Handbook of Research on Computer-Enhanced Language Acquisition and Learning

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ABSTRACT

The present study is situated in the context of cognitive aspects of language processing as it focuses on the learning and teaching of grammar in various modes of presentation. The success of the programs developed for, and used in, the study is measured in terms of short- and long-term learner performances in the application of grammatical rules. Four groups of informants were formed to test four different combinations of the presented materials. The groups used either a cognitive/functional or traditional rule-governed approach to grammar explanation in either an animation or static presentation mode. The results document the overall superiority of the cognitive/functional approach to grammar when presented in the animation mode. The design of the study and its results could serve as a reference point for further research and could help refine parameters for the evaluation of effective language learning software.

INTRODUCTION

The use of electronic media in language learning can be seen as the result of a wide variety of economic or pedagogic reasons, often driven by the aim to offer a method for accelerated learning. However, software producers and publishers rarely provide evidence for the success of their products. In other words, software often is not evaluated at all or evaluated in an introspective manner by means of checklists or reviews. While checklists allow for a more-or-less systematic and structured evaluation, the typical review includes basic information about the program

and the reviewer's subjective description. The types of criteria found in a checklist and a review largely overlap (see Hubbard, 1992; Knowles, 1992; Schmueckler & Shuell, 1989). Often the criteria employed in a review vary according to the reviewer's taste. Rarely are they derived from a theoretical approach to evaluation. In contrast, empirical evaluations require an extended use of the materials by actual learners (see Scholfield, 2000 for a detailed discussion). A survey of recent evaluation projects of an empirical type (Reeder, Heift, Roche, Tabyanian, Schlickau, & Gölz, 2001) has found a lack of methodological rigour and a lack of agreed upon methodological protocols in the empirical assessment of language learning software.

In order to provide more systematicity in the evaluation process, Hubbard (1992) argues for the application of a curriculum development approach to software evaluation as part of a triangular model for CALL courseware, the other two components being development and implementation. Within the model, Hubbard (1992) argues for the networked operation of these components in a framework which is similar to a curriculum and instructional scheme. In this way, software development, implementation, and evaluation can be explicitly related to instructional principles and their related components.

Following Hubbard's approach, Reeder et al. (2001), Hufeisen & Leitner (2007), Roche (2003) and Roche (2008) developed a criteria-based framework for software assessment while incorporating cognitive aspects of language processing and acquisition which were largely unconsidered in Hubbard's model. While the profession is beginning to approach the issue of software assessment more systematically, more research is still needed in order to understand the fundamental principles of media-based language learning, that is, how the use of media leads to an added value in language learning and why positive effects of media use are often difficult

to measure. This is a long-term endeavour which is still in its initial phases.

The study presented in this paper can therefore be no more than a small piece in a large mosaic whose overall size is yet unclear. It is rooted in the cognitive theory of multimedia learning (Mayer, 2005) and uses the integrated text and visual comprehension model (Schnotz, 2005) as well as the cognitive load theory (Sweller, 2005) as reference points.

The aim of this chapter is to test the hypothesis that modern electronic media are particularly efficient in language learning when they are properly tuned to the cognitive processes of language acquisition and the coordinated processing of dynamic visual and verbal information. Based on this assumption, the authors of the present study first developed relevant design criteria which were then used in a comparative study involving four different modes of presentation on a particularly difficult grammatical topic. This particular grammar topic generates various, and often lasting, production errors for most learners of German as a foreign language (L2) regardless of their first language (L1).

The design criteria derived from previous research led to the development of four instructional units including a sequence of grammar animations on two-way prepositions in German. The success of the programs developed for, and used in, the study was then measured in terms of learner performance in the correct application of the grammar rules under investigation. A previous pilot study on related grammar topics conducted with fewer informants in a setting similar to the one designed for the present study had shown that learners' performances increase, error frequencies decrease and retention improves when animations are used (Roche & Scheller, 2004). In the pilot study, 47 animations covering different grammar focus areas (such as syntax, two-way prepositions, pronoun *es* (*it*), word formation rules) were processed by a group of intermediate and advanced learners of German with different L1.

The results of the pilot study were instrumental in focussing the design of the study reported in the present paper. Overall, we used more detailed visual clues for the depiction of functional and semantic parameters. We also offered a longer viewing exposure to the animations and expanded the practice sequences for the informants.

RESEARCH BACKGROUND

The central element of the cognitive theory of multimedia learning (Mayer, 2005) is the dual coding theory (Paivio, 1986; Sadoski & Paivio, 2004) which claims that the processing of verbal and visual information occurs in two functionally separate representational subsystems in the semantic memory. As a result, two separate mental projections are produced during the simultaneous processing of verbal and visual information modes.

Processing information in different modes and coordinating the processes relies on the availability of sufficient cognitive capacity as processing resources are not unlimited at any given time. An excessive demand on available capacity can produce an overload effect making it more difficult or impossible for a learner to process the information or reintegrate it into a coordinated entity. The success of the learner not only relies on the availability of sufficient resources but also on the manageability of the resources. Cognitive overload can be caused by processing tasks which are irrelevant for learning. In these cases, the manageability of processing can be secured or restored by reducing the extraneous load. This component of the cognitive theory of multimedia learning is known as the "cognitive load theory" (Sweller, 2005).

The strict separation of processing channels originally formulated in dual coding theory has received some criticism more recently which led to far reaching modifications (Engelkamp & Rummer, 1999; Engelkamp & Zimmer, 2006).

Instead of assuming that the results of the separate processes are stored largely in separate ways and only recombined at a later stage, the modified theory emphasizes the benefits of an early and continuous coordination of semantic information on a non-modal processing level. A lack of an early and continuous coordination of semantic information received through different input channels would require largely independent and fairly inflexible processing structures in the brain as well as a lot of attention during the recombination process. Early and continuous coordination of the different processes, on the contrary, relies on partially shared processing structures in the brain, divides the attention required for the processing into smaller tasks and allows for more flexible reactions when the processed information is complex, for example, when the visual and verbal input do not fully correspond or are modified during processing.

However, it remains undisputed that the formation of referential connections between verbal and visual information and the construction of an adequate mental model which relies on information stored in the long term memory is essential for meaningful learning. Only when verbal and visual information is integrated into a common mental model can meaningful learning occur. This is known as the "generative learning principle" (Mayer, 2005).

Mayer, Moreno, Boire, and Vagge (1999) and Mayer and Sims (1994) therefore stress the importance of a close temporal and spatial coordination of separately processed information for generating positive effects on the activation of stored knowledge and retention of new information. This effect has become known as the "contiguity effect." In language learning a contiguity effect can occur when verbal information is accompanied by related and well coordinated visual information. In such instances, it can provide support for the learner's mental processing of the content. If the processing is not coordinated, however, interferences are likely to occur making it more difficult

for learners to process and retain the information (cf. the critical review of research literature in Seel, 2000).

Within the integrated model of text and picture comprehension, the comprehension of verbal and visual information is described as a process in which multiple mental representations are constructed and visualisation has a significant effect on the construction of mental models. Research by Schnotz (2005) provides empirical evidence to support this model.

Since the constructed mental models are dynamic in nature, we conclude that they might be best supported by dynamic forms of visualisation, that is, animations. As a result, when designing the experiment we expected that the groups working with animated programs obtain better results than those working with static grammar presentations. We expected a similar positive effect as a result of another design feature: a conceptual and functional presentation of grammar. We assumed that both design features would produce a cumulative effect. By combining the conceptual and functional presentation with a dynamic delivery system (i.e., in animations) we distinguished our experiment from Caplan's study (2002). Caplan (2002) designed her comparative study of an animated and static mode of presentation of German modal verbs based on conventional and formal teaching materials which she collected from common textbooks. Her hypothesis stated that word animations lead to a better understanding of morpho-syntactic grammar rules than static presentations. However, the results of her study did not confirm the hypothesis. The formal materials used in the study as well as the fact that modal verbs in German have few semantic connections to movement in our view provide only restricted use for animations and therefore can explain the negative results of Caplan's study.

In order to study the effect semantic and functional connections between the grammatical principles and the animation might have, we chose a grammatical topic which does reflect the expression of movement as a distinctive feature: prepositions. German has four distinct cases which express semantic roles in an utterance, such as:

- Subject (nominative case)
- Object (accusative)
- Indirect object/receiver of an action (dative) and/or
- Possession (genitive).

These roles are often marked by prepositions. Consequently, nouns require a nominative, an accusative, a dative or a genitive marking, which is also expressed by the accompanying article. For more information on German grammar such as articles, please refer to Appendix A.

Among the prepositions requiring a case marking is a small group of highly frequent prepositions known as the two-way prepositions. These prepositions can take both the accusative and the dative depending on their functions in a sentence. Two-way prepositions are governed by various grammatical, functional and semantic parameters which often are not well understood by language teachers and not well explained in textbooks and therefore pose a particular problem to learners.

Local prepositions in German such as "in" (this corresponds roughly to "in" in English), "auf" ("on"), or "vor" ("in front of") require a different case according to whether they mark a direction (thus requiring the accusative form of the article) or a location (thus requiring the dative form of the article). However, traditional grammar guides operate with a variety of more or less accurate criteria to explain the difference to students, ranging from the very formal approach of prescriptive rule learning to contextual approaches using embedded context utterances in specific settings. A typical example for rule learning found in almost every German textbook would be: "The prepositions in, auf, vor, an ... require the dative to express a static position. They take the accusative with verbs of motion."

Teachers often add: "The dative answers to the question wo?, the accusative answers to wohin?" (cf. http://www.canoo.net/services/OnlineGrammar/Wort/Praeposition/Kasus/2Kasus.html). The differences of accusative and dative in German and their correspondences in English is illustrated in Table 1.

The following example serves to illustrate the communicative context of the grammatical choice:

1. The question: Wo fuhren Sie? (Where were you driving?)

suggests that the speaker wishes to know on what static platform, location, or surface someone was driving. This is equivalent to the question "On what surface were you driving at the time?" (may be used in a court of law to establish whether the surface on which the defendent was driving might have caused the accident). In this case, the answer would be something like:

> ... auf einer Landstraße
> ... on a country road. (auf = on in English).

2. The question, Wohin fuhren Sie? (Where were you driving to?)

suggests that the speaker wishes to know to what destination the person was driving towards. The answer that question could be:

> in die Stadt.
> ... into the city. (This sentence suggests a movement to a place not a location.)

However, asking the right question does not always result in the appropriate allocation of the case as such questions do not always lead to the right answer. The following example can serve as a counter example of why asking a "wohin" or "wo" question would not work:

Wir	fahren	über	die Brücke
We're	driving	across	the bridge

Die: *an article that marks the accusative*

This is because neither the question ‚"wo fahren wir?" ("where are we driving?," "wo?" dative, requiring *der*) nor the question "Wohin fahren wir?"("where are we driving to?," "wohin?," direction requiring the accusative) leads to the accurate answers. Neither of the question words can appropriately capture the movement onto the bridge. Simplified textbook explanations therefore often fail to produce positive short- or long-term effects on students' proficiency (Freitag & Vandermeeren, 2004; Wilmots & Moonen, 1997).

Table 1. A summary of related grammar points in German

	accusative *(wohin?)*	dative *(wo?)*
German	Sie hängte das Bild an die Wand.	Das Bild hängt an der Wand.
English	*She hung the picture on(to) the wall.*	*The picture is hanging on the wall.*
German	Du setzt dich auf den Stuhl.	Du sitzt auf dem Stuhl.
English	*You sit down on(to) the chair.*	*You are sitting on the chair.*
German	Wir legten uns in die Sonne.	Wir lagen in der Sonne.
English	*We lay down in(to) the sun.*	*We were lying in the sun.*
German	Sie rannten hinter das Haus.	Sie spielten hinter dem Haus.
English	*They ran behind the house.*	*They played behind the house.*

In contrast to formal descriptions of grammar, functional approaches have stressed the significance of the crossing of an (imaginary) boundary as the determining feature for the choice of the accusative with two-way prepositions (Freitag & Vandermeeren, 2004; Roche, 2005; Roche & Webber, 1996; Wilmots & Moonen, 1997). Consequently, the differentiating criterion for two-way prepositions is not the semantic feature of movement inherent to the verb but the functional feature of the marking of a boundary crossing in the meaning of the utterance. Accordingly, the location or movement within a given boundary or area is marked by the dative regardless of whether the verb expresses movement or not. This description is consistent with a model of cognitive grammar in which relations of moving objects in space are conceived as the contrast between a background (landmark) and the moving subject (trajector) (Langacker, 1999). A landmark represents the spatial area in which a moving object is situated. Accordingly, the criteria for choosing the appropriate case in German are as follows:

dative: the prepositional subject (*trajector*) remains within the immediate search area of the prepositional object (*landmark*); the *landmark* area is not being crossed,
e.g. Der Hubschrauber schwebt über der Brücke.
The helicopter hovers over the bridge.

The trajector (subject) is "der Hubschrauber" (the helicopter); landmark is "die Brücke" (the bridge).

accusative: the prepositional subject (*trajector*) moves into the immediate area of the prepositional object (*landmark*) and crosses its boundaries.
e.g. Wir fahren über die Brücke.
We are driving across the bridge.

HYPOTHESES

The hypotheses that motivated our investigation are consequently based on the assumption that conceptual and cognitive criteria pertaining to the dynamic processes of spatial markings described above are ideally suited for (dynamic) animations in multimedia learning.

Two hypotheses were tested on the assumption that the functional concept of boundary crossing reflects the grammatical principles more adequately than any formal or abstract description:

1. Learners who are presented with functional-conceptual instructional units in any presentation mode yield better results in terms of learning the rules and applying them over an extended period of time than learners who are presented with traditional explanations.

2. Learners who use functional-conceptual instructional units with computer animations outperform all other groups in terms of learning the rules and applying them.

We expected that the performance of all groups would drop over time unless the grammatical structures in question continue to be highlighted or are extensively used in further instruction. We assumed that a structure or rule which is better understood in the first place would lead to enhanced retention of that structure.

METHOD

The experiment took place in September 2006 at the Linguistic University of Minsk (Belarus). Eighty-nine first year university students, aged 17 to 22, who all spoke Russian as their L1 and were enrolled in the field of German Studies or the translators programme participated in our study. Ninety one percent were female, nine percent were male students. Despite the fact that the students

had a first-year status at the university, they were all intermediate or advanced students of German and had been exposed to the grammar of two-way prepositions in their previous language instruction in public schools in Belarus. However, they had achieved different proficiency levels in German because of the highly variable quality of teaching conditions in public schools in Belarus. The results of the grammar pretest on the correct use of two-way prepositions are shown in Table 2.

The dependent variable measured by the pretest was the choice of the right case with the two-way prepositions. To this end, participants of the study had to assign the accusative or dative case in the sentences presented to them.

We then assigned the informants at random to four groups:

1. A group that used functional descriptions in an animated mode ("boundary marking in animated mode," GA)
2. A group that used formal grammar descriptions in an animated mode ("wo-wohin in animated mode," WA)
3. A group that used functional descriptions in a static mode ("boundary marking in static mode," GS)
4. A group that used formal descriptions in a static mode ("wo-wohin in static mode," WS).

Based on the assignment, we conducted a variance analysis (ANOVA) as a global comparison of all pretest results of all groups. The test did not produce a significant difference between the groups in the pretest (F=1.6, p=0.19, p>0.05).

For the experiment we developed four different instructional units, each 45 minutes in length and containing instructional text passages, depictions, and exercises. The formal units were largely based on materials which are commonly used in textbooks for the teaching of German. For the functional units we based our design on criteria and concepts proposed by Roche and Webber

(1996), Freitag and Vandermeeren (2004), and Wilmots and Moonen (1997). For group GA an animated instructional unit on two-way prepositions of about 45 minute length was developed. It consisted of 25 interconnected animations on two-way prepositions embedded in explanatory text passages and exercises.

Following the pretest which consisted of a fill-in-the-blank exercise, we conducted the actual experiment after a brief introduction to the operation of the respective computer programs, the participants of the study had about 45 minutes to work through their units independently. They were asked to read the instructional texts and do the exercises only once and in the prearranged order. Immediately after the treatment, we conducted posttest 1 in order to measure short-term effects of the experiment. One week later, we conducted posttest 2 in order to assess long-term effects of the treatment.

All three performance tests (Pretest, Posttest 1, und Posttest 2) used identical or very similar test sentences in order to ensure comparability. However, some exercises were slightly altered with respect to their content, and the order of the test sentences was slightly modified to avoid interferences between the three tests, such as mechanical repetitions of learner answers (cf. Bortz & Döring, 2002; Diekmann, 2001).

Following this, all groups were asked to fill out a questionnaire in order to evaluate the animations or the static presentations in their respective programs and in order to obtain further qualitative data. This questionnaire is based on a study by Lewalter (1997) on learning with pictures and animations. Lewalter's study focussed on the thematic interests of the learners including affective ("interesting") as well as value-based components ("complicated," "helpful"). It was chosen because it is designed to produce results which can be validated empirically and because it allows the measuring of emotional and value-oriented parameters in different dimensions. Finally, we were interested to study to what extent

Figure 1. A screenshot taken from a task in the animated instructional units. Picture 1 shows a car travelling on a road which requires the dative (der) as in "Das Auto fährt auf der Straße" (on the road). Picture 2 illustrates the use of the accusative case (die) as in "Das Auto fährt auf die Straße" (onto the road), thus crossing a boundary.
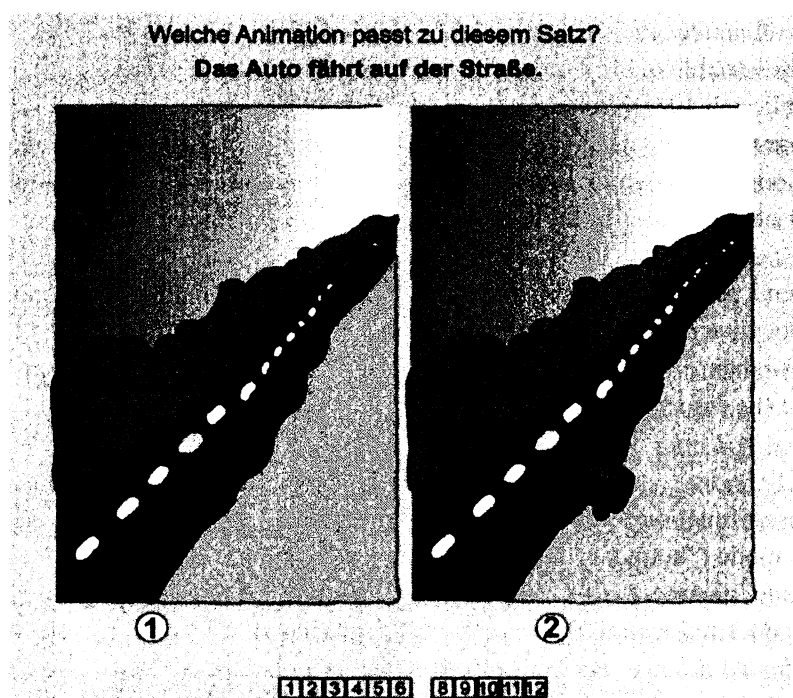
students in the various groups were able to transfer the skills they acquired in the experiment to a meta-cognitive knowledge level. Such a transfer would indicate how well students have understood the grammatical principles and whether or not they can monitor the correct or incorrect application of the grammatical rules with ease on their own. Results of a transfer test can be used as an indicator for long-term effects of the experiment. However, the findings of the transfer test are not presented or discussed here in further detail for brevity reasons. The issue of the development of meta-cognitive skills in a grammatical monitoring unit in language acquisition is discussed within its proper research context and illustrated using the complex supporting data of the transfer test in Scheller (2008).

RESULTS

We used nonparametric methods (Mann-Whitney-Test, Wilcoxon-Test) for pair comparisons because of the small size of the groups and because these methods are robust in terms of the standard distribution hypothesis (cf. Zöfel, 2003). In addition, we used a mixed linear method for data analysis. This method uses randomized personal traits in the analysis of the data in order to test for possible influences which could have an impact on measuring the learning effects. Both effects, mode of presentation (static vs. animated) and concept of explanation (formal vs. conceptual), show highly significant results overall. The concept of explanation is significant on the 5 percent level

(p = 0.000, no error probability). The presentation mode is significant on the 5 percent level (p = 0.001, virtually no error probability).

Table 2 shows that the standard deviation for GA is much smaller than for all the other groups. This suggests that the performances of students in GA are much more consistent than those of the other groups. Variation (STD) of GS and WA group actually increased in Posttest 2 whereas GA's performances stayed stable (as indicated by the decreasing trend).

In particular, the comparison of the results of the four groups in Table 1 shows that group GA (functional/animated) outperforms all other groups in both the posttests. This group shows a highly significant improvement in learning

performance in posttest 1 (p = 0.000). Also, comparisons of group pairs in posttest 2 resulted in highly significant differences between group GA and all other groups (p = 0.000). The comparisons did not produce statistically significant differences between the other groups.

The group obtaining the lowest results is the one that worked with the formal "wo-wohin" explanation in the static presentation mode (WS): the performance did not change with respect to the pretest level. The other two groups show improvement in posttest 1, but this increase is not significant and quickly dissipates as the sharp performance decline in posttest 2 indicates.

Our hypothesis which claimed that a conceptual approach to presenting grammar in conjunc-

Figure 2. Boxplots of the four groups in relation to the three points of assessment (WS: formal/static, WA: formal/animated, GS: functional/static, GA: functional/animated)
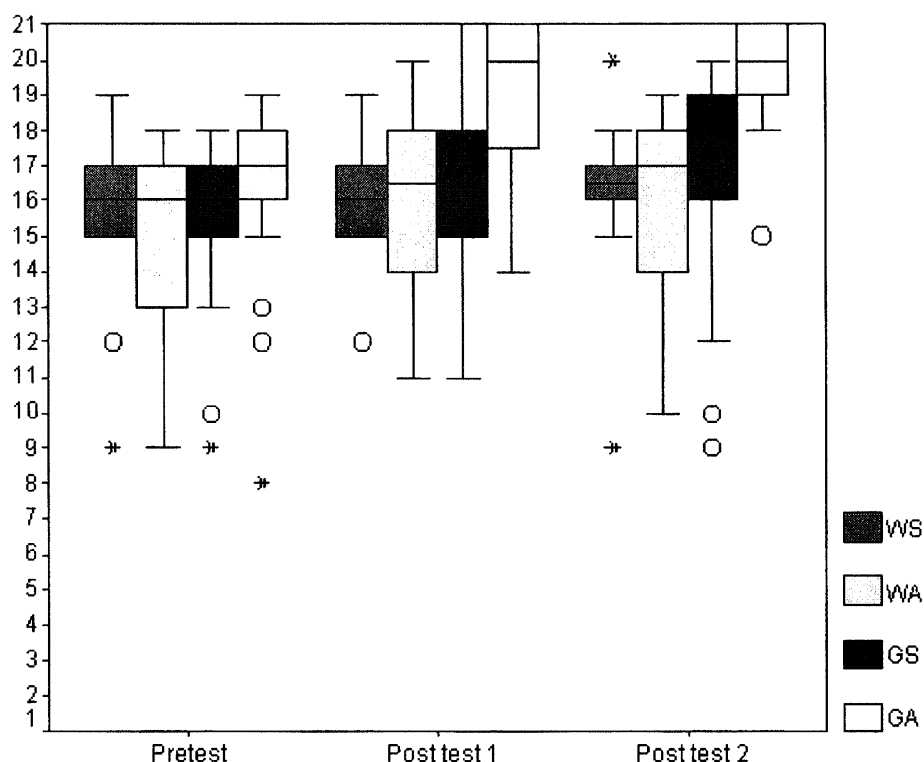
Table 2. Statistical data for all four groups in relation to the three points of assessment

	WS			WA			GS			GA		
	Pre	P1	P2	Pre	P1	P2	Pre	P1	P2	Pre	P1	P2
Mean	15.6	15.7	15.9	14.6	16.1	15.8	15	16.7	16.5	16.3	19.2	19.9
Median	16	16	16	15,5	17	17	16	17	17	17	20	20
Std. Deviation	2.46	2.01	2.42	2.89	2.78	2.91	2.96	2.51	3.06	2.48	1.98	1.53

Key:

WS: Formal/static

WA: formal/animated

GS: functional/static

GA:functional/animated

tion with an animated presentation mode would produce a positive and lasting effect on learning was therefore clearly confirmed. Nevertheless, we were surprised by the fact that the other groups showed such minimal improvement and virtually no lasting effect of the instruction.

We were also interested to see whether or not the performance of the students corresponds to their own assessment of instructional quality. To this end, we analyzed the respective comments made by the students on their post-experiment questionnaires. The analysis shows that the three groups of students performing best on the tests were generally satisfied with the quality of the instruction in our experiment. However, the WS group which received the lowest results does not rate the instruction as positive as the other groups (r (Pearson) = 0.218, p = 0.04). As was to be expected. These results indicate that the cognitive approach to teaching grammar using modern media does not only produce positive performance effects but appeals better to the students and therefore enhances their motivation to learn a foreign language.

DISCUSSION

Despite the fact that the learners' L1 (Russian) uses two-way prepositions as well as the L2 (German) and despite the fact that the linguistic concepts of goal-orientedness and movement versus static position at a location show similarities in both the L1 and L2, learners produce a high number of errors. This is particularly noteworthy as most informants in this study had a fairly long exposure to German as their L2 before entering the experiment. An analysis of the errors using the students' statements from the transfer test and questionnaire indicates that students make more errors when they do not fully understand the meaning of the verbs or the appropriate context of a verb.

Particularly problematic are those sentences in which the motion expressed by the verb is wrongfully associated with the accusative case:

e.g. Der Junge läuft auf <u>den</u> Sportplatz (incorrect)
the boy is running onto (accusative)
auf <u>dem</u> Sportplatz (correct)
on the sports field (dative)

or

Du kannst hinter den Bahnhof parken (accusative) (incorrect)

hinter dem (dative) Bahnhof parken (correct)

you can drive/park the car behind the station.

Furthermore, a large number of errors occur in sentences such as *der Bleistift ist auf dem* (dative) instead of *den* (accusative) *Fußboden herunterge- fallen (the pencil dropped to the floor)*. We suspect that a different case is chosen by the students in such instances because the goal-orientedness (movement) inherent to the verb meaning interferes with the perfectiveness of its tense marking (here present perfect) which students possibly link to a static result. This hypothesis is supported by the fact that an overproportional number of our informants in the formal groups produce case errors in the respective test sentences.

In addition, the experimental studies conducted by Wilmots & Moonen (1997) and Freitag & Vandermeeren (2004) support our claim as well. Our data sets show a clear division of the test groups: both formal groups produce an increase in errors in posttests 1 and 2, but error rates drop in both groups that worked with the functional concept as the main element for explaining the grammatical principle. The functional concept thus produces a more complete understanding of the rules. Moreover, the combination of the conceptual approach to grammatical rules and grammar animations enhances language learning more than any other mode.

CONCLUSION

The study leads to some preliminary conclusions as to the conditions of use of visual elements in language learning. It indicates that animations themselves do not automatically lead to an en-

hancement in language learning. Rather, only animations constructed according to a closely defined set of didactic and functional (cognitive) principles are able to produce positive learning effects. This might be the reason why Caplan's study (2002), which relied on the grammar presentation of conventional textbooks, was not able to produce significant results on research hypotheses similar to ours. It must be noted that the participants of our study were experienced, linguistically interested and motivated learners who had a common first language (Russian) and shared a learning culture. Generalisation to all learners of German or all language learners subsequently is not yet possible and therefore necessitates further research. A decision on the choice of design principles of animations for other language programs can only be reached after further research and analysis of the grammatical concepts in question. This not withstanding, many of the animations tested in the pilot study, as well as in the study reported here, are now being used in identical or modified ways in language learning programmes for German offered by the Deutsch Uni Online (DUO), a virtual language school with course offerings in German, English, French, Japanese, Mandarin Chinese, and Brasilian/Portuguese. These animations already made their way into regular course offerings where, at the same time, they are serving as research instruments for further studies.

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KEY TERMS

Case Markings: Languages such as Russian, French or German use an inventory of grammatical cases to mark certain grammatical functions in a sentence, such as the subject ("doer of an action"/nominative, object/accusative or "receiver of an action"/dative). In English, only the genitive case (Mary's friend) explicitly is marked. The markings are generally expressed by endings of the nouns and/or, as in German, by particular forms of the articles.

Cognitive Theory of Multimedia Learning: The central element of the cognitive theory of multimedia learning is the dual coding theory which claims that the processing of verbal and visual information occurs in two functionally separate representational subsystems in the semantic memory. As a result, two separate mental projections are produced during the simultaneous processing of verbal and visual information modes. Processing information in different modes and coordinating the processes relies on the availability of sufficient cognitive capacity as processing resources are not unlimited at any given time. An exceeding demand on available capacity can produce an overload effect making it more difficult or impossible for a learner to process the information or reintegrate it into a coordinated entity. The success of the learner not only relies on the availability of sufficient resources but also on the manageability of the resources. Cognitive overload can be caused by processing tasks which are irrelevant for learning. In these cases, the manageability of processing can be secured or restored by reducing the extraneous load. This component of the cognitive theory of multimedia learning is known as the "cognitive load theory".

Conceptual and Functional Presentation of Grammar: Other than formal and rule-governed explanations of grammar, conceptual and functional approaches focus on understanding and explaining the underlying concepts as well as the semantic and pragmatic functions of grammatical structures. They are often process-oriented approaches to language rather than merely structural ones.

Contiguity Effect: In language learning a contiguity effect can occur when verbal information is accompanied by related and well coordinated visual information. In such instances it can provide support for the learner's mental processing of the content. If the processing is not coordinated interferences are likely to occur making it more difficult for learners to process and retain the information.

Grammar Animation: Grammar animations are used to visualize grammatical rules which are otherwise difficult to explain. Grammatical rules which express a movement or process are best suited for animations. Abstract verbal descriptions or static visual information often do not capture the essence of such rules.

Prepositions: Prepositions are used in many languages to connect content words such as verbs, adjectives, names, nouns and pronouns to other content words. In languages such as English, French and German they often require an article (the, a, an in English) to connect to a noun. In German, that article generally marks the semantic function of the connected noun or a purely grammatical link using a particular case marking. The markings are frequent and often carry meaning. Two-way prepositions require a certain case marking based on whether or not they mark a change of location or a crossing of a boundary. Because prepositions are plentiful and require grammatical markings, they pose a particular problem to learners.

Software Evaluation: The evaluation of software usually is done by applying non-systematic checklists to a particular program. More recently, theory-based approaches to software assessment

have been proposed which incorporate relevant criteria derived from linguistic, pedagogical and psychological models of language learning and teaching.

APPENDIX A

This is taken from http://www.learnplus.com/guides/germangrammar03.html

There are two kinds of articles in German: definite and indefinite:

Definite articles are used to indicate specific nouns (e.g. the person of which we have already spoken in a speech, the thing about which we have already read in a written passage, etc.) The German definite articles are:

- Singular masculine - der Brief *[the letter]*
- Singular feminine - die Tasche *[the bag]*
- Singular neuter - das Mädchen *[the girl]*
- Plural for all genders - die Leute *[the people]*

Indefinite articles refer to nouns in a non-specific way. The German indefinite articles are:

- Singular masculine - ein Tisch *[a table]*
- Singular feminine - eine Zeitung *[a newspaper]*
- Singular neuter - ein Glas *[a glass]*