

Problems of Equivalence in Some German and English Constructions

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The time has come when well-organized and thoroughly worked out transfer grammars should be developed. Such a grammar should be composed of formal statements equating the construction-types of the input language with those of the output language and indicating the appropriate transformations which must be made to produce the target language constructions.

In connection with the problem of structural transfer, a study was made of the behavior of some English verbs and their German equivalents in a fixed number of constructions. The verbs were grouped in syntactic classes on the basis of their respective distributions. The conditions were stated under which it is possible to use the same combination of constituents in a construction when translating from German to English and vice versa.

This work should be regarded as a preliminary study of that information about syntactic restrictions on verbs which should be encoded in an automatic dictionary as an aid in solving problems of structural transfer.

The problem of translation may be divided into three stages, as suggested by Yngve¹: analysis (recognition), structural transfer, and synthesis (construction). In the first stage, the syntactic structure of a sentence in the input language is analyzed and noted in terms of structural specifiers; in the second stage, the input language specifiers are mapped onto output language specifiers; in the third stage these output language specifiers are used to construct the equivalent sentence in the output language.

To date considerable work has been published on the analysis of languages both from the viewpoint of descriptive linguistics and from the viewpoint of linguistics applied to problems of mechanical translation. Also an ever increasing amount of attention is being devoted to sentence generation and, in particular, to the construction of a generative grammar of English. In regard to structural transfer, some work has been done by Harris² and his followers and recently an introductory study of the problem was made at Harvard by Foust and Walking.³ Nevertheless, comparatively little concrete progress has been made in the construction of adequate transfer grammars, even though structural transfer is the most crucial part of the translation process.

The Need for Transfer Grammars

The need for a transfer grammar is obvious to anyone working with languages where the syntactic constructions used to express a given meaning in the one language differ radically from those used to express the same meaning in the other language. Under these cir-

cumstances, if mechanical translation is to be realized, some sort of exhaustive formal list of the constructions in the output language which are equivalent to the constructions in the input language is needed. The compilation of such a list will, admittedly, be a laborious and tedious task.

To any one working with languages which employ similar constructions for expressing the same idea, the need for an exhaustive transfer grammar may not be so obvious. The easier and quicker solution to the problem, as it concerns similarly structured languages, appears, at first blush, to be simply to make a word-for-word translation, following which a modicum of rearranging of words would be carried out. The translation resulting from such a procedure would presumably be understandable to those familiar with the general subject matter, but it would be so sadly lacking in style as to be incomprehensible to others.

The research problems which will be encountered in the compilation of a transfer grammar for structurally similar languages are probably more complex than those encountered in the compilation of a transfer grammar for structurally dissimilar languages, because the temptation is greater to assume that, because construction *c* in Language A is translatable by construction *c'* in Language B some of the time, *c'* will always be an acceptable translation of *c*. The constructions *c* and *c'* may, in fact, be equivalent only with certain classes of words. For example, the sentences *Er zog vor, zu arbeiten* and *He preferred to work* are based on the same underlying structure (Noun + Verb + Infinitive phrase), but only by a study of individual verbs—or of mistranslations—would one discover that *Er hoerte auf zu arbeiten* requires a differently structured sentence in English as an equivalent, namely *He stopped going to school*.

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Organization and Operation of a Transfer Grammar

There are various ways of constructing a transfer grammar, ranging from *ad hoc* statements of structural transformations to elaborate statements of equivalence. In any case, the final transfer grammar should consist of a list of statements of structural transformations. The various kinds of structural transformations will include insertion, deletion, full or partial substitution (modification) and rearrangement of words (permutation). Whenever a construction in one language may be translated into the other language with the same type of construction, the statement to this effect can be very brief in the final transfer grammar.

As envisaged by the author, a transfer grammar will be activated after a text in the input language has been analyzed syntactically and after the output language lexical equivalents for each input language word have been found. The transfer grammar will be made up of a small executive program and a list of statements which will indicate the construction or alternative constructions which may be used in the output language as a good translation of any given construction in the input language.

The executive program will first locate the input language construction in the list of statements of structural transfer. Then it will select from the list those equivalent output language constructions in which the particular lexical items under consideration can appear. This selection will be made on the basis of syntactic information stored in the dictionary, and in the transfer grammar.

Along with each lexical item in the output language dictionary there will be stored information not only about the general syntactic function of the item, e.g., noun, verb, adjective, but also about the particular constructions with which this item may or may not be used. In other words, not only will the fact that a given lexical item is, say, a verb be stored in the dictionary, but also the various constructions which this verb governs will likewise be stored in the dictionary.

This information may be stored in the dictionary in various ways. One method would be simply to append to each word in the dictionary a complete list of the constructions with which that word can be used. This list could be compressed and stored efficiently as one or two twelve-character machine words in any automatic dictionary with a format similar to that of the Harvard Automatic Dictionary developed by Oettinger.⁴ Each position in the machine word could be used to identify a whole list of syntactic constructions. Another method of storage would be to place the words which can occur in the same construction or groups of constructions in the same syntactic classes and then append to each word in the dictionary the list of syntactic classes to which that word belongs. This list would hopefully be brief enough to make elaborate encoding unnecessary. This is the method of storage envisioned in this paper.

For purposes of this paper, it is assumed that a list of numbers marking the word as a member of one or more syntactic classes has been appended to each word in the dictionary. It is also assumed that the transfer grammar consists of statements of structural transfer in which the constituents of the output language constructions are marked appropriately as members of these same syntactic classes.

The executive program of the transfer grammar will use syntactic information in the following way. It will look for and select an output language construction whose constituents are in the same syntactic classes as the particular output language words involved. For example, if the output language equivalent of a given verb is intransitive, a construction will be selected which calls for an intransitive verb; if, on the other hand, the only possible translation of a given *construction* is one with a transitive verb, and there are two possible translations of the given verb, then the verb which is transitive will be selected. Thus, although *work* means both *arbeiten* and *bearbeiten*, in the context *He worked the clay* only the transitive verb *bearbeiten* would be selected in a translation into German because the equivalent German construction requires a transitive verb and this fact would have been noted in the transfer grammar. This simple example illustrates how syntactic compatibility can be used to decide among alternative constructions and words in translation. If the grammar has been properly constructed, there should be at least one construction which is compatible with the syntactic class requirements of the individual words concerned. When more than one construction and lexical item in the output language are compatible, the appropriate intersection may have to be selected with semantic criteria or according to some set of priorities.

The following example may serve as a somewhat more complicated illustration of how the transfer grammar described above would operate. A statement is needed to express the fact that the German sentence *Der Mann fährt ihr den Wagen* should be translated as *The man drives the car for her*. The following crude equation could be placed in the transfer grammar:

$$\begin{aligned} & NP_1/\text{case nom} + \text{VERB}/x + NP_2/\text{case dat} \\ & \quad + NP_3/\text{case acc} \\ = & NP_1/\text{case subj} + \text{VERB}/x' + NP_3/\text{case obj} \\ & \quad + \text{for} + NP_2/\text{case obj} \end{aligned}$$

where *x* stands for specifiers of tense, number, and person and *x'* stands for the corresponding English morphological specifiers. NP stands for either a noun with its modifiers or a pronoun. Only in regard to pronouns will the case specifiers be needed in English. The above sentences can be successfully translated by applying this equation. If this statement of structural equivalence were always valid, all that one would need to say about a verb would be that it was a verb, and further specification would be unnecessary.

The preceding equation, however, will not yield the

correct English translation for a sentence like *Der Mann gibt dem Mädchen ein Buch*. According to the equation, this sentence would be translated as *The man gives a book for the girl*, instead of the correct sentence *The man gives a book to the girl*, or more simply, *The man gives the girl a book*. (We shall disregard the problem here of choosing the correct tense form of the verb, since this problem should be coped with at another level in the transfer grammar.) In order that mistranslations do not result, the verb *give* should be marked in some way so that it will not be treated in the same manner as *drive* and *add*.

Although the words in any language function together in syntactic constructions within the overall structure of that particular language, it is possible for limited purposes to equate some of the constructions of similarly structured languages. Thus, the sentences *Der Mann gibt dem Mädchen ein Buch* and *The man gives the girl a book* may be said to have the same structure, since they both consist of subject + verb + indirect animate object + direct inanimate object. In this particular construction the ordering of the elements is also the same. The verbs *give* and *geben* may be considered as structurally identical in regard to this construction, since they fulfill the same role and govern the same types of objects in their respective linguistic systems. All that is needed in the transfer grammar to translate constructions in which a verb like *geben* appears is a simple statement of structural identity. In this study those verbs which can appear in constructions exemplified by *the man* $\left\{ \begin{array}{l} \text{gives} \\ \text{buys} \end{array} \right\}$ the girl a book

will be marked as 'Vt.indO'. Other verbs will be treated in the same manner as *drive* and *add* in constructions involving an indirect object.

Method and Objective of Present Study

In line with the eventual goal of compiling a transfer grammar for German and English, the author undertook the study of a selected number of German and English verbs and constructions involving verbs. This study was concerned only with a restricted number of those German and English constructions which are both structurally similar and translationally equivalent. The purpose of this study was to determine how closely structural similarity could be correlated with translational equivalence in these two languages. This study was concerned, for example, with determining whether and to what extent a German verb followed by a certain type of predicate complement can always be translated by an English verb followed by the same type of complementation. This study was an attempt at determining which of the selected correspondences are regular and predictable.

Fifteen English constructions involving verbs were compared with seventeen corresponding German constructions. Forty English verbs, selected because of the wide variety of constructions in which they can appear,

were closely studied in these fifteen constructions. It was noted which verbs can be substituted in any given construction and which cannot. The results of this study were compared with results of a similar study of sixty-five approximately equivalent German verbs in the corresponding German constructions. Native informants were regularly used in the study of the German verbs. The methods of substitution used were similar to those used by Harris and by Fries, among others. From the various selected predicate constructions, the verb head was extracted. The remainders of these constructions were called, after the terminology of Harris, diagnostic environments.⁵ For example, *He . . . into the park* is a diagnostic environment of the verb *run*. The string of morphemes *He ... into the park* cooccurs with various forms of the paradigm of the verb *run*. Also this string of morphemes can be used as a sample diagnostic environment in which other verbs can be substituted, e.g. in this study, *jump*. This was a test of syntactic, not semantic substitutability. Therefore, whenever there was any doubt as to the syntactic substitutability of any verb in a given environment, one of the words in this environment was replaced by another word which can fit in the same slot, i.e. by another member of the same syntactic class. In the above environment *park* can be replaced by *ocean*. Thus it may be verified that *jump* is substitutable in this environment. Those verbs which are mutually substitutable in one or more sample diagnostic environments or in environments similar to these, were placed in the same class.

Constructions Studied

The German and English constructions which were assumed at the beginning of this study to be both structurally and semantically equivalent are listed below. These verb constructions will be referred to throughout this report by the accompanying abbreviations.

Parentheses around any constituent in one of these constructions indicate that this constituent is an optional member of the construction.

NP stands for a pronoun or a noun phrase containing one or more constituents.

V stands for verb.

Aux stands for the appropriate bound and free morphemes designating the number, tense, mood and voice of a verb. (Only active voice was considered here, however.) These morphemes include —s, —ø, —ed, —te, —ten, *have, haben, sind, werden, will, etc.*

Adv_{loc} stands for an adverb or adverbial phrase of location.

Abbreviation Construction

SV	NP—Aux—V
	Sample Diagnostic Environments (DE):
	He... .
	Er

SVPN	NP—Aux—V—Adv _{loc} DE: He ... in the park. Er ... in dem Park.	Ger. NP ₁ —Aux—V ₁ —dass—NP ₂ —(NP ₃) —V ₂ —Aux DE: He ... that it was raining. Er ... , dass es regnete	
SVIp	Eng: NP ₁ —Aux—V ₁ —(in order) to—V ₂ — (NP ₂) Ger: NP ₁ —Aux—V ₁ —um—(NP ₂)—zu— V ₂ DE: He ... in order to please them. Er ... , um ihnen zu gefallen.	SVOct	Eng: NP ₁ —Aux—V ₁ —NP ₂ —that—NP ₃ — Aux—V ₂ —(NP ₄) Ger: NP ₁ —Aux—V ₁ —NP ₂ —dass— NP ₃ — (NP ₄)—V ₂ —Aux DE: He ... the man that it was raining. Er ... d— Mann—, dass es regnete.
SVCp	Eng: NP ₁ —Aux—V ₁ — ^{so} { in order } that— NP ₂ —Aux—V ₂ —(NP ₃) Ger: NP ₁ —Aux—V ₁ —(so) dass—NP ₂ — (NP ₃)—V ₂ —Aux DE: He ... so that he might please them. Er ... , so dass er ihnen gefalle.	SVIo	Eng: NP ₁ —Aux—V ₁ —(to)—V ₂ —(NP ₂) Ger: NP ₁ —Aux—V ₁ —(NP ₂) —zu—V ₂ DE: He ... to do this. Er ... dies zu tun.
SVO	SVO _{acc} The German constructions SVO _{acc} , SVO _{dat} SVO _{dat} , and SVO _{gen} were all assumed to SVO _{gen} be equivalent to the English construc- tion SVO _{acc} (or, more simply, SVO) in which case is not distinctively marked except when O is a pronoun.	SVOIo	Eng: NP ₁ —Aux—V ₁ —NP ₂ —(to)—V ₂ — (NP ₃) Ger: NP ₁ —Aux—V ₁ —NP ₂ —(NP ₃) —(zu) —V ₂ DE: He ... the man to do this. Er ... d— Mann—, dies zu tun.
SVO _{acc}	NP _{nom} —Aux—V—NP _{acc} DE: He. ... the book. Er ... das Buch.	SVintoN	NP ₁ —Aux—V—PrepPhrase _{direction} DE: He ... into the park. Er ... in den Park.
SVO _{dat}	NP _{nom} —Aux—V—NP _{dat} DE: (not applicable in English) Er ... dem Mann.	SVOintoN	NP ₁ —Aux—V—NP—PrepPhrase _{direction} DE: He ... the book into the park. Er ... d— Buch— in den Park.
SVO _{gen}	NP _{nom} —Aux—V—NP _{gen} DE: (not applicable in English) Er ... des Buches.		
SVOPN	NP ₁ —Aux—V—NP ₂ —Adv _{loc} DE: He ... the book in the park. Er ... d— Buch— in dem Park.		
SVOIp	Eng: NP ₁ —Aux—V ₁ —NP ₂ —(in order) to —V ₂ —(NP ₃) Ger: NP ₁ —Aux—V ₁ —NP ₂ —um—(NP ₃) — zu—V ₂ DE: He... the book in order to please them. Er ... d— Buch—, um ihnen zu ge- fallen.		
SVOcP	Eng: NP ₁ —Aux—V ₁ —NP ₂ — ^{ so } [in order] that—NP ₃ —Aux—V ₂ —(NP ₄) Ger: NP ₁ —Aux—V ₁ —NP ₂ —(so) dass— NP ₃ —(NP ₄) —V ₂ —Aux. DE: He ... the book, so that he might please them. Er ... d— Buch—, so dass er ihnen gefalle.		
SVO _{dat} O _{acc}	Eng: NP ₁ —Aux—V—NP ₂ —NP ₃ Ger: NP ₁ —Aux—V—NP _{dat} —NP _{acc} DE: He ... her a book. Er ... ihr ein Buch.		
SVCt	Eng: NP ₁ —Aux—V ₁ —that—NP ₂ —Aux— V ₂ —(NP ₃)		

Analysis of Verb Distributions

The entire distributions of some of the verbs considered in this study, i.e. the list of constructions with which each verb can be used, can be determined by substitution in the constructions analysed in this study, but the distributions of other verbs cannot be completely determined nor can the verbs, consequently, be assigned to all of the appropriate syntactic classes, until other constructions are considered. For example, the verb *choose* may be substituted not only in several of the environments listed above, but also in the environment *They . . . the man president*. This should not be confused with the similarly structured environment *They . . . the man a dog*, which is semantically and transformationally

[for]
related to *They . . . a dog* { to } *the man*. The environ-
ment *They . . . the man president* was not considered in this study, but should be taken into consideration when the distributions of the various verbs are being determined.

Two other verbs in this study, *treffen* and *meet* are members of a small, but noteworthy class of verbs, also not considered in detail. This is the class of reciprocal verbs. These verbs are obligatorily transitive when the subject is singular, but when the subject is plural, the object may be omitted, e.g. *She met the man in the park* and *They met (each other) in the park*, but not *She met in the park*.

In order to complete the distribution of verbs in German and English, it may be useful to learn whether a specific noun is used with the verb. A somewhat dubious

example of this is the “verb” *Rechenschaft ablegen* meaning *account for*. This was treated both as a compound verb in two parts and as a verb plus object. The author was not completely satisfied with either treatment. The German reflexive verbs present a similar problem. Should a reflexive pronoun used with the verb be deemed an object or a part of the verb? In this study *sich* with *erinnern* was considered as part of the verb because *sich erinnern* has a different distribution from *erinnern* plus object.

It may also be useful to discover if a particular preposition is normally used with the verb with or without an intervening object, e.g. *account for*, *sich erinnern an*, *accuse* (Object) *of*.

Finally, in English verbs it may be useful in a transfer grammar to know which verbs can be used with an object verb in *-ing*, e.g. *He stopped writing*. This construction will be considered in a later section in connection with the German constructions SVIo and SVOIo.

The reader may wonder why a total of eight common transitive and intransitive constructions were used instead of two in determining the distribution of the individual verbs. These constructions were used to verify the transitivity and intransitivity of the verbs. It was discovered that it is possible to predict that any verb may appear in all of the constructions SVO, SVOPN, SVOIp, and SVOCp, if it can appear in any *one* of them. However, it is *not* always the case that a verb which can appear in one of the common intransitive constructions SV, SVPN, SVIp, and SVCp, may appear in all four. Some verbs are acceptable as constituents of some intransitive constructions, but not of others. For example, the verbs *wissen*, *wollen*, and *mögen* may occur in SV when an object O is understood from the context, but they cannot appear in the other three intransitive constructions. In this report only those verbs which may occur in all four of the common intransitive constructions have been considered as members of the obligatorily or optionally intransitive verb-classes.

Finally, in connection with the distribution of individual verbs it should be noted that in this study usually only one meaning of a verb was considered in the determination of the distribution of the verb. If a verb could appear in a certain construction, but had a different meaning in that construction, the construction was not included as part of the distribution. For example, *want* was analysed in the sense *desire*. It was not considered as a possible constituent of the construction SV, as in *He wants*, because in this construction *want* means *lack*. Nevertheless, two meanings each were considered of three English verbs: *know*, *live* and *run*. These verbs were considered essentially as homographs, each of which has a different distribution. There were also other verbs in this study which are ambiguous in the limited environments provided in these constructions. Only one distribution of each of these verbs was worked out. Some clues as to the limitation of the distribution of the various meanings of these verbs may be found by looking

at the distributions of their various German equivalents. The ambiguous verbs in this study and their German equivalents here considered are the following: *add*, meaning *say further—hinzufügen*, *add*, as in *add a column of figures—addieren*; *stop*, meaning *cease—aufhören*, *stop*, meaning *brake (an automobile)—anhalten*, *stop (momentarily)*, i.e. *delay—aufhalten*; *tell*, meaning *relate—erzählen*, *tell*, meaning *command—befehlen*, also *tell*, meaning *say—sagen*; *see (with the eyes)*, also meaning *understand—sehen*, *see* meaning *realize—einsehen*.

Some German verbs also presented problems in meaning. Usually only one meaning of each of these verbs was dealt with and only one English equivalent for each of these verbs was analysed; *treffen—meet*, but also *hit*; *wählen—choose*, but also *vote*; and *erklären—account for*, but also *explain*.

Syntactic Verb-classes

All of the verbs that were selected for study were tested in the constructions listed above. Those verbs which are substitutable in the same construction or constructions were placed in the same syntactic verb-class. Because of the great variation in distribution noted among the verbs, it proved impractical to place in the same class only those verbs which are substitutable in the same *total* collection of constructions. In the interest of simplicity, and also to show more clearly which English verbs may appear in the same construction as their German equivalents, criteria for membership in a class were generally reduced to the criteria of transitivity (or intransitivity) as a minimum. Most of the verbs were members of other classes as well. These classes have been labeled mnemonically.

Three of the more noteworthy syntactic classes are those which distinguish obligatorily transitive verbs from obligatorily intransitive verbs and from optionally transitive or intransitive verbs.

Obligatorily transitive verbs can all appear in the constructions SVO, SVOPN, SVOIp, and SVOCp, but cannot appear in the constructions SV, SVPN, SVIp, or SVCp.—For simplicity in this study the class of transitive verbs has been extended to include verbs governing an object in the dative or genitive case.

Obligatorily intransitive verbs, unlike the transitive verbs cannot appear in the constructions SVO, SVOPN, SVOIp, or SVOCp, but may appear in the constructions SV, SVPN, SVIp, and SVCp.

Optionally intransitive verbs are transitive verbs which may appear in the above constructions in which obligatorily transitive verbs cannot appear; and conversely, optionally transitive verbs are intransitive verbs which may appear in the above constructions in which obligatorily intransitive verbs cannot appear.

In the presentation of verb-classes below, the following conventions have been adopted:

1. A comma between verbs indicates that these verbs have the same total distribution, i.e. that these verbs are

members of the same group of syntactic classes.

2. A single semicolon between verbs indicates that these verbs are members of different groups of syntactic classes.

3. A double semicolon is placed before that group of verbs which may also be used in the common intransitive constructions. The double semicolon separates obligatorily transitive verbs from optionally intransitive verbs.

In this study only two obligatorily intransitive verbs were found. These have been classed as follows:

Vi.com—arbeiten.

This intransitive verb can appear only in the common intransitive constructions SV, SVPN, SVIp, and SVCp. This class would also contain verbs like *arrive*, *depart*, *disappear*, and *vanish*. This class is small because many normally intransitive verbs can appear in transitive constructions with a cognate object. (See class Vt.opt.cog below)

Vi.to—aufhören.

This verb can appear not only in the common intransitive constructions, but also in the construction SVIo, as in *Er hört auf das zu tun*.

Two verbs were found in this study to be anomalous. These are the verbs *wohnen* and *live* (meaning *dwell*). They are anomalous syntactically because they may appear only in the construction SVPN. They have been placed in a class designated as Va.

All the rest of the verbs in this study were placed in classes designated in part by Vt because they can all appear in the common transitive constructions SVO, SVOPN, SVOIp, and SVOCp. These verbs have been classed as follows:

Vt.opt—stop, work; addieren, anhalten, geben, kaufen, buy, give; leben, schlafen, live (not meaning *dwell*), sleep; begreifen, verstehen, einsehen, know (not meaning *be acquainted with*), understand, add; sehen, see; remember; unterschreiben; sign; helfen; help, choose; run (meaning go *quickly*), jump; laufen, springen; accept.

All of the verbs in this class may appear in the common intransitive constructions SV, SVPN, SVIp, and SVCp in addition to the common transitive and other constructions.

Vt.opt.cog—leben, schlafen, live (not meaning *dwell*), sleep; run (meaning go *quickly*), jump, laufen, springen.

These are all optionally transitive verbs. They may appear in transitive constructions only when the object is either a word which is identical with or derived from the verb, or a word which is synonymous with a word which is identical with or derived from the verb, e.g. *He lived his life, He ran a run, He ran a race*.

Vt.opt.com—stop, work.

These verbs can appear in the four common transitive

and four common intransitive constructions, but they cannot appear in any other of the constructions considered in this study.

Vt.obl—All Vt verbs in this study which were not listed in class Vt.opt.

None of the verbs in this class can appear in the constructions SV, SVPN, SVIp, or SVCp.

Vt.obl.com—anblicken, annehmen, ansehen, aufrichten, bearbeiten, bekommen, besprechen, betrachten, empfangen, erhalten, erörtern, kennen, unterstützen, account for, discuss, know (meaning *be acquainted with*), look at, straighten, support; treffen, meet.

These verbs can be used *only* with the four common transitive constructions SVO, SVOPN, SVOIp, and SVOCp.

Vt.dat—raten; befehlen; erzählen, sagen, vorschlagen;; helfen.

Whenever a verb of this class appears in a construction where there is an animate noun used predicatively, this noun will be in the dative case.

Vt.gen—sich erinnern, gedenken.

Any noun used predicatively with a member of this class may be in the genitive case. (With *sich erinnern* the predicate noun may be used in the accusative case after the preposition *an*.)

Vt.indO—machen, (Rechenschaft) ablegen; bewirken, erklären, hinzufügen; befehlen; tell; erzählen, sagen, vorschlagen, wünschen; aufhalten; auswählen, wählen, fahren; bringen, nehmen, bring, take; make;; addieren, anhalten, geben, kaufen, buy, give; unterschreiben; laufen, springen.

All of these verbs may appear in the construction SVO_{dat}O_{acc}, e.g. *The man bought the boy a dog*.

Vt.that—wissen, say, suggest; raten, advise; sich erinnern, gedenken; vorziehen, prefer; mögen, wollen; bewirken, erklären, hinzufügen; befehlen; tell; erzählen, sagen, vorschlagen; wünschen;; begreifen, verstehen, einsehen, know (not meaning *be acquainted with*), understand, add; sehen, see; remember; unterschreiben.

All of the verbs in this category can be used in the construction SVCt, e.g. *He said that the sum was shining*.

Vt.Othat—raten, advise; erinnern, mahnen, remind, persuade; erzählen, sagen, vorschlagen; beraten; tell;; sign, unterschreiben.

All of the verbs in this class can be used in the construction SVOct, e.g. *He told her that the sun was shining*.

Vt.to—want; sich erinnern, gedenken; vorziehen, prefer; aufhalten; wünschen;; helfen; help, choose; remember.

All of the verbs in this class can be used in the construction SVIo, e.g. *He wanted to write a letter*.

Vt.Oto—raten; advise; erinnern, mahnen, remind, persuade; want; auswählen, wählen; befehlen; tell; beraten, überzeugen, überreden; helfen; help, choose; sehen, see; sign.

All of the verbs in this class can be used in the construction SVO_{lo} as in *The girl wanted the boy to write a letter* and *She saw the boy go home*.

Vt.into—fahren (meaning *drive*);; sehen, see; run (meaning go *quickly*), jump; sign(?); laufen, springen.

All of the verbs in this class, can be used in the construction SVintoN as in *He jumped into the pool* and in the apparently similarly structured sentence *He signed into the hotel*.

Vt.Ointo—bringen, nehmen, bring, take; fahren; receive, run, (meaning *operate*); make;; run (meaning *go quickly*) (?), jump; laufen, springen; accept; sign.

All of the verbs in this class can be used in the construction SVOintoN as in *He brought the book into the room*.

Some Comparisons of the Distributions of German and English Verbs

The problem of determining the distributions of German and English verbs and of assigning the verbs to syntactic classes for use with a transfer grammar can be simplified if general rules of equivalence can be formulated so that it will be possible to predict that whenever a verb *v* is used in input language A in construction *c*, its equivalent *v'* in the output language B can be used in construction *c'*. As an aid in making general statements and predictions of this kind, the respective distributions of equivalent German and English verbs were compared. The distribution of each member of sixty-three out of the sixty-five pairs of German and English verbs considered were found to vary from one another in not more than five constructions. Both members of twenty-two of these verb pairs can occur in the same constructions, and each member of twenty-two of the verb pairs can occur in the same constructions as the other member of the pair except for one construction; in this construction one member of the pair may appear, but the other cannot.

The principal difference noted in the distributions of the German verbs in contrast to those of their English equivalents was that many German verbs can appear in the construction SVO_{dat}O_{acc}, while their English equivalents cannot. This difference was noted in twenty verbs. Further, this difference is one-sided, that is to say that while the English equivalent of a German verb in this construction cannot also be used in this construction, for every English verb which could appear in this construction there is a German equivalent which can appear in the same construction.

Because this difference is so marked, it would seem expedient in the construction of a German-to-English transfer grammar to eliminate the structurally similar English construct. This could simplify the task of determining the distribution of the English verbs. In place of testing for substitutability in this construction, one

could test for substitutability in the construction NP—Verb—NP—to—NP_{anim}. In the transfer grammar all German SVO_{dat}O_{acc} constructions could be equated with NP—Verb—NP—for—NP_{anim}. For example, *Er kaufte dem Jungen ein Buch* would become *He bought a book for the boy*. This structural transfer would be made except when the English verb equivalent is a member of the special, more easily definable class of verbs of *presenting and transport*. When the verb is a member of this special class, the English construction would be NP—Verb—NP—to—NP_{anim}. For example, *Er brachte dem Jungen ein Buch* would be translated as *He brought a book to the boy*. By using short-cuts such as this, the problems of translation can be simplified and dealt with more quickly. Such short-cuts as this one have the advantage also of simplification of the problem without alteration or distortion of the meaning of a given construction.

Anyone trying to determine the exact distributions of German and English verbs should be alert to the various constructions in which the verbs of the one language have been observed to be substitutable, while their equivalents in the other language are not. While more German verbs may appear in the construction SVO_{dat}O_{acc} than their English equivalents, more English verbs may appear in the constructions SVintoN and SVOintoN than their German counterparts. A total of eleven instances of this difference were noted.

Verbs of *motion and transport* in both German and English may appear in these two constructions, e.g. *He jumps into the water*, *He brings the book into the park*: *Er springt ins Wasser*, *Er bringt das Buch in den Park*. However, there is a marginal group of English verbs which may be used in one or both of these constructions while their German equivalents may not. For example, the sentence *He made the box into a table* has a different structure in its German translation, as may be seen in the sentence *Er machte aus der Kiste einen Tisch*. The sentence *He signs into the hotel* requires yet another construction in German, namely a reflexive and a prepositional phrase of location instead of direction in the sentence *Er schreibt sich in dem Hotel ein*. In general, it may be said that all of the German verbs in this study which can occur in the constructions SVintoN or SVOintoN can be translated into English with the same type of construction with minimal change in meaning, but this working rule does not hold in translation from English into German.

By using another construction in the tests of substitutability the class of verbs useable in SVOintoN can be subdivided into the verbs of *motion and transport* and the remainder. This sub-class of verbs of *motion and transport* includes an English equivalent for every German verb in the class and *vice versa*. The construction that would be added to the test would be SVOAdv_{dir}:NP₁—Aux—Verb—NP₂—Adv_{direction}, where Adv_{direction} is an adverb indicating a movement to another geographical position, such as the adverb *dahin* or the obsolete *thither* in *Er brachte das Buch dahin* and

He brought the book thither. This construction makes it possible to distinguish *bring into* from *make into*.

Striking similarities in the distributions of the German verbs and of their English equivalents were noted in connection with the constructions SVCt, SVOct, SVIo, and SVOIo. There were few instances noted in the verbs studied where a verb of the one language can appear in one of these constructions while its equivalent in the other language cannot. This similarity in distributions was particularly noticeable in the constructions SVCt and SVOct.

Also in the constructions SVIo and SVOIo there is generally some German verb or other in the classes Vt.to and Vt.Oto respectively which may be used as a translation of the English verb used in the input language construction. However, this simple structural transfer cannot always be made in translation from German to English. Not all English verbs which are the equivalents of German verbs occurring in these two constructions may be used in these same two constructions. For example, although *Er hilft dies zu tun* can be translated as *He helps to do this*, the translation of *Er hört auf dies zu tun* as *He ceases to do this* is stilted. This sentence is more commonly translated with a construction involving a verb with the suffix *-ing*, e.g. *He stops doing this*. Consider also the verb *vermeiden*, which was not closely examined in this study; this verb can occur in the construction SVIo, but it has no English equivalent which may appear in the corresponding English construction. When *vermeiden* appears in this construction, its English equivalent *avoid* appears in a construction verb + gerund or gerundive. Instead of an introductory particle to there is a suffix *-ing*: *Er vermeidet dies zu tun* → *He avoids doing this*. Similarly, when a German verb appears in the construction SVOIo, its English equivalent may be a verb which cannot be used in this construction. For example, the verb *abhalten* in SVOIo may be translated as *keep* in a dissimilar construction; *Er hält ihn (davon) ab es zu tun* → *He keeps him from doing it*.

More English verbs proportionally may be used than German verbs in the entire series of transitive constructions, SVO, SVOPN, SVOIp, and SVOCp, combined with the common intransitive constructions SV, SVPN, SVIp, and SVCp, that is to say, more English verbs can be used both transitively and intransitively than German verbs. Because of this, the English verbs may be described as having more flexibility structurally than their German equivalents. A clear example of this is the verb *work*. It is a member of class Vt.opt.com. It may be used both transitively and intransitively, but only in the common constructions. This verb has two German equivalents, *arbeiten* and *bearbeiten*. *Arbeiten* can only be used intransitively and *bearbeiten* can only be used transitively. The one verb *work* has structural flexibility and also semantic flexibility because it can be used to translate two differently structured sentences in which the meaning of the verb is somewhat different; *Er arbeitet in dem Keller* → *He works in the cellar* and *Er*

bearbeitet den Ton in dem Keller → *He works the clay in the cellar*.

In this study it was observed that whenever a German verb occurs in a common transitive or intransitive construction, it may be translated by an English verb in the similar English construction. When an English verb appears in a common transitive construction, one of its German equivalents may usually be used in a similarly structured German sentence. When, however, an English verb appears in a common *intransitive* construction, it is not always possible to find a German equivalent which may be translated in the similar German construction.

In sum then, as may be seen in Table 1, when one is trying to determine the distribution of German verbs, he must be particularly alert to the possibility of "poorness of fit" in the constructions SVintoN, SVOintoN, SVPN, SVIp and SVCp. As touched upon earlier, German and English obligatorily transitive verbs may sometimes be used in the construction SV with the object understood. One clue that is useful in determining the transitivity of German verbs is the prefix *be-*, as in *bearbeiten*. All of the German verbs in this study which have the prefix *be-* were found to be obligatorily transitive.

In the determination of the distributions of English verbs, one should be alert to the possibility of poorness of fit in the construction SVO_{dat}O_{acc}, if this construction

TABLE 1.
TRANSLATABILITY OF A FIXED NUMBER OF
GERMAN AND ENGLISH VERB CONSTRUCTIONS

German Constructions		English Constructions
SVOPN	↔	SVOPN
SVOIp	↔	SVOIp
SVOCp	↔	SVOCp
SVO _{acc}	} ↔	SVO
SVO _{dat}		
SVO _{gen}		
SVCt	↔	SVCt
SVOct	↔	SVOct
SV	→	SV
SVPN	→	SVPN
SVIp	→	SVIp
SVCp	→	SVCp
SVintoN	→	SVintoN
SVOintoN	→	SVOintoN
SVIo	←	SVIo
SVOIo	←	SVOIo
SVO _{dat} O _{acc}	←	SVO _{dat} O _{acc}

An arrow means that with the verbs studied it is always possible to translate a given construction in the input language into the output construction indicated. For an explanation of the structural designations, see the list of constructions studied.

is included in the test, and in the constructions SVI₀ and SVOI₀ in contrast to constructions where the verb is followed by a verb with the suffix *—ing*.

The above statements about structurally equivalent constructions in German and English should not be construed as universal laws, but simply as regularities of correspondence affecting certain verbs. These statements concern only a few of the possible types of output language constructions which are equivalent to a few construction-types present in the input language.

The researcher in the field of mechanical translation should use the structural equivalences presented here only as a guide in the determination of the distribution of individual verbs and in the writing of a simple transfer grammar.

Summary

The problems of structural transfer constitute an important part of mechanical translation and should be dealt with systematically and thoroughly. This study is concerned with a detailed analysis of a very small, but frequently used number of constructions that should be dealt with in a transfer grammar. Nineteen German verb constructions were postulated as equivalent to seventeen English verb constructions. These were selected because a minimum of permutation and modification is necessary to transform the constructions of the one language into the constructions of the other language.

In order to test the postulated equivalences and to gather material needed for a rudimentary transfer grammar, the writer tested forty English verbs and sixty-four equivalent German verbs for substitutability in

these constructs. These verbs were then placed in a number of syntactic classes according to the constructions in which they can be substituted. Thus obligatorily transitive, obligatorily intransitive, optionally intransitive, and anomalous verbs were placed in separate syntactic classes. In addition to being a member of one of these classes each verb is a member of one or more other classes, if it can be followed by an infinitive phrase with *to* or *zu*, a subordinate clause introduced by *that* or *dass*, a prepositional phrase of direction, or a predicate containing an indirect object. The list of syntactic classes to which a given verb belongs may be stored in an automatic dictionary for use with a transfer grammar.

The distributions of the verbs of each language were compared with the distributions of other verbs of the same language and of the other language in order to discover predictable regularities that could be used for a more efficient determination of the distributions of other verbs not yet studied. Sometimes the distribution of a verb in German can be used as an aid in determining the distribution of its equivalent in English and *vice versa*. Once the distribution of a verb is known, it is a relatively easy matter to assign it to syntactic classes for use in mechanical translation.

The German and English constructions that were postulated at the beginning of this report as equivalent were found to be equivalent only with certain types, or classes, of verbs. This report has been an attempt at classifying German and English verbs and determining when a construction in one of the languages is equivalent to a certain structurally similar construction in the other language.

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