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ABSTRACT

A computer-assisted instructional (CAI) system for teaching Russian to college students is described. It was operational at Harvard University until September 1971 and then transferred to the State University of New York at Stony Brook. Treatments of second language acquisition, a critique of previous work in the field, and some remarks on CAI language teaching are followed by a discussion of the present system. The points are made that the course is non-linear and individualized, allowing students to choose their own learning paths, and that a large amount of data is collected which can be analyzed for basic study regarding the acquisition of a second language by individual students. Also indicated is the fact that although the course stresses the Russian morphological system, the construction of the computer program is applicable to other languages and language teaching specialties. (Author/PB)

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ABSTRACT

We describe a prototype Computer Aided Instruction system for teaching Russian, which has been operational at Harvard University (Sept. 1970 to Sept. 1971), and at the State University of New York at Stony Brook (Sept. 1971 until present, depending on funds). The course allows the student to work his way through, choosing his own learning path, and the system provides "audit trails"; it gathers and analyzes data for basic study in the acquisition of a second language by individual students. Although the course stresses the Russian morphological system, the construction of the computer program is applicable to other languages and language teaching specialities.

General Comments

Intense linguistic debate during the last decade has given birth to powerful new tools of linguistic analysis. In the study of English, research has revealed unexpected structure in our language (e.g., Reibel & Shane, 1969); newly developed linguistic concepts have enabled us to pose and sometimes to answer questions concerning first language acquisition by children (Gruber, 1969; Lenneberg, 1967; Laban, 1963). We are beginning to reconcile the views of linguistics, philosophy, psychology, and biology on language (Carroll, 1965; Chomsky, 1968). However, recent linguistic science has, so far, hardly turned its attention to the theory of second language acquisition nor to empirical descriptions of second language learning (Carroll, 1960). Records have not been kept of the progress of second language learners in vivo (as has been done many times now with childhood acquisition of English). nor has classroom training in a second language been a natural medium--first, because the student's training is not individualized, and second, because the student is not in control of his learning options but rather is given a necessarily linearly organized textbook reflecting the author's linguistic ideology. (For example, note the Modern Language Association Spanish textbook with its heavy emphasis on phonemics and oral-aural techniques.) Moreover, he is graded on certain types of performance, on examinations and the like, but no records are kept which could give any clue as to what pat he followed toward linguistic

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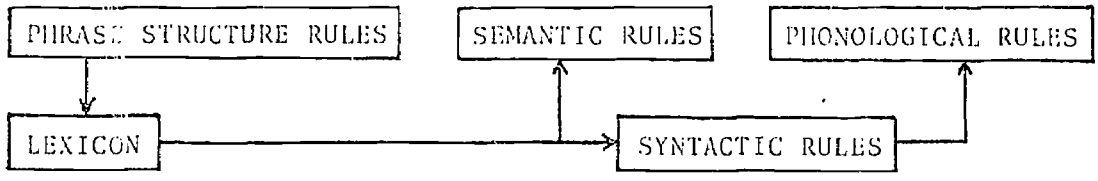
competence (e.g., Scherer and Wertheimer, 1964). Whatever defects a computer-based teaching system has, it at least overcomes the three just listed. It can be non-linear, individualized and can collect masses of data for analysis (e.g., Adams, Morrison and Reddy, 1969; Morrison and Adams, 1969; Adams, 1968, 1969; Stolurow, 1969).

Our starting point is the observation of the similarities in the process of adult second language acquisition and first language change. The theoretical bases of first language change are most clearly presented in Kiparsky ("Linguistic Universals And Linguistic Change", 1968) and are firmly rooted in the studies of generative grammar conducted during the past decade by Chomsky, Postal, Katz, Ross, Lakoff, and McCawley, for example.

What is Second Language Acquisition?

Let us begin by assuming to be reasonably true the model of language competence used by modern grammarians, which can be diagrammed as follows.

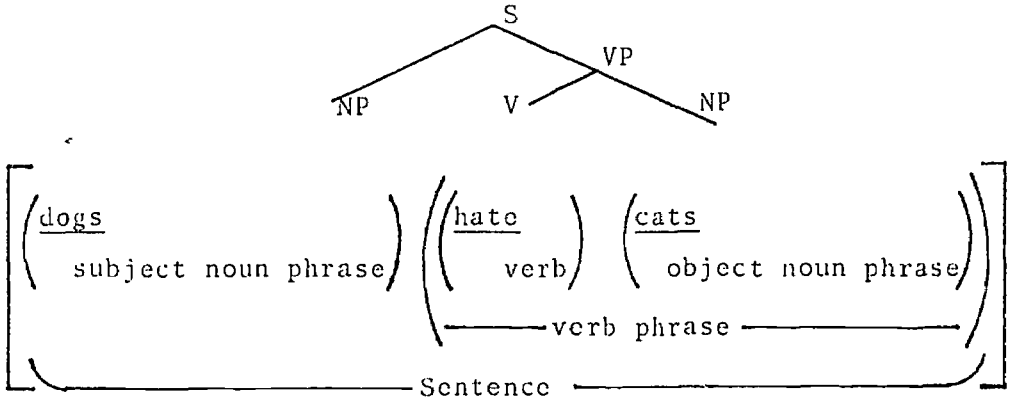


The phrase structure rules generate the simple sentence forms, e.g.:

((NP) subject noun phrase ((V) verb (NP) object noun phrase)) verb phrase)

Sentence

Then the lexicon inserts words, e.g.,



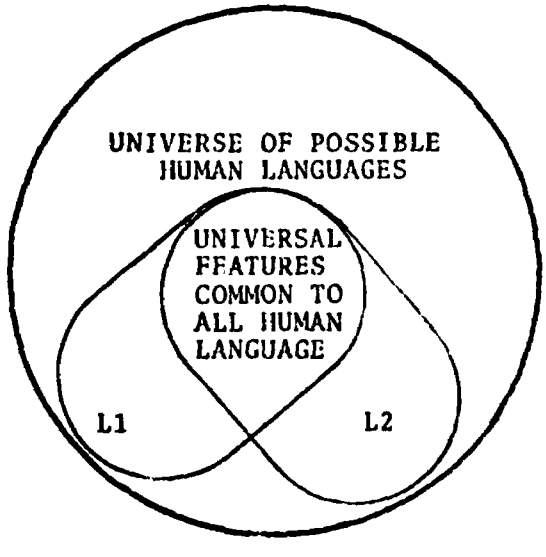
Semantic rules explain what the sentence means; syntactic rules such as passive formation and question formation transform the simple sentence (e.g., "Are cats hated by dogs?"); and phonological rules tell you how to pronounce the sentence.

Moreover the rules are ordered. For example, passive formation is ordered before question formation to give 1) "Cats are hated by dogs." and 2) "Are cats hated by dogs?" Applying these rules in the wrong order would give 2) "Do dogs hate cats?" and then 1) "Do cats be hated by dogs?", which is anomalous English.

The final point to keep in mind is the distinction between language competence and language performance. As an illustration, if a powerful computer and a weak computer employ the identical programming language (say, FORTRAN) they have identical competence--only the first one performs much better than the second. In the same way we may teach two students second language vocabulary, grammar, etc., to identical levels of competence; that is, they will have similar ability to characterize grammatical and nongrammatical sentences correctly. But they may have wildly dissimilar levels of performance due to such imponderables as second language embarrassment, lack of interest in some type of performance such as writing, differing tolerance of cross-language interference, etc.

We will carry on the rest of the discussion emphasizing competence, how the student establishes it, and how we verify that the student finally has it.

In the past some linguists have argued that "since sound is primary", aural-oral methods are sufficient (see Carroll, 1960). Many pedagogues believe, however, that there is a way to facilitate L2 learning. The approach they advocate, (sometimes called the "cognitive code-learning theory") is to bring the structure and rules of L2 to conscious awareness and wait until they sink in to the point where they are unconsciously integrated into a generative L2 grammar. If linguists--as opposed to polyglots--learn L2's faster than other people, it is presumably because such sublimation does occur; if a person is a linguist and a polyglot and if he learns L2 yet more quickly, it must be because he has trained his sublimation mechanisms. So far as we know, thoughts on the question of whether bringing rules to consciousness and then sublimating them is efficient have not passed the level of speculation. This is one of the key questions our system is designed to investigate.



It is our prejudice that most L2 learning by college-age learners consists essentially of simple addition of marked rules and lexical items, coupled with neutralization of old rules which are inappropriate, and that the component of internalized grammar which is both most receptive to and efficacious for L2 learning is the lexicon. The lexicon in particular seems to be receptive to innovation at any age level: a person is always able, for instance, to pick up a new jargon when he changes jobs.

But whether this or any other proposed optimum scheme of L2 learning is appropriate (i.e., whether it is appropriate to prejudice an L2 teaching algorithm in any particular direction) awaits research into the mechanisms of L2 learning. Providing a maximally unstructured learning environment of the type proposed and watching the paths chosen by students as they increase their competence, is the first step toward this goal.

The answer to the question of how to test for L2 competence is contained in the meaning of competence, which we have defined to be the ability to characterize grammatical sentences as grammatical and nongrammatical as not. Thus, for evaluation purposes, the students are presented with test sentences some of which would be correct in L2 and some incorrect. Correct classifications define competence.

We can characterize correct and incorrect L2 sentences into +L1 if their grammar is very similar to G1 and -L1 if it is novel relative to G1. For example, in Russian the correct (+L2) "Ja ej ono daval" is -L1 (i.e., -English) because English does not permit us to place indirect object pronouns before the verb. Again, the morphologically incorrect (-L2) "Ja perezubnul poezdom v Leningrad." is -L1 because English morphological rules are irrelevant in this case.

Thus, all the sentences presented to students can be characterized as (+L1, +L2), (-L1, +L2), (+L1, -L2), or (-L1, -L2). We have suggested that a student starts off using his L1 grammar on L2 and gradually switches over. If Hi, Med, and Lo refer to the frequency of characterizing a sentence as correct, we would expect a progression

from

	+L2	-L2
+L1	Hi	Hi
-L1	Lo	Lo

through

	+L2	-L2
+L1	Hi	Med
-L1	Med	Lo

to

	+L2	-L2
+L1	Hi	Lo
-L1	Hi	Lo

as the student progresses in his competence. But the details of this progression are not at all clear and must be investigated. The Role of Morphology in Second Language Acquisition

Previous research on second language vocabulary learning has usually assumed, and if necessary insured, that there be no internal lexical structure; that is, the lexical items are all statistically independent.

The typical experiments have been paired-associate tests where either nonsense words or foreign words were used either as the stimuli or the responses. The articles by Kopstein and Roshal (1954, 1955) and the books by Underwood and Schultz (1960) and by Osgood (1953) are illustrative. Even in the Crothers and Suppes (1967, p. 144) model the "assumption is now made that the items are learned independently of one another....all the data to be reported bear on the original model which does assume independence."

In English we know hundreds of thousands of words; but we didn't have to learn them all separately. To be sure, there are some words like Winnepesaukee or chimpanzee which have no "parts" and are related to no other words; we have to learn them whole. But most words have parts. For example, "television" has the parts tele and vision, and because there are other words in English (e.g., telephone, telegraph, revisionist, visionary, etc.) which contain these same parts with roughly the same meaning, we get the word "television" almost for free. Likewise, "design, designate, designation, designational" are not four separate words. One learns a base word and learns what endings, e.g., (Ø, -ate, -ation, -ational, -ationality) it can take. Thus "design" can take the 1,2,3, & 4th endings; "resign" can take only the 1st and 3rd endings; "nation" cannot take the 1st and 2nd endings. In Finnish, where nouns have 2 numbers, 14 cases, and 6 personal endings, one recognizes that to learn the 168 possible "words" he need only learn one base form. In Russian there are also word nests where a single root gives rise to a great number of words with various prefixes and suffixes. Thus, for example, the following is a small fraction of the derivatives of the root "vod" (or "ved") which has a primitive meaning of lead.

vod-it	lead
raz-vod	divorce
pere-vod	translation
v-ved-en-ie	introduction
pro-ved-en-nyj	drawn out
pro-iz-ved-en-ie	ouvres
pro-iz-vod-stvo	production
ruk-o-vod-it-el	leader

This is the usual situation in language: words have parts and appreciation of these parts simplifies enormously the acquisition of the vocabulary.

Thus, it is not surprising to discover in the conclusion of Crothers and Suppes' (1967, p. 311) work, Experiments in Second Language Learning, the statement that "... in these second language learning experiments the proportion of correct responses usually seemed to depend more on the detailed structure of the item than on the presentation order variables that were examined." In our system we have applied the brunt of our effort toward facilitating the students' apprehension of the Russian morphological system and toward testing his comprehension of it.

Critique of Earlier Work

In general, we find most recent work to be either overburdened by behavioralist baggage and preoccupied with the phonetic aspect of verbal behavior (Lane, 1965), or too nonspecific to be of any potential help. More

recent views are more relaxed but perhaps too simplistic in comparing first and second language learning.

First, a quote without editorial comment from a recent book by Oliva on second language pedagogy.

> Given America's contemporary needs (sic!!!) the audio-lingual goals of modern foreign language instruction should receive primary stress. There can be no doubt that students are learning foreign language better than they have in the past, and what is more, they are learning to communicate in the language, a skill that older programs did not develop. (Oliva 1969, p. 13)

Lane's article is an exercise in behaviorism.

> The new emphasis is that linguistic specifications are a sine qua non for the conditioning enterprise: they codify group norms for verbal behavior in the relevant language community and, therefore, provide the programmer with criteria for acceptable forms and sequence of responses. (Lane 1965, p. 584)

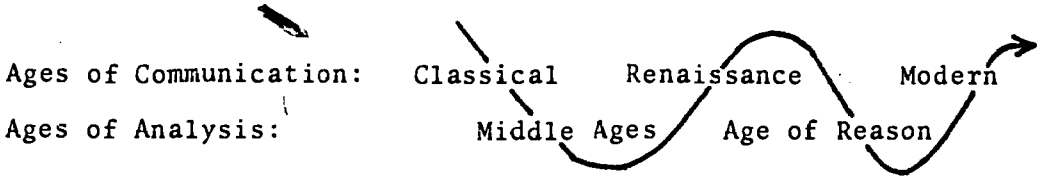
Modern theoretical linguists have hardly touched the topic of second language learning. Among the exceptions are Cook (1969), Jakobovits (1968), Richie (1967), Newmark and Reibel (1968), and Ratatoskr (1969). Cook suggests that grammatically richer examples can be given the student than is ordinarily the case. Jakobovits questions the efficacy of pattern drills and practice in general. Richie argues among other things that visual presentation of sentence structure is often better than oral-aural techniques for instilling competence.

Newmark and Reibel (1968, p. 161) note that since nothing is known about the differences between first and second language learning, the safest assumption about how to teach a second language is to do it like a first one, since that is known to work, at least with children. This "enables the learner to acquire the general use of a foreign language by observation and exercise of particular instances of the language in use." They say such observation and exercise is necessary because without it language cannot be learned as language, and sufficient because the learner can do the analysis himself.

Ratatoskr's work emphasizes that grammatical forms which native speakers would never employ can nevertheless be effective instruments in communicating with the second language learner. Often, general principles of communication (for example, make your interlocutor supply you with the vocabulary; use the base form if you do not know the ending) supersede principles of the particular grammar. Moreover, initial technically "wrong" attempts in the language can be the basis for later, more "correct" use.

Perhaps the most sober assessment of language teaching methodology is contained in Kelly's 25 Centuries of Language Teaching. He notes that views of language teaching are subject to tides of fashion. As indicated by the diagram below, there is oscillation between the mechanical and

philosophical, between the study of language for the sake of communication and for the sake of analysis.



> It is clear that ideas do not exist on their worth alone. If this were so there would have been no evolution after the formation of a definitive corpus, and development would have stopped with Quintillian or Erasmus. Two factors have worked against this state of affairs: the changing perception of needs in the teaching profession; and the tendency of ideas to become sterile and men doctrinaire, causing independent minds to rebel and strike out on their own. These have been the motivations that have occasioned teachers to develop as many resources as possible to meet the changing problems of the transmission of knowledge. As in the fine arts, needs, approaches, and resources change, and one generation's heresy becomes the orthodoxy of the next. (Kelly 1969, p. 408)

General Remarks on Computer-Aided Language Instruction

Most previous treatments of computer-aided language instruction have operated in a rather tight behavioristic context: "In thinking how a computer can be important as an aid in learning, I am influenced by the view of learning as operant behavior" (E.N. Adams 1968, p. 1). "Learning is made possible only by the abilities of the organism to perceive the demands of the environment." (P.S. Rosenbaum 1968, p. 3)

The immediate consequence of this approach to the teaching of a second language is that a structured teaching environment is developed that channels the student's performance with respect to a set of objectives. This implies, moreover, that an ordered sequence of goals be chosen and that progress be determined by an arbitrary set of criteria such as high achievement on some particular test. Considerations of efficiency lead typically to very linear programs, which follow a specific point of view of the path learning ought to take.

There are three objections. The first is that it allows for no multiplicity of goals either in the obvious sense of choosing, say, among learning to read, to speak, or to write; or in the general sense of self-motivated goals such as beginning to learn by first ignoring grammar and amassing vocabulary, simply because the student likes to learn this way.

Secondly, such an approach allows for no multiplicity of paths toward competence and assumes that pedagogical science already understands the learning process well enough to justify confining a student to fixed learning strategies.

Thirdly, there is an obvious competing view of learning: not that the environment impels students to learn but rather that they propel themselves

by a spontaneous joy in understanding. This view implies a different role for the pedagogue. He should present to the student complex data and then, to the extent that it is possible to perceive them, lower the barriers to understanding.

Leon Jakobovits in his excellent book Foreign Language Learning expresses our point of view.

> Development of computer-based programmed instruction in language offers the possibility of a real alternative to the present inadequate policy of basing teaching practices on theoretical generalizations gained from laboratory experiments. Computer-based individuated instruction, when fully developed, will not represent a teaching method as this is understood today. Rather it will consist of a conglomeration of many techniques and combinations thereof, fitted to the individual learner in terms of his own learning strategies, learning capacities, interests and goals. Each student will be taught by a different method when one considers the total teaching process from beginning to end, that which is most effective for him and most consistent with the goals he has for learning the language. (Jakobovits 1970, p. 39)

It is obvious that the best teaching aid for a student learning a second language is intense personal involvement. But we must ask what tasks we can perform with limited facilities (i.e., the impersonal computer), and what tasks are better left untouched. First, we would like to disclaim responsibility for teaching a native pronunciation. That is something a person with this kind of receptivity learns sometime after landing among native speakers of the second language, and until that time an approximate pronounciation is sufficient to allow him to learn vocabulary accurately. Similar remarks apply to the inculcation both of racy contemporaneous idiom and of elegantly literary and impeccably grammatical writing style--these are best absorbed in association with the respective peer groups at such time as a student encounters them. Moreover, the computer is poorly adapted to handle such teaching tasks.

However, we feel there are two attainable goals: 1) helping the student to attain a minimum competence in the language, which is the prerequisite to any sort of performance in speaking and writing, and 2) helping him read at some level of adequacy any arbitrarily demanding text in the second language.

Our System

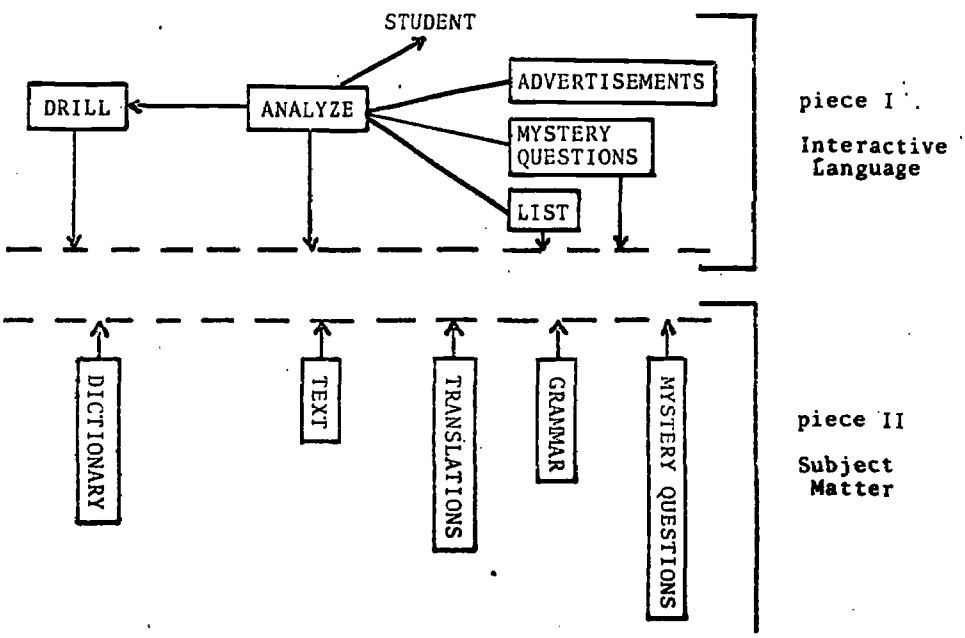
We are presenting our system as a text in which vocabulary is introduced in such a way as to facilitate comprehension of the lexical structure. We are not restricting the syntactical richness of the text except to keep sentence length down to human dimensions and to forbid an inordinate amount of syntactic activity (transformations or whatever) from taking place in any one sentence.

We offer to the student an explicit syntactic and semantic analysis of every sentence, but we do not teach grammar per se, nor do we organize our text in any syntactically motivated order.

While we are making no particular effort to teach anything but vocabulary and grammar in our system, we note that there is an increasing conviction among linguists (e.g., Newmark, Richie, Reibel, Jakobovits) that unsequenced presentation is the optimal strategy for second language learning anyway. That is how children learn their first language, and we doubt that adults have lost that much language learning ability. After all, adults easily pick up new job jargons and it is known that adults can make the changes in their (phonological and syntactical) rule inventories that are responsible for the well documented phenomena of language change.

In our system the student typically takes a text oriented learning path. Alternatively he might prefer to browse through the grammar section with easy reference to the text for examples. He is able to switch paths or move vertically into deeper layers of linguistic knowledge and out again. For example, from reading the text he can ask the meaning or etymology of a word; if the explanation of the etymology is confusing or interesting, he can ask for an explanation of the grammatical terms (e.g., he could type in the words "verbal noun" and the computer would explain what a verbal noun is); the computer can also provide references to locations in the text of examples of grammatical categories, and the student can puruse these; the computer keeps track of all the student's vocabulary questions and the student can review vocabulary at any time; then the student can return to and proceed further in the text from the point at which he left. During his conversation with the computer the student is also given Advertisements and Mystery Questions. The Advertisements gradually acquaint the student with the full capabilities of the system. The Mystery Questions are a collection of Russian sentences and semi-sentences chosen to illustrate correct and incorrect application of lexical grammatical rules; the student (in the only coercive part of the program) is required to characterize the sentences as grammatical or ungrammatical to allow the investigator to follow the student's learning path and to allow the student to see areas in which he needs further work.

The following diagram presents, in schematic form, our view of a Computer-Aided Language Instructional System.



The program is written in CAILAN, a dialect of COURSEWRITER III, and was run on an IBM system 360/65 at Harvard. The program consists of two completely independent pieces. The first piece is an interaction language that allows the student to interact with his subject matter. It is language independent: it could be used to teach Spanish or (European) Georgian as well as Russian. The second piece is the subject matter itself, consisting of the text, the translation, the grammar, and the dictionaries. To compile this second piece no computer expertise is necessary; any language teacher could load his own course into the computer. We only loaded enough material into this second part to serve demonstration purposes: it amounts to only 7 sentences of text, 7 sentences of translation, 20 items of grammatical information, and about 300 dictionary entries. Despite being so abridged it seems able to keep a second year student happily occupied for as long as five hours. At current Harvard prices it costs about a nickel per student interaction. Typically students spend somewhat more than a minute per interaction so per hour costs of something like $2.00 are typical.

The text itself is fairly dull; it seems that dull text best illustrates complex word formation in Russian. The grammar section is of quite high quality, being based on the research of Alex Lipson into Russian morphology. We tried out a preliminary version of the program on 15 students of Russian, who were then asked to respond to the following questionnaire. (see page 15; numbers of responses are circled).

* * * * * * * * * * * * * * * * * *

Editor's Note: Readers who would like more information about this project, including an extensive sample conversation illustrating many features of the system, are invited to contact Tom Manwell, Box 27, Conway, MA 01341. The Final Report is also available through the ERIC Clearinghouse on Media and Technology, Stanford University, Stanford, CA 94305.

Questionnaire

1. Was it fun?

   1. very (6) 2. moderately (9) 3. neutral 4. moderately unpleasant 5. extremely unpleasant

2. Did you learn anything?

   1. nothing 2. a little (6) 3. some (3) 4. quite a bit (4) 5. a great deal

3. Do you think that this system holds promise? Especially with respect to programmed instruction?

   1. a tremendous amount 2. a lot (10) 3. some 4. a little (1) 5. none at all (1)

4. Did communication with the Mentor seem like a real conversation?

   1. completely (5) 2. very much (3) 3. somewhat (1) 4. a little (2) 5. not at all (4)

5. How was the transcription?

   1. impossible 2. very difficult (1) 3. difficult 4. annoying (3) 5. no problem (9)

6. Did you progressively understand more of the program's capabilities?

   1. not at all (1) 2. a little 3. somewhat (1) 4. quite a bit (4) 5. very much (9)

7. Did you have an impression of depth, i.e., that the computer could answer questions in as much detail as you needed?

   1. very much (8) 2. quite a bit (1) 3. somewhat 4. a little 5. not at all (6)

8. How much time did you spend at the terminal? *average 30 minutes*

   How much time should one spend per session? *average 1 1/2 hours*

   How many sessions per day? per week? *average 1 session/day*

9. Is working on this project a worthy occupation for Western Civilization?

   1. in general a good project for Western Civilization (10)
   2. in general not worth doing (3)

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