

Some Notes on Russian Predicative Infinitives in Automatic Translation*

by Henrik Birnbaum, University of California, Los Angeles

Some considerations are presented regarding certain aspects of automatically translating Russian predicative infinitives into English. Emphasis is placed on the analysis (decoding) of the pertinent infinitive constructions in the source language rather than on the synthesis (encoding) of their equivalents in the target language. The paper does not aim at an exhaustive treatment of the problem, but merely offers some tentative and peripheral suggestions as well as some criticism of previous endeavors to tackle the problem of Russian predicative infinitives in machine translation.

The following remarks and suggestions are by no means offered as an exhaustive treatment of the problem of manipulating predicative infinitive occurrences in Russian-English machine translation, or even of some particular fraction of that problem. What follows is rather a tentative contribution to a discussion in progress apt, at best, to offer some additional angles or perhaps to raise some points hitherto overlooked.

Of the two fundamental computer-internal components of the machine translation process (and, incidentally, of all translation), namely, analysis (or decoding) of the source language (here Russian) and synthesis (or encoding) into the target language (here English), we will deal in some detail only with the former component, that is, mechanical recognition and more specific identification of the Russian predicative infinitive. In addition to analysis (of the input data of the source language) and synthesis (into the output of the target language) many experts in the field now assume a third, independent component of the translation process, namely, transfer (of information, from one linguistic structure to another). The restriction to the analysis aspect of automatically translating Russian predicative infinitives imposed in this paper is motivated not only by the narrow scope of the author's own competence in the field of machine translation but also by the current state of pertinent research and its general outlook (cf., e.g., recent contributions by Abraham,¹ Oettinger, esp. p. 11;² and Bar-Hillel³). The fact that English translations of Russian infinitive sentences are frequently offered does not imply any discussion of the problem of synthesis into English. A genuine discussion of that problem would, among other things, require in-

sights into the deep structure of English not yet available (at least to the present writer); also, such a discussion would fall beyond the limited scope of this paper. Therefore, wherever translations are given, they serve only to render the meaning of the respective Russian examples (using, one may say, English as a sort of metalanguage), not to elaborate on or even to illustrate the linguistic aspects of translation into English. Moreover, our following observations and suggestions are meant only to serve as a point of departure for the computational linguist and the computer technician concerned with the practical application of linguistic analysis to linguistic computation (i.e., the devising and programming of the appropriate algorithms), and to hardware techniques, including those of input and output. Clearly, the unproductive uses of the Russian infinitive in idiomatic combination with some other lexical item or items, fairly limited in number, can simply be listed (to the extent frequency considerations and the particular needs involved make it desirable) as fixed idioms or idiomatic phrases and entered in the automatic dictionary as uninflected forms. On dictionary problems and procedures in automatic translation, see, for example, Oettinger,⁴ Mounin (including a discussion of "word groups" and idioms),⁵ and a recent sketch by Harper.⁶ This would apply, for example, to so-called parenthetical infinitive expressions such as *tak skazat'* "so to speak," *pravdu (po pravde, vpravdu) skazat'* "to tell the truth, frankly," *priznat'sja* "I (you, one, etc.) must admit" (along with *priznajus'* "I admit"; also, with virtually the same meaning, *priznat'sja skazat'*), *ni dat' ni vzjat'* "no more, no less; just so, exactly" (cf. English "give or take ..." in the sense "... more or less"), etc., as well as to certain fixed "nuclear infinitive" expressions, for example, *(ne) vidat'* "you can(not) see" (also in the expression *ni zgi ne vidat'* "you can't see a thing; it's pitch dark"), *(ne) slyxat'* "you can (not) hear," *naplevat' na gore* "hang care," and a number of others. In his monograph on the semantics of the Russian infinitive, van Holk lists among "fixed nuclear infinitives" also expressions of the general form *ne + infinitive + stat'*, and *byt' + infinitive*. While one must

* This paper is a slightly revised version of section 5 of the author's monograph, *Studies on Predication in Russian, II: On the Predicative Use of the Russian Infinitive* (RM-4477-PR), available from the RAND Corporation, 1700 Main Street, Santa Monica, California. It goes without saying that any views expressed in this paper are those of the author and should not be interpreted as reflecting the views of the Linguistic Group at RAND or the official opinion or policy of the RAND Corporation or any of its governmental or private sponsors. This paper was submitted before its author could familiarize himself with the full text of M. Pacak's article, "Infinitive Constructions: Structural Delimitations," in preparation.

disagree with van Hoik's interpretation of the use of *byt'* in his example, his labeling of the expression *ne + infinitive + stat'* is wrong altogether.⁷ The word *stat'* is here not the infinitive form, but a homophonous noun used as a "predicative."^{8,9} The misconception that the form *stat'* in this construction is an infinitive (and not a noun) is widespread in current textbooks and dictionaries.

Provision has to be made to distinguish between some of these "frozen" infinitives and their homonyms (homographs). Thus it would be necessary, for example, to make it possible to distinguish between the idiom *tak skazat'* "so to speak" and the phrase *tak skazat'* in a context like *Tak skazat' nikak nel'zja* (or *Nikak nel'zja tak skazat' / Nikak tak skazat' nel'zja*) "It is absolutely impossible to say so"; or between the fixed phrase *pravdu skazat'* "to tell the truth, frankly" and the corresponding word combination in sentences such as *Pravdu skazat' vseгда stoit* (*Vseгда stoit pravdu skazat'*) "It always pays to tell the truth" or *Pravdu skazat' ja bojus'* "I am afraid to tell the truth" (cf. *Pravdu skazat', ja bojus'* "Frankly, I am afraid"), and so forth. Non-idiomatic use of word combinations which can also serve as idiomatic phrases will, in all probability, normally be fairly infrequent as compared to the corresponding idiomatic use (at least if one considers the average of a large amount of Russian text). The probability of occurrence of such homonymic non-idiomatic phrases can be expected to be reasonably low in various kinds of scientific Russian. However, the risk for confusion, or rather for non-discrimination, between idiomatic and non-idiomatic use may somewhat increase in the case of idiomatic one-word expressions such as, for example, the parenthetic *priznat'sja* (approx. = *priznajus'*) "I (one) must admit" as compared to the infinitive *priznat'sja* used, say, in a sentence like *On nikogda ne xotel priznat'sja v svoix ošibkax* "He never wanted to admit his mistakes."

In the instances just quoted, and in many similar cases, it will be necessary to pay special attention to punctuation and sentence juncture. The idiomatic phrases under discussion are always syntactically interpolated (parenthetic) in relation to the remainder of the sentence in which they appear, that is to say, they are always either surrounded by commas, or, when occurring at the sentence boundary—normally at the beginning of the sentence—separated by commas from the rest of the sentence. All that is required in order to single out the idiomatic infinitive expressions from their non-idiomatic homonymic (homographic) counterparts is therefore to add under the respective entries in the automatic dictionary some information to the effect that these idioms are always surrounded by some punctuation mark (if under this term we subsume the signals to indicate beginning of the entire corpus or of a new paragraph as well as the traditional graphic marks occurring at sentence boundary and the comma.)

Another way to handle at least some of these idio-

matic items would be simply to consider them what they originally were and, in a sense, still are, namely, independent, though nested or embedded minimal sentences. With an implied dative agent (*mne* or *nam*, for example), the infinitive (say, *priznat'sja*) could thus be interpreted as a separate, inserted sentence, derivable from a finite expression: *Mne priznat'sja* ← *Mne nado priznat'sja, Ja dolžen priznat'sja* or the like, meaning "I must admit," while its two-membered counterpart *Priznajus'* "I admit" could be considered its zero-modal equivalent (cf. Isačenko, especially p. 164, where one-membered infinitive sentences also are considered transforms of underlying finite verb sentences¹⁰). Compare also that, conversely, a sentence like *Priznajus', ja ne čital ètoj knigi*, taken out of its context, is somewhat ambiguous as concerns the interpretation of its first element: It can mean literally "I admit (that) I have not read that book" (paratactic *Priznajus', ja ne čital. . .* equaling hypotactic *Ja priznajus', èto ja ne čital. . .*), or it can serve merely as some sort of modal modifier, "Frankly, I have not read that book" (*Priznajus', ja ne čital ètoj knigi = Ja, priznajus', ètoj knigi ne čital = Ètoj knigi, priznajus', ja ne čital*, etc.). Largely, this is a problem of beginning delexicalization or, to be more exact, of "lexical fading."

So much, in passing, for a few of the problems occurring in connection with automatic translation of unproductive, "frozen" infinitives of contemporary standard Russian.

To narrow down the scope of the present discussion even further we will exclude from consideration all stylistically strongly restricted predicative infinitives, that is, those infinitives which occur in two-membered sentences (type *On — bežat'* "He began to run; he broke into a run"), since this actor-infinitive construction will hardly ever be encountered in the sort of Russian text likely to be subject to automatic translation (at least at the current stage of progress in mechanical translation theory and application; for a thorough discussion of this sentence type compare, in addition to our monograph quoted above, the special article by van Holk.¹¹ Weakly restricted predicative infinitives, found in one-membered sentences (types *Čto delat'?* "What should one do? What is to be done?", *Mne exat'* "I have to go," etc.) and in conditional clause-equivalent infinitive phrases without a subordinating conjunction (type *Posmotret', tak èto čudo* "To look at it, it's just wonderful") will, on the other hand, be included here, along with the stylistically unrestricted clause-equivalent infinitive phrases with a subordinator (type *Esli prinjat' . . .* "If we assume . . .," *Čtoby ponjat' . . .* "In order to understand . . .," etc.), because of their high frequency in colloquial Russian (although they are virtually lacking in scientific Russian text), and because the problem of their semantic interpretation can perhaps be attacked by some techniques which allow automatization (algorithmic treatment). As for the less fre-

quent conditional infinitives without a subordinator, the problem of their automatic recognition and identification with the stylistically unrestricted *esli* + infinitive phrases seems, at least in principle, solvable.

We can agree with Garvin's suggestion to assign a special grammar code digit to the infinitive as opposed to the finite verb. However, Garvin seems to think in terms of splitting up the traditional word class verb into two new classes (though these classes in a grammar code designed for machine translation must be defined in morphosyntactic rather than simply in morphological terms) primarily because the Russian infinitive supposedly has the characteristic of "not having a capability for taking a subject." At any rate, he suggests that his "grammar code assigns to them [i.e., the infinitives] a separate 'infinitive' digit, while finite verb forms are coded for 'predicateness,'" along with short-form ("predicative") adjectives.¹² For our part, we would single out the Russian infinitive and assign to it a separate grammar code digit to indicate: (1) its lack of any primary (basic) syntactic function, and, hence, (2) its susceptibility to assume a number of secondary (contextual) functions—in short, its "syntactic ambiguity." For some elaboration of this view see our previously mentioned monograph *Studies on Predication in Russian, II: On the Predicative Use of the Russian Infinitive* (section 4.2), available from the RAND Corporation. Further automatic recognition routines are needed to subclassify and identify the particular grammatical meanings that the Russian infinitive can express in various syntactic contexts.

In her paper on "Russian *-sja* Verbs, Impersonally Used Verbs, and Subject/Object Ambiguities," Lynch included (as "Appendix 2: Preliminary Flowchart," p. 487) also a brief treatment of non-finite verb forms of Russian, that is, infinitives, gerunds, and participles.¹³ Her Preliminary Flowchart was devised with a view to separating these forms of the Russian verb before its other, finite, forms are referred to a special Flowchart I resolving subject/object ambiguities supposedly not encountered in non-finite verb forms (see ref. 13, pp. 488-92). On the other hand, if the infinite verb form ends in *-sja* (or *-s'*, i.e., the reflexive marker), it is referred to a Flowchart III devised to automatically translate Russian *-sja* verbs (see ref. 13, pp. 496—98). In a subsequent, as yet unpublished, study entitled "Russian Infinitives, Gerunds, and Participles in Automatic Translation," submitted as Report No. NSF-13: *Mathematical Linguistics and Automatic Translation*, to the National Science Foundation (A. G. Oettinger, principal investigator), Computational Laboratory, Harvard University, Cambridge, Massachusetts, March, 1964, in section VI, 4-10, the same author has amplified and somewhat elaborated on her treatment of non-finite verb forms in machine translation, devising another Preliminary Flowchart to automatize the process of analyzing the pertinent Russian forms and of synthesizing their English equivalents.

It ought to be mentioned at this point that, while subject/object ambiguities are unlikely to arise in infinitive constructions, if by subject is to be understood strictly the actor in the nominative, it is important to realize that agent/object ambiguities, on the other hand, can occur in one-membered infinitive sentences. Where both an explicit agent (in the dative) and a dative object are present, word order—or, to be more specific, a rule to the effect that agent precedes object—can resolve the apparent ambiguity. Consider, for example, such Russian sentences as *Mne dat' tebe knigu* / *Mne tebe dat' knigu* / *Knigu mne dat' tebe* / *Knigu dat' mne tebe*, all of which convey the information "I have to give you the/a book" and differ only in emphasis (least emphasis being placed on the third word in each of the above sentences; on the "suprasyntactic" category of emphasis, see in particular Worth¹⁴). An automatic routine for checking word order could be applied uniformly to all one-membered infinitive sentences (hence preventing even the occurrence of ambiguity), or it could be applied only in the event of double dative occurrences. One-membered infinitive sentences with only one dative occurrence would, on the other hand, have to be subject to some more sophisticated dative agent/object ambiguity checking routine which presumably would have to be devised in such a manner as to include contextual information gathered from some part of the text preceding the infinitive sentence under discussion, since, to take an example, a sentence like *Tebe dat'?* can allow at least two quite different interpretations (and, consequently, translations, namely, "Should you give?" or "Should one give (to) you?"). This would presumably require some algorithmic formalization of phenomena falling under the general heading of "functional sentence perspective" (also known as "information-bearing structure of the sentence" or "thematic organization of the sentence"), as pioneered by some members of the Prague school (notably V. Mathesius) and recently again tackled by various linguists (see, e.g., Mathesius, esp. pp. 50-63;¹⁵ Mistrik;¹⁶ Pala¹⁷).

According to Lynch, "the automatic translation of Russian infinitives, gerunds, and participles into English is comparatively simple. The similarities among these three forms, in their Russian use as well as in their English translation, promulgated [*sic!*] their separation from all other verbal forms, and thus a reasonable translation can be obtained with the help of the 'preliminary flowchart'. . . All Russian infinitives are translated as English infinitives, but the *-sja* infinitives are referred to Flowchart III as the difference in meaning for those of them whose meaning may be changed through the addition of *-sja* depends on the animate-inanimate agent in the same manner as it does for other verbal forms." With reference to automatically translating Russian infinitive occurrences, Lynch then offers more specific suggestions: "Tentatively, translation of Russian infinitives into English may be of the following pattern: (1) as 'one should' plus infinitive not preceded by 'to' in conditional

Russian clauses beginning with '*esli*,' '*kogda*,' etc.; (2) as infinitive not preceded by 'to' (*a*) when part of the imperfective future tense, (*b*) when used with the verb '*moč*,' (*c*) when used with '*možno* or other '-o' adjective which is translated as 'one can,' 'one must,' etc. (but not as 'one needs'), (*d*) when used with the personal form of '*dolžen*'; (3) in all other cases, as infinitive preceded by 'to.' The above pattern, however, should be more extensively tested." (The quotations are from p. 2 of Lynch's above-mentioned unpublished Report No. NSF-13, section VI.)

In terms of her "Preliminary Flowchart" (NSF-13, section VI, 4-5), devised to single out and handle infinitives, gerunds, and participles, the infinitive occurrences (ascertained and tested by Lynch, to be sure, only on a limited corpus of Russian scientific text) pass through a certain number of yes/no decision steps which lead to one of two "translation instructions": (1) Infinitive, gerund, or participle? If "yes," (2) Ends in *-sja* or *-s*? If "yes," (4) Infinitive? If "yes," (6) Translate as English infinitive according to Flowchart III (i.e., the elaborate device designed for handling the semantics of the Russian *-sja* verbs; the details and adequacy of this device, though questionable, we need not go into here). If the answer at step (2) is "no," then a different series of yes/no decisions is triggered: (5) Passive participle (any form)? If "no," (9) Infinitive? If "yes," (14) Translate as English infinitive.

It should be readily clear that the two resulting instructions, (6) and (14): "Translate as English infinitive," with the addition "according to Flowchart III" in the former case, without such qualification in the latter, cannot, except perhaps in some very rudimentary stage of machine translation, be considered anything nearly adequate, even if one is to take into account the further specification of the "tentative pattern" for translating "as English infinitives" quoted above. This lack of adequacy is due both to incomplete synthesis (of the English output) and to insufficient analysis of the semantic-syntactic properties of the infinitive occurrences (of the Russian input). Since in this paper only the analysis aspect of automatically translating Russian predicative infinitives shall be discussed at some length, we can refrain from commenting here on the English equivalents suggested by Lynch or from offering any supplementary "translation instructions," and will limit ourselves to commenting only on the complexities of handling Russian infinitive occurrences in the analytic phase of the machine translation process.

It is assumed here that the mechanical identification of Russian infinitives as such is technically feasible. Such an assumption now has rather general acceptance (cf. Lynch's flowcharts just discussed) and is based both on theoretical considerations, such as the existence of certain formal, "machine-recognizable" properties of the Russian infinitive, and on the practical experience of a number of automatic language data-processing programs currently in operation, where Russian infinitives are

being sorted out, along with other grammatical forms, with virtually no, or only reasonably low, percentage of failure.

Basically, such programs can identify Russian infinitives in two ways: Either (*a*) they simply match every new word occurrence of the text that is to be analyzed with the items already entered and coded (i.e., usually manually annotated) in the automatic dictionary, thus providing an automatic identification not only of its lexical meaning but also of its syntactic function (and "infinitive" could serve as a grammar code label for something like "semantic-syntactically ambiguous verb form to be further specified"); or (*b*) the mechanical translation program can contain some algorithm by means of which infinitives are automatically recognized on the basis of some of its formal properties (allowing for a relatively low percentage of failure). Of course, also (*c*) some combination of the two procedures is conceivable. The following is a concrete illustration of such a combined automatic recognition procedure (which can be described here only in an oversimplified and hence slightly distorted manner). (1) Refer all word occurrences ending in vowel + *t'* (except (*a*) *-èt'* and *-jut'* and (*b*) *-ot'* preceded by consonant other than *-l-* or *-r-*) to an algorithm, which (2) will further process these occurrences to decide whether they are or are not infinitives. (Such an algorithm would presumably have to contain a set of rather sophisticated rules accounting for additional formal criteria of the word under examination, such as certain characteristics of the root morpheme, presence of a verbal prefix, etc., as well as for specific infinitive-diagnostic contextual configurations within which the particular word occurrence appears, thus involving scanning over word strings of various length.) (3) Apply an automatic dictionary-matching procedure to all other Russian word occurrences ending in *-t'* (i.e., in effect, those where *-t'* is preceded by some consonant, as a rule by *-s-*, *-z-*, or *-r-*, and also by *-o-*, not following *-l-* or *-r-*, all other letter combinations with final *-t'* being statistically negligible) as well as to those ending in *-ti* and *-č'*.

Given the above qualifications the discussion will therefore take for granted the possibility of automatic identification of Russian infinitives and focus rather on the problems and prospects of automatizing the semantic analysis of this high-frequency form of contemporary standard Russian, susceptible to a variety of syntactic functions and semantic connotations, and thus offering an instructive instance of the controversial issue of semantic-syntactic ambiguity (on semantic-syntactic ambiguity, cf. ref. 2, especially pp. 11-15, with further bibliography; also Kuno and Oettinger¹⁸).

The first step in a semantic analysis of Russian predicative infinitives would presumably imply an automatic separation of predicative and non-predicative infinitives. Can such a separation be accomplished automatically, that is, can rules for this sort of semantic classification be formulated in terms of a computer program?

A direct procedure for identification of predicates in the broad sense, that is, including not only finite verb forms but also predicative infinitives as well as various non-verbal word classes (adjectives, adverbs, and substantives) functioning as "predicatives" (types *On bolen* "He is sick," *Zdes' xolodno* "It is cold here," *Tak nel'zja* "That way it is impossible," *On učitel'* "He is a teacher"), and for subsequent isolation of predicative infinitives, easy as such a procedure may seem theoretically in terms of linguistic analysis, must probably be considered a difficult, if not impossible, task for a computer-programmed algorithm. It therefore appears more realistic first to account for the syntactic (and stylistic) contexts in which predicative infinitives occur, and then to take these contexts as a point of departure for further identification. In the following we shall be concerned only with the stylistically unrestricted or weakly restricted occurrences of predicative infinitives in modern Russian (for some instances of stylistically restricted infinitive occurrences see the discussion at the beginning of this paper). The unrestricted and weakly restricted predicative infinitive occurrences can be classified as follows:

A. Unrestricted

Predicative infinitives in clause-equivalent phrases with a subordinator (conjunction).

B. Weakly restricted

1. Predicative infinitives in clause-equivalent (conditional) phrases without a subordinator.
2. Predicative infinitives in one-membered sentences (with or without a dative agent).

Even if we include the casual, colloquial variety of the Russian language in our further considerations, type B1 must be considered extremely rare and could for most practical purposes be disregarded. Still, the formulation of rules by means of which such infinitive occurrences could be identified automatically is possible. Thus, it seems feasible, for example, to apply a rule to the effect that an infinitive introducing a clause-equivalent phrase followed by a main clause which begins with *tak* "then" (or an equivalent correlate; thus, "infinitive . . . , *tak* + main clause") is to be identified as being a conditional predicative infinitive, and hence should be translated by some corresponding English expression (say, by "infinitive without *to* + *and* + subject + finite verb" or by a complex sentence consisting of an *if*- and a *then*-clause; cf., e.g., *Poslušat' vas, tak my naxodimsja vne čelovečestva, vne ego zakonov*, taken from Turgenev's novel "Otcy i deti," "Listen to [obey] you and we are out of the bounds of mankind, outside man's laws" or, simply, "If we listen to [obey] you, then we are [will/would be] out of ...").

For the unrestricted clause-equivalent infinitive phrases with a subordinator (conjunction), an algorithm could be devised by means of which these expressions would be identified as synonyms (transforms) of—and

hence perhaps converted back into—the corresponding subordinate clauses, used impersonally. Thus, for example, *esli* + infinitive could be rendered by something like "if one" + finite verb. Only in the case of the highly frequent phrase *čtoby* + infinitive could one perhaps implement a mechanism to translate this phrase by "(in order) to" + infinitive, rather than insist on a stereotyped translation of the type "so that one" + finite verb (leaving the idiomatic rephrasing of such a raw translation to a posteditor). No semantic shades and contextual connotations (modal, actional, etc.) need usually be considered in the process of automatically translating these phrases, at least as concerns the source language parsing component of the translation process. Modal connotations introduced by means of adding a dative agent can perhaps in some way be accounted for by some procedure for matching such expanded dependent infinitive phrases with corresponding independent sentence constructions. Compare, for example, *Esli prinjat'* . . . "If one assumes" ⇒ *Esli nam prinjat'* . . . "If we are to (or "have to, can," etc.) assume ...". The specifics of such a matching procedure (and its automatization) would require a detailed treatment falling beyond the scope of the present study.

This problem is central, on the other hand, in the process of translating predicative infinitives in one-membered sentences. The recognition of predicative infinitives in these formally subjectless sentences does not require any particularly sophisticated parsing procedure. As a rule, it will suffice to identify as predicate an infinitive in a one-membered sentence which contains neither a finite verb (type *Morosit* "It drizzles") nor a "predicative" proper (i.e., a word belonging to the so-called category-of-state; type *Tak nel'zja skazat'* "You/One cannot say so"). Short-form adjectives (type *On bolen* "He is sick") and predicate complements (in English school grammar usage also inadequately termed "predicate nominatives"; type *On učitel'* "He is a teacher") depend always on a personal subject (in the nominative) and need therefore not be considered here.

Only exceptionally may some ambiguity arise as a result of double infinitive occurrences in one-membered sentences; compare, for example, *Mne daže ne uspet' pročest' utrom gazetu* "I don't even have (the) time to read the newspaper in the morning," or *Počemu mne spesit vam rasskazat'*? "Why should I hurry to tell you?" Particularly in the second example, where both infinitives are preceded by dative forms (the first one subjective, the second one objective), only a fairly sophisticated algorithm could recognize the proper predicative infinitive. In such cases additional rules (e.g., accounting for word order) would be required to resolve most of the possible ambiguities as to which of two infinitives functions as predicate.

The various semantic connotations found in most one-membered infinitive sentences present a more complicated problem for the computer. These sentences can express at least the following modal shades:

I. Without *by*

- A. Debitive modality (i.e., obligation)
- B. Deliberative modality (i.e., hesitation)
- C. Destinative modality (i.e., predetermination)
- D. Imperative modality (i.e., command or exhortation)

II. With *by*

- A. Desirative modality (i.e., desirability), combined with debitive-destinative modality and occasionally coupled with hypothetic modality
- B. Hypothetic modality (in its pure form, i.e., supposition or assumption)

To a certain extent it is possible, of course, to use formal criteria by which to identify these semantic subcategories. Thus, absence of the particle *by* immediately refers one-membered infinitive sentences to Group I. Specific modalities can be further identified tentatively by such characteristics as punctuation: an exclamation point (at the end of an infinitive sentence without *by*) suggests imperative modality—an extremely rare subtype, incidentally; a question mark qualifies a one-membered infinitive sentence without *by* as a strong candidate for deliberative modality (usually, though, with a debitive undertone); and so forth. Also, the English counterparts to be selected as output (such as "should" + infinitive phrases) often display a considerable semantic ambiguity or wide range allowing for a number of contextually conditioned correct interpretations. This partial isomorphism between the semantic structures of the Russian and English expressions would certainly have to be taken into account in any overall discussion of the automatic translation process of the Russian predicative infinitives in one-membered sentences.

While in the practice of machine translation (or even machine-aided translation) fairly high degree of refine-

ment with regard to semantic subclassification can be achieved by means of such formal criteria as those just mentioned, an increasingly significant role in the attempts to solve problems of semantic-syntactic ambiguity in automatic translation seems in recent years to have been attributed to automatic transformation. This is not the place to discuss the current progress in the theory and practice of transformational methods now being suggested and introduced also in machine translation, particularly since much of the pertinent work has barely come beyond its inceptive stages (cf., e.g., Revzin and Rozencvejk, esp. pp. 98-103 and 195-200,¹⁹ Matthews,^{20, 21} and the recent study by Tosh, esp. pp. 9-66²²). However, if automatic transformation procedures or, to put it differently, automatic "analysis by synthesis" will indeed be further refined and improved so that algorithms can be written for such procedures and they become an integral part of the process of automatic translation, the predicative infinitives of modern Russian—being convertible into semantically unambiguous underlying finite equivalents—will become manageable in a far more satisfactory and precise manner than what seemed reasonable and feasible until only recently.

Received August 11, 1966

Addendum: Only after this article was submitted did the author have an opportunity to familiarize himself with Isačenko's most recent work on word order in Russian. Isačenko treats some of the problems of ambiguity discussed here (dative + infinitive, infinitive with double dative) using a combination of methods including those of transformational-generative grammar. (Cf. A. V. Isačenko, "O grammatičeskom porjadke slov", *Voprosy jazykoznanija*, No. 6, [1966], and *id.*, "Porjadok slov v poroždajuščej modeli jazyka," to appear in the Czechoslovak contributions to the VIth International Congress of Slavists [Prague, 1968].)

References

1. Abraham, S. "O principial'no vozmožnyx perspektivax mašin'nogo perevoda," *Voprosy jazykoznanija*, No. 2 (1965).
2. Oettinger, A. G. "Automatic Processing of Natural and Formal Languages," in W. A. Kalenich (ed.). *Information Processing 1965. Proceedings of IFIP Congress 65*, Vol. 1. Washington and London: Books, Inc., Publishing Co., 1965.
3. Bar-Hillel, Y. *Language and Information*, pp. 9-10, 174-84, 211-18. Reading, Mass.: Addison-Wesley Publishing Co., 1964.
4. Oettinger, A. G. *Automatic Language Translation*, chaps. v-x. Cambridge, Mass.: Harvard Univ. Press, 1960.
5. Mounin, G. *La machine à traduire*, chaps. vii-xii. The Hague: Mouton & Co., 1964.
6. Harper, K. E. "Dictionary Problems in Machine Translation," in P. L. Garvin (ed.). *Natural Language and the Computer*. New York: McGraw-Hill Book Co., 1963.
7. Holk, A. G. F. van. *The Semantic Spectrum of the Russian Infinitive*, pp. 80 and 100. Leiden: A. W. Sijthoff's Uitgeversmaatschappij N. V., 1953.
8. Ušakov, D. N. (ed.). *Tolkovyj slovar' russkogo jazyka*. Vol. 4, col. 497. Moscow: Gosudarstvennoe izdatel'stvo inostrannyx i nacional'nyx slovar'ej, 1940.
9. Vasmer, M. *Russisches etymologisches Wörterbuch*, Vol. 3, p. 6. Heidelberg: Carl Winter Universitätsverlag, 1958.

10. Isačenko, A. V. "O sintaksičeskoj prirode mestoimenij," *Problemy sovremennoj filologii. Sbornik statej k semi-desjatiletiju akademika V. V. Vinogradova*. Moscow: Izdatel'stvo "Nauka," 1965.
11. Holk, A. van. "On the Actor-Infinitive Construction in Russian," *Word*, Vol. 7, No. 2 (1951).
12. Garvin, P. L. "Syntax in Machine Translation," in P. L. Garvin (ed.). *Natural Language and the Computer*. New York: McGraw-Hill Book Co., 1963.
13. Lynch, I. Paper 22 in *1961 International Conference on Machine Translation of Languages and Applied Language Analysis, Proceedings . . . Teddington . . .*, Vol. 2, London: H. M. Stationary Office, 1962. (Also submitted as a report to the National Science Foundation.)
14. Worth, D. S. "Suprasyntactics," in H. G. Lunt (ed.). *Proceedings of the Ninth International Congress of Linguists*, Cambridge, Mass., August 27-31, 1962. The Hague: Mouton & Co., 1964.
15. Mathesius, V. *Řeč a sloh*. Prague: Československý spisovatel, 1966.
16. Mistrík, J. *Slovosled a vetosled v slovenčine*. Bratislava: Vydavateľstvo Slovenskej akadémie vied, 1966.
17. Pala, K. "O nekotoryx problemax aktual'nogo členenija," *Prague Studies in Mathematical Linguistics*, Vol. 1. Prague: Academia, 1966.
18. Kuno, S., and Oettinger, A. G. "Multiple-Path Syntactic Analyzer," in C. M. Popplewell (ed.). *Information Processing 1962. Proceedings of IFIP Congress 62*. Amsterdam: North Holland Publishing Co., 1963.
19. Revzin, I. I., and Rozenčevj, V. Ju. *Osnovy obščego i mašinnogo perevoda*, pp. 85-112, 195-210. Moscow: Izdatel'stvo "Vysšaja škola," 1964.
20. Matthews, G. H. "Analysis by Synthesis of Sentences of Natural Languages," *Proceedings of the 1961 International Conference on Machine Translation of Languages and Applied Language Analysis . . .*, Vol. 2. London: H. M. Stationary Office, 1962.
21. ----- . "Analysis by Synthesis in the Light of Recent Developments in the Theory of Grammar," *Kybernetika*, Vol. 1, No. 3 (1965).
22. Tosh, W. *Syntactic Translation*. The Hague: Mouton & Co, 1965.