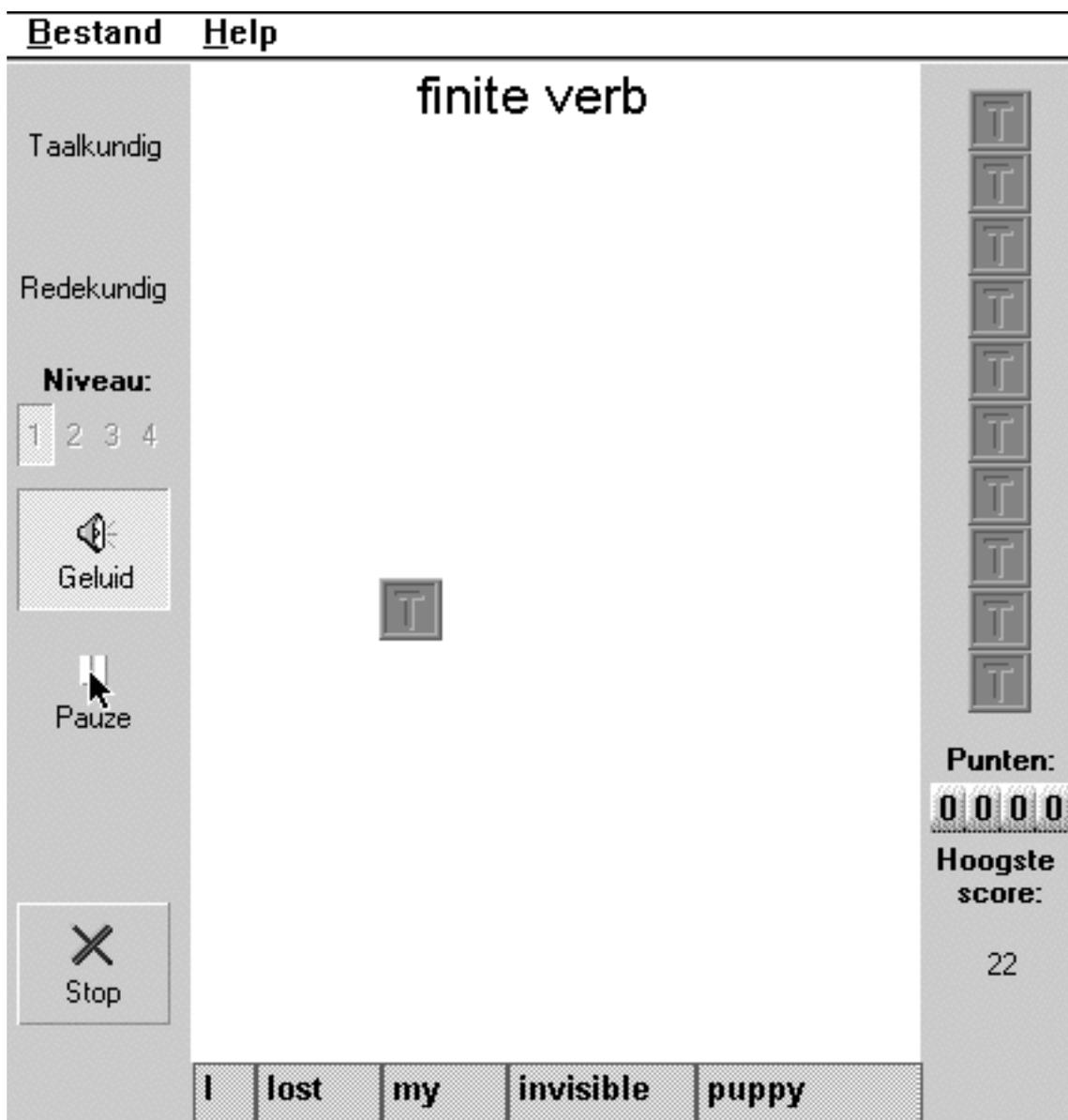

Figure 7. Screendump of Taaltris in 'part-of-speech tagging' mode (Du. Taalkundig Ontleden). By hitting arrow keys, the player should direct the rapidly falling block (in the middle of the screen) toward the finite verb *lost*. In 'syntactic parsing' mode (Du. Redekundig Ontleden), the sentence at the bottom is divided

into major clause constituents rather than individual words. This grammar game has been published in 1997 by A.W. Bruna Informatica in Utrecht.

Taaltris is the second grammar game implemented by Diesveld & Kempen (1993). The player's task is somewhat similar to that of the computer game Tetris (Du. *taal = language*; see Figure 7). Informal user tests with several groups of fifth- and sixth-graders showed not only that most children are fond of the game but also that the acquired grammatical skills transfer to paper-and-pencil grammar exercises. Recently, a revised version (Kempen & Diesveld, 1997) has appeared which allows teachers—and children—to create new sentence materials and to adapt the grammatical terminology to personal preference (also in other languages). A novel component consists of extensive explanations of grammatical terminology in hypertext format (HTML; also user-modifiable). The publishing house is planning to construct a WWW site for downloading and uploading additional sentence materials. This feature exploits the third didactic benefit of multimedia technology: easy access to knowledge sources.

6. Conclusion: integrating grammar and spelling instruction

At the beginning of this chapter we saw that spelling instruction is hampered by the lack of grammatical insights in students and by insufficient transfer of such insights to writing tasks. At the same time, many teachers believe that grammar instruction lacks compelling arguments in support of its immediate practical usefulness. The obvious solution to both problems is an integrated grammar and spelling curriculum. In this paper I have focused on the grammatical partner of this liaison. For some proposals concerning design and implementation of the orthographic partner, I refer to Kempen (1992b), Kempen & Vosse (1992), Vosse (1994) and Kempen & Dijkstra (1994).

The liaison will create the need for specialized CAWLL software (computer-assisted *written* language learning) that supports the integrated didactic approach. The options for such as system are legion—varying from a word processor that provides easy access to grammar instruction and training modules, to ... a tamagotchi that wants to be addressed in writing (in the child's mother tongue or a foreign language) but cannor stand spelling and writing errors.

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