

ON USING THE LEXICON-GRAMMAR IN A BILINGUAL DICTIONARY

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One of the most vexing problems encountered when attempting to write a program of automatic translation is the polysemy of most words. A simple inspection of the chaotic presentation of the translations recorded in any bilingual dictionary will convince one that it would seem impossible to impose an order on the arbitrary translations of any given entry. Some translations are imposed by a particular syntactic context, e.g., *abuser*:

(1) a. *Max abuse* —> *Max overdoes it*
b. *Max abuse de N* —> *Max takes advantage of N*

Here, the argument structure of *abuser* contains a series of objects, each of a particular structure: when *abuser* is followed by 0, the translation is *overdo it*; when it is followed by *de N*, it is *take advantage of*.

However, many different translations may be needed for a given argument structure due to the appearance of particular subclasses of words, e.g., *absorber*, in the structure *N0 absorbe N1*:

(2) a. *Na (Le travail) absorbe Nh (Max)* —> *Work engrosses Max*
b. *Nc (Le buvard) absorbe Nc (le liquide)* —> *The blotter
absorbs the liquid*
c. *Nh (Max) absorbe Nc (la boisson)* —> *Max imbibes the drink*

The problem is made even more difficult if it is expressed in terms of semantics, i.e., by saying that most words have many meanings which are hard to distinguish by formal means. Nevertheless, examples (1) and (2) point up the essential problem: how is one to decide on the meaning of a polysemous word, based on the information furnished by a polysemous context?

Lehrberger & Bourbeau (1988, *Machine Translation*, Amsterdam/Philadelphia: J. Benjamins pp. 114-116) for example, point to the many senses of the English preposition *on* as a difficulty that it may not be possible to overcome without further advances in semantic analysis. Their example is instructive, and will repay looking at. Let us examine the French equivalent of this problem: the prepositional phrase *sur N*.

In general, the translation of any prepositional phrase is closely linked to the context in which it is found: the translation varies according as it is in

a sentence adjunct, for example, or in the object of a verb. Consider the translation of the prepositional phrase *sur ce point*:

(3) a. *Paul embête Max sur ce point* —> *Paul bothers Max about this point*
 b. *Sur ce point, Paul est inflexible* —> *On this point, Paul is inflexible*

In (3a), *sur ce point* is in the object of *embête*, so that *sur* translates as *about*. In (3b), *sur ce point* is a sentence adjunct, and the translation of *sur* should be *on*.

Let us now examine the translation of the phrase *sur N* in the object position as the noun *N* and the verb vary.

(4) a. *(La maison) donne sur (le jardin)* —> *(The house) looks out on (the garden)*
 b. *(Le pion) avance sur (l'échiquier)* —> *(The pawn) advances on (the chessboard)*
 c. *(L'armée) avance sur (l'ennemi)* —> *(The army) advances against (the enemy)*
 d. *(Paul) l'emporte sur (Max)* —> *(Paul) prevails over (Max)*
 e. *(Paul) interroge Max sur (ce point)* —> *(Paul) interrogates Max about (this point)*
 f. *(Paul) pose le verre sur (la table)* —> *(Paul) sets the glass on (the table)*

There are two ways of looking at this array of varying translations for *sur*. In the first instance, one can declare *sur* to be highly polysemous, since it can be translated as *on*, *over*, *against*, etc. Furthermore, each such translation is arbitrary, so that no formal rules could be constructed that would choose the proper translation. The conclusion then follows that automatic translation of polysemous words is an intractable problem that cannot be handled in any systematic fashion.

In the second instance, however, we note that in each of the above sentences, the decision as to the required translation of *sur* can be taken on the basis of the argument structure in which it appears and, if necessary, the semantic sub-classes of the nouns appearing with it. In sentence a, *sur* is in the prepositional object *sur N2* of *donner*, and its translation is *on*. In sentences b and c, the same object *sur N2* appears after *avancer*, but here the translation of *sur* depends on the subclass of *N2*: in b, *N2* is a concrete noun; and in c it is *Nh*, a 'human' noun. The same prepositional object in sentence d after *emporter* requires that *sur* be translated as *over*. In sentence e, the object of *interroger* is *N1 sur N2*, and the translation of *sur* is *about*. However, the same formal structure, *N1 sur N2*, as the object of *poser* in sentence (f) leads to a translation *on* for *sur*.

We see that the problem here does not lie in the multiple meanings of *sur*, but rather in finding formal definitions of each of the contexts in which it can appear. This in turn suggests that it may be possible to utilize the dependence of translation on context for handling the question of polysemy in a formal, systematic way. At first sight, this dependence on context seems

to be linked both to the multiple meanings of individual words and to the multiple meanings of the surrounding context induced by the polysemy of the words appearing in that context. The resolution of the problem of polysemy thus seems *a priori* extraordinarily complex, involving the simultaneous juggling of polysemous words and polysemous contexts.

However, a detailed compilation of verb uses in French that has recently been completed at the L.A.D.L. may be of help in this question. This compilation shows us that relatively few syntactic and semantic sub-classes of nouns, verbs, etc. are required to describe verb uses in French, at least in a quite general way. With the help of this compilation, it is now possible to search *systematically* for the translation of each verb use in the sentence defining that use in order to choose the best one. In so doing, we shall also see how many semantic sub-classes of nouns are required to carry out this project.

The study of verb uses proposed above amounts to a direct and systematic examination of the problem of polysemy. For each verb use is defined by a sentence containing the verb, its subject and its complements, so that the detailed listing of verb uses in effect makes available all the sentential contexts in which a given verb might be found. Suppose that one were to try to translate all these verb uses into English, for example. One could then see how many different translations would be required for each verb, and whether it would be possible to determine the translation by means of formal rules. The number of different translations that would be required is a measure of the polysemy, and the resolution of the polysemy (i.e., the choice of the correct translation) would depend on being able to provide an operational definition of the semantic sub-classes appearing in the formal rules used by the translation module in order to effect this choice.

An examination of the polysemy in this fashion constitutes an experiment in French-English translation. The variables are the semantic sub-classes of nouns required to describe the verb uses of French, and the English equivalents of each verb use. Each verb use is an entire sentence, e.g.,

(5) *Max abaisse Luc à demander 10F* → *Max humbles Luc into asking for 10fr*

The syntactic analyzer produces an analysis of such a sentence using the information that both the subject and object of *abaisser* (*humble*) must be 'human' nouns, for this verb use. The object can be a 'concrete' noun in another use of *abaisser*, but then the translation is different:

(6) *Max abaisse le rideau* → *Max lowers the curtain*

In this way, both the syntactic analyzer and the translation program make use of the sub-classes of nouns introduced to describe the verb uses. The experiment can now be set up in the following way.

(i) I first translate a portion of the lexicon of verb uses of French, say all the verbs beginning with a, taking care to use the minimum number of

different English equivalents needed to translate correctly all the verb uses of a given verb. In certain cases, this means using an approximate translation in order not to increase the number of different translations.

(ii) Many provisional semantic sub-classes of nouns are required in order to carry out the translations of the previous step. Some such classes are already in the string grammar of French, and are used by the restrictions of the grammar to eliminate incoherent analyses. Three of the the most important of these classes are the following:

(7) *Nh* 'human' nouns: *Max, man, person, jury, council*.
Na 'abstract' nouns: *despair, construction*
Nc 'concrete' nouns: *table, lamp, chair*

These are quite approximate semantic classes, and a classification of nouns using only these three sub-classes amounts to a rough and ready partition of nouns. Nevertheless, for many verbs, such a tripartition is sufficient to separate the translations of verb uses. For example, the translations of the verb absorber given in (2) are separated using just these three sub-classes.

It turns out that a classification of nouns based on these three classes: *Nh* (human), *Nc* (concrete), and *Na* (abstract) suffices to separate the translation equivalents for most of the verb uses. Note that this result is not a priori predictable, e.g., from theoretical considerations alone.

(iii) For some verbs, particular semantic sub-classes of nouns are required in order to separate the translation equivalents. Certain additional noun sub-classes have already been introduced into the verbal classification carried out at the LADL. For example, the following two sub-classes discriminate certain verb uses:

(8) a. *Nt* text nouns: *book, report, manuscript,...*;
b. *Np* psychological nouns: *mind, spirit, wits,...*

They appear in the following types of verb complements:

(9) a. *Max accroche au rapport que P* → *Max appends to the report that S*
b. *Cet effort ancre dans son esprit que P* → *This effort fixes it in his mind that S*

These are the contexts for which *Np* and *Nt* were originally defined; they are useful however in other verb uses, where they separate the translations:

(10) a. *Max annonce le gagnant* → *Max announces the winner*
b. *Ce résultat annonce une intelligence (Np)* → *This result gives signs of intelligence (not: *announces an intelligence)*
c. *Max adresse une lettre (Nt) à Nh* → *Max addresses a letter to Nh*
d. *Max adresse son client (Nh) au docteur (Nh)* → *Max refers his client to the doctor (not: *addresses his client to the doctor)*

Here, the difference between *Nh* and *Np* or *Nt* allows us to choose the appropriate translation of *annoncer* and *adresser*.

It turns out that more semantic sub-classes than these are required in order to separate the translations of other verbs; these sub-classes are listed in Annex 1. Some of them are described here, together with a sampling of the verb translations for which they are needed.

(i) *Nal*. Sub-class of laws, regulations. This class is a sub-class of the major class *Na*. The verb *annuler* translates as *annul* when its direct object is *Na*, unless the direct object is *Nal*, when its translation is *repeal*; and similarly for *appliquer*:

- (11) a. *Ils ont annulé (le déficit + le résultat) —> They annulled (the deficit + the result)*
- b. *Ils ont annulé cette loi —> They repealed this law*
- c. *Max a appliqué cette méthode —> Max applied this method*
- d. *Le policier a appliqué la loi —> The policeman enforced the law*

(ii) *Nb*. The sub-class 'boat' of *Nc*. Certain verbs have quite specific translations when the subject or object is a word designating a ship, e.g., *aborder*. This verb has two translations when it appears with *Nh* or *Na*, and different ones for *Nb*:

- (12) a. *Nh aborde Nh: Max a abordé Ida —> Max accosted Ida*
- b. *Nh aborde Na: Max aborde un nouveau problème —> Max tackles a new problem*
- c. *Nh aborde Nb: Max aborde le bateau —> Max boards the ship*
- d. *Nb aborde Nb: Le canoë a abordé le hors-bord —> The canoe collided with the outboard*

(iii) *Ne*. The sub-class 'tool' of *Nc*. This sub-class can be used for the verb *aiguiser* and the adjective *acérée* in order to distinguish a tool and an abstract noun *Na*:

- (13) a. *La lame acérée (était...) —> The sharp blade (was...)*
- b. *Son sarcasme acéré (était...) —> His stinging sarcasm (was...)*
- c. *Max a aiguisé la lame —> Max sharpened the blade*
- d. *Ce texte a aiguisé leur hostilité —> This text excited their hostility*

Note that the sub-class *Ne* is not indispensable for the above distinctions; it suffices for the translation module to observe that the object of the verb *aiguiser* or the noun modified by *acéré* is not *Na*, for it to be able to choose one of the alternate translations *sharpen* or *sharp*. It may be the case, however, that the class *Ne* will be useful when the lexicon is expanded.

(iv) *Nf*. The sub-class 'machine' of *Nc*. Like *Ne* above, the class *Nf* is not indispensable for *animer*:

- (14) a. *Na anime Nf: Une combustion chimique anime le moteur —> Chemical combustion drives the motor*

- b. *Na anime Nh: Cette idée anime Max* → *This idea urges on Max*
- c. *Na anime Na: Une joie de vivre anime le spectacle* → *A joie de vivre livens up the show*

For the verb *amorcer*, the class *Nf* separates one of three possible translations:

- (15) a. *Nh amorce Nc de Ni: Max amorce la canne à pêche d'une mouche* → *Max baits the fishing rod with a fly*
- b. *Nh amorce Nf: Max amorce (la bombe + la pompe)* → *Max primes (the bomb + the pump)*
- c. *Nh, Nf amorce Na: (Max + La navette) amorce sa descente* → *(Max + The shuttle) begins its descent*

A similar separation can be effected for the verb *allumer*.

(v) *Ni*. The sub-class *Ni* of 'animate' nouns includes all higher-order animals except *Nh*. Many verbs of animal sound will take only nouns in *Ni* as subject: *hennir* (neigh), *piauler* (cheep), etc. These verbs take *Nh* as subject only in special circumstances. However, there are a few verbs whose translations differ according as the subject (or object) is *Ni* or *Nh*:

- (16) a. *Nh apprivoise Ni: Max apprivoise l'oiseau* → *Max tames the bird*
- b. *Nh apprivoise Nh: Max apprivoise l'enfant* → *Max wins over the child*
- c. *Ni s'attroupent: Les oiseaux s'attroupent* → *The birds flock together*
- d. *Nh s'attroupent: Les enfants s'attroupent* → *The children gather together*

For the verb *s'attrouper*, the passe-partout translation *gather* would suffice for both cases.

(vi) *Nj*. The sub-class 'body part'. *Nj* separates the translations for many verbs; for *acquiescer*, one can even distinguish translations involving the head or other parts of the body:

- (17) a. *Nh acquiesce de la tête* → *Nh nods agreement*
- b. *Nh acquiesce de son petit doigt* → *Nh signals agreement with his little finger*

The direct object of *assouplir* yields three different translations according to sub-class:

- (18) a. *Na, Nh assouplit Nc: (Un bon graissage + Max) assouplit le cuir* → *(A good lubrication + Max) softens leather*
- b. *Na, Nh assouplit Nj: L'exercice assouplit les muscles* → *Exercise makes muscles supple*
- c. *Na assouplit Nh: La souffrance a assoupli Max* → *Suffering has mellowed Max*

In the same way, the sub-class of the direct object of *atteindre* separates its translations:

- (19) a. *Naa atteint Nj*: *Le cancer atteint les poumons* —> *The cancer affects the lungs*
- b. *Naa atteint Nh*: *La grippe a atteint Max* —> *Max has caught the flu*
- c. *Nh atteint Nc*: *Max atteint la ville* —> *Max reaches the town*

The class *Naa* is the sub-class 'disease' of *Na*. Note the inversion of subject and object in sentence *b*. The class *Nj* affects the translations of many other verbs: *affluer, adapter, affubler, agacer, agiter, allonger*, etc.

(vii) *Nm*. Sub-class 'metal'. The verb *s'allier* has two particular translations for the sub-classes *Nd* (color) and *Nm*:

- (20) a. *Nd s'allie avec Nd*: *Le rouge s'allie avec le rose* —> *Red blends with pink*
- b. *Nm s'allie avec Nm*: *Le fer s'allie avec l'étain* —> *Iron alloys with tin*

The translations of *affiner* can also be separated in this way, but a good *passe-partout* translation is *refine*:

- (21) a. *L'éducation a affiné (cet homme + son style)* —> *Education has polished (this man + his style)*
- b. *Ce processus affinera le métal* —> *This process will refine the metal*

(viii) *Nn*. Sub-class of 'sounds'. The translation of *assourdir* varies with the sub-class of its direct object:

- (22) a. *Nh assourdit Nc*: *Max assourdit la chambre* —> *Max muffles the room*
- b. *(Nc + Na) assourdit Nn* —> *(Le tapis + De tapisser la chambre) assourdit le bruit* —> *(The carpet + Carpeting the room) deadens the noise*

When *Nn* is the subject of the reflexive *s'assourdir*, the translation is *die away*:

- (22) c. *Nn s'assourdit*: *Le bruit s'assourdit* —> *The noise dies away* (not: ??*The noise deadens itself*).

(ix) *No*. The sub-class 'function' denotes official functions such as presidency etc. The verb *accéder* has different translations for the sub-classes *Nc, Na* and *No* of its indirect object:

- (23) a. *Nh accède à Nc*: *Max accède à la rue (par la porte)* —> *Max accesses the street by the door*
- b. *Nh accède à Na*: *Max accède à la demande* —> *Max complies with the request*
- c. *Nh accède à N*: *Max accède à la présidence* —> *Max accedes to the presidency*

The sub-class Noa is the title of the function: *president*, *ambassador*, *chief*, etc., which is needed for verbs such as *agréer* (*accept*), *acclamer* (*acclaim*), and *accepter* (*accept*):

(24) a. *Nh agréee Nh pour Noa: Ils ont agréé Max comme délégué*
 → *They accepted Max as delegate*
 b. *Nh acclama Nh Noa: Le peuple acclama Roland empereur*
 → *The people acclaimed Roland emperor*

(x) *Ns*. Sub-class of 'measure' nouns. The translation of *accuser* varies with the sub-class of its direct object:

(25) a. *Max accuse Paul* → *Max accuses Paul*
 b. *La balance accuse 85kg* → *The scale shows 85 kg*
 c. *Max accuse ses 85 kg.* → *Max shows (his) 85kg.*

The subclass *Ns* appears in the measure adjunct *de Q Ns* (where *Q* is a number) of verbs like *abaisser* (*lower*), *affaïsset* (*sag*), *agrandir* (*enlarge*), etc.; in this case, the preposition *de* translates as *by*:

(26) a. *Nh abaisse Nc de Q Ns: Max abaisse le rideau de 5 cm.* →
 Max lowers the curtain by 5 cm.
 b. *Nh allonge Nc de Q Ns: Max allonge le lit de 1 mètre* →
 Max lengthens the bed by 1 meter

(xi) *Nv* (vehicle). This subclass separates the translations of verbs like *accrocher* and *accidenter*:

(27) a. *(Nh + Nv) accroche Nv: (Max + Le bus) accroche la voiture* → *(Max + the bus) runs into the car*
 b. *Nh accroche Nh: Max a accroché Luc* → *Max button holed Luke*
 c. *(Na + Nh) accidente Nv: (Une mauvaise conduite + Max) a accidenté la voiture* → *(Bad driving + Max) damaged the car*
 d. *Na accidente Nc: Une catastrophe naturelle a accidenté le terrain* → *A natural catastrophe gave variety to the land*

Similarly for *affréter* (*hire out*), *aplatir* (*bash*), *atteler* (*harness*), etc.

(xii) *Nw* (weather). This subclass differentiates the translations of *s'abattre* and *s'annoncer*:

(28) a. *(Nh + Ni) s'abat sur Ni: (Max + le chien) s'abat sur le chat* → *(Max + the dog) pounces on the cat.*
 b. *Nw s'abat sur Nl: La tempête s'abat sur la ville* → *The storm sweeps down on the city*
 c. *Nh s'annonce: Max s'est annoncé* → *Max announced himself*
 d. *Nw s'annonce: Une tempête s'annonce* → *A storm is brewing*

These semantic classes have been defined, approximately, in the following way. Consider a verb use that contains one of these semantic classes

in subject or object position, e.g., *Na*. Thus the verb *abasourdir* is translated as *dumbfound* when the subject is *Na* or a complement clause: *Cet échec a abasourdi Max* → *This failure dumbfounded Max*. This translation is different from the translation of another use of *abasourdir* where the semantic sub-class 'sound', *Nn*, appears in the subject: *Ce bruit a abasourdi Max* → *This noise deafened Max*. In this case, *abasourdir* translates as *deafen*. This difference in translation defines the sub-class 'sound', *Nn*.

A word is classified in a given semantic sub-class *Nx* when the following condition is satisfied. Consider a French verb *Vf* for which several translations are possible that depend on the semantic subclasses of the nouns in its argument positions. One of these positions, say *Ni*, can be filled by a noun classified in *Nx*, in which case the appropriate translation is the English verb *Ve*. When the question is whether a given word can be classed in *Nx*, then the following sentence is constructed. The main verb is *Vf*, and the word in question appears in the defining argument position *Ni*. This sentence is examined, and if it is then the case that *Ve* is the appropriate translation there of *Vf*, the word is classed in *Nx*. Thus, for example, a word is classified in *Nn* ('sound') if its appearance in the subject position of *abasourdir* entails that *deafen* is the appropriate translation. The difficulty attached to this definition of a semantic sub-class is that the members of a class defined in this way, e.g., *Nn* above, may vary when that semantic sub-class appears with a different verb from the one whose translation served as the reference point. Thus, with another verb than *abasourdir*, the members of *Nn* may be different. This question can be resolved only by translating a greater portion of the French-English lexicon than I have done so far and classifying French words according to the sub-classes obtained.

I have carried out these three steps for the 400 French verbs beginning with *a* whose uses have been studied in the LADL, and have found that about 25 semantic sub-classes similar to those discussed in (i)-(xii) above are required to separate all those translations which cannot be distinguished by the use of only the three classes *Nh*, *Nc* and *Na*. The semantic subclasses are presented in Annex 1, and excerpts of the translations of verb uses are given in Annex 2.

Note that these semantic sub-classes are not defined absolutely, by reference to their meaning in isolation. Rather, they are defined by a difference in meaning between two translations, as mentioned in the condition discussed above: given two verb uses yielding two different translations, a semantic sub-class can be defined by the translation required for the verb appearing with that sub-class.

The problem of how to handle polysemy is now replaced by another, perhaps more tractable question: to what extent is it possible to obtain a coherent classification of nouns using the semantic sub-classes defined above in terms of translation equivalents? Posing the question in this way amounts to asking whether the differences in meaning, under translation, of a given verb can be captured by a classification of the nouns appearing with it. On

the other hand, trying to characterize the polysemy of a verb directly amounts to attempting to define its absolute meanings, which is considerably more difficult.

Results

It turns out that the syntactical differences among the verb complements of a given verb use, taken together with the rough classification of nouns according to the three classes *Nh*, *Na* and *Nc* is often sufficient to separate all the translations of the uses of a verb. Thus, I find the following translations to be adequate for the verb *s'acharner*:

(29) a. *(Nh + Na) s'acharne contre, sur Nh* → *(Max + fate) hounds Luc*
 b. *Nh s'acharne (à + sur) Na* → *Max slaves at his work*
 c. *Nh s'acharne à faire cela* → *Max is bent on doing that*

Note that the difference between (29a-b), when the preposition is *sur*, is the difference between *Nh* and *Na*; this is enough to differentiate the translations. The translation for (29c) is obtained by noting the difference in the complement: the complement is *Prep N* in (29a-b), but *à V^oW* in (29c).

For some verbs, the translation does not change with the change in complement:

(30) a. *Nh acclame (Nh, Na)* → *Max acclaims (Luc, the suggestion)*
 b. *Nh acclame Nh No* → *Max acclaims Luc emperor*
 c. *Nh acclame Nh de faire cela* → *Max acclaims Luc for doing that*

Here, *No* is a noun of 'function': *president, king, emperor, ambassador*, etc. However, its exact nature is of no concern here, since the translation is invariable.

Similarly for *acculer*:

(31) a. *Na accule Nh à Na* → *This event drives Max to despair*
 b. *Na accule Nh à faire cela* → *This event drives Max to do that*
 c. *(Na, Nh) accule (Nh, Nc) contre Nc* → *(Luc, the force) drives (Max, the box) against the wall*

Various semantic noun sub-classes appear in the verb uses of other verbs, but it is frequently possible to avoid having to depend on them for a decision as to the required translation. Sometimes, it is the difference in argument structure of the verb that allows us to make the right decision:

(32) a. *Nh avale N* → *Max swallows N*
 b. *Nh avale que P* → *Max accepts that S*
 c. *Nh avalise N* → *Max endorses N*
 d. *Nh avalise que P* → *Max backs it that S*

For both of these verbs, the difference in translation depends on the nature of the verb complement. In each case, the noun phrase complement accepts only a limited sub-class of nouns. The verb *avaler* is usually followed by a noun indicating food or drink, and the verb *avaliser* by a noun like *check*, or certain abstract nouns. However, the difference between the verb complements is enough for choosing the correct translation, so that a more precise specification of the noun phrase is unnecessary.

The verb *atteindre*, on the other hand, has a different translation for various noun sub-classes when its object is a noun phrase.

(33) a. *Nh atteint Nl (ville)* —> *Max reaches the town*
 b. *Nh atteint Nc (boîte)* —> *Max reaches for the box*
 c. *(Nh,Na) atteint Nh* —> *(Luc,disaster) overtakes enemy*
 d. *Nh atteint Nta (cinquantaine)* —> *Max is getting on to 50*
 e. *Nh a atteint Nt (65)* —> *Max reached 65*
 f. *Naa (cancer) a atteint Nj (poumons)* —> *Cancer has reached the lungs*
 g. *(Naa + Nac) atteint (Nhpl + Nhcoll): (une carence grave + un virus) atteint (les personnes âgées + la population urbaine)* —> *(A serious deficiency + a virus) affects (old people + the urban population)*
 h. *Nh est atteint de Naa (tuberculose, la fièvre jaune)* —> *Max has caught (TB, yellow fever)*

The following noun sub-classes are needed, in addition to *Nh*, *Na*, and *Nc*:

(34) *Naa: disease (cancer, mumps)*
Nl: place (town, room, street)
Nu: time (year, week)
Nua: approximate time (20s, 30s)
Nj: body part (lungs, arm, leg)

The most difficult class to define is *Nl*, nouns of 'place'; in (34)b, the box can either be a concrete object, or a place where something is to be put. The translation of *atteindre* depends on this interpretation.

Special cases

(i) The passive participle

The French passive participle, whether in the noun phrase or in a passive sentence, is generally translated by the addition of the passive morpheme (-ed, -en, etc.) to the infinitive. This is the case for the majority of the verbs so far translated; no translation is shown for the passive participle for these verbs.

However, there are two cases where the passive participle is not translated by the addition of the passive morpheme to the infinitive. The first case occurs when there is no passive of the English translation, and the second when the French passive participle is adjectival in nature. The first type can be illustrated with *abonner* and *affectionner*.

(35) a. *Max a abonné Ida au journal* → *Max gave a subscription to Ida to the newspaper*
 b. *Ida a été abonnée au journal par Max* → *Ida was given a subscription to the newspaper by Max*
 c. *Max affectionne les cravates roses* → *Max is fond of pink ties*
 d. *Les cravates roses ont longtemps été affectionnées par Max* → *Pink ties were for a long time dear to Max*

Since *affectionner* has no passive, the participle *affectionné* must be specially handled. A similar type of special handling for *abonner* is needed if it is translated as *give a subscription to*. The passive participle must then be translated as *given a subscription*, so that two occurrences of *to* are not furnished when *au journal* is translated as *to the newspaper*. A similar treatment is required for the following verbs also:

(36) a. *assiéger* → *throng about, assiégué* → *(was) beset*;
 b. *atteindre* → *get, catch; atteint* → *(be) stricken with, etc.*

The second case is the passive participle after *être (be)*, which is almost adjectival. Whether treated as an adjective or as a verbal form, it requires special treatment, e.g., *agripper*:

(37) a. *Max s'agrippe au balcon* → *Max clutches at the balcony*
 b. *Max est agrippé au balcon* → *Max is clutching the balcony*

(ii) The reflexive *se*

The particle *se* does occasionally translate into the English reflexive *self*.

(38) a. *Max s'arroge le droit de..* → *Max arrogates to himself the right to..*
 b. *Max s'est absenté aujourd'hui* → *Max absented himself today*.

However, it frequently requires special treatment, so that its appearance with any verb must be examined carefully. In the case of *abandonner*, for example, the argument structure (the verb complements) determines the translation:

(39) a. *Max abandonne* → *Max gives up*
 b. *Max s'abandonne* → *Max lets himself go*
 c. *Max s'abandonne au désespoir* → *Max gives way to despair*
 d. *Max s'abandonne à V.O* → *Max goes so far as to V.O*

For other verbs, the semantic subclass of the arguments (subject, object) may determine what translation is required, e.g., *abattre*:

(40) a. *(La température + le vent) s'abat* → *(The temperature + the wind) subsides*
 b. *Le mur s'abat* → *The wall falls down*

(iii) Idioms

Studies of French indicate that there are approximately as many idiomatic expressions as there are verb uses. Hence, the necessary inclusion of idioms in the dictionary will double its size. I have indicated the type of idiomatic expressions that have been collected for just the three verbs *abaisser*, *abandonner* and *abattre*. The entries for such idioms consist of particular words, not sub-classes:

(41) a. *Max abandonne la lutte* —> *Max gives up the struggle*
 b. *Max abaisse ses cartes* —> *Max lays down his hand*
 c. *Max abat ses atouts* —> *Max pulls trumps*

The final results for the translations of the verb uses of verbs beginning with *a* are the following. For about 205 verbs, either the syntax of the object, or the use of the three sub-classes *Nh*, *Nc*, and *Na* suffices to separate the translations. Another 118 verbs have only one possible translation, and so present no special problem. Thus, there remain about 80 verbs, out of the 400 beginning with *a*, that require the use of the semantic sub-classes in Annex 1 for translation, i.e., about 20% of the verbs.

Conclusions

Rather than speak of the polysemy, or multiple meaning, of words, it is more helpful to note that the translation of most words varies with the syntactic and semantic context surrounding them. Their argument structures can be ordered for French verbs by using the list of entries of the lexicon-grammar of French. Each entry corresponds to a separate verb use, so that this listing constitutes an ordering of the sentential contexts of the verb. This ordering, in turn, represents the regularity of the French-English lexicon; the irregularity is confined to the translation of each item.

After this ordering of the verbs, there remain the semantic differences among the contexts. I have treated these by defining semantic sub-classes of nouns in an approximate fashion, in order to handle those syntactic contexts that differ only by some difference in the nouns appearing with the verb. The question now remains whether these sub-classes will suffice to handle the remaining verbs of the lexicon. Translating the remaining verbs of the lexicon-grammar will complete the partial experiment discussed here.

ANNEX 1: SUB-CLASSES

Na abstract	Naa sickness	Nab bad (disaster)	Nal law
Nb boat			
Nc concrete	Nea liquid	Ncb food	Ned musical instr
Nd color	Nda form		
Ne tool			

Nf machine			
Ng cards			
Nh human	Nha military	Nhb country	Nhc party,group
Nhd name			
Ni animate			
Nj body part	Nja feature		
Nk Sing. Collective			
NI Place	Nla city; region	Nka group	
Nm metal			
Nn sound			
No function			
Np psych.			
Nq special			
Ns measure			
Nt text	Nta word	Ntb sentence	Ntc Ling. element
Nu time	Ntd music		
Nv vehicle	Nua Q-aine	Nub date	
Nw weather			
Nx chem.prod.	Nxa acid	Nxb drug	
Ny money	Nya debt;tax		
Nz clothes			

ANNEX 2: EXCERPTS FROM THE DICTIONARY

Nh	abaisser	Nc de Q Ns	
Nh	abaisser	Na (temp.;fever) de Q Ns	lower Nc by 5 (cm)
N	abaisser	Nh	lower Na by 5 (degrees)
N	abaisser	Nh à ce que Ph	humble Nh
N	abaisser	Nh à V O	humble Nh into Ving O
Nc	s' abaisser	0	humble Nh into Ving O
Nh	s' abaisser	devant Nh	subside
Nh	s' abaisser	jusqu'à V O	Nh humble -self before Nh
Nh	abandonner	Nh	Nh stoop to Ving O
Na	abandonner	Nh	
Nh	abandonner	Nl (lieu)	desert
Nh	abandonner	Nl à Nh	desert
Nh	abandonner	Nl à Nh	leave (place) to (Max)
Nh	abandonner	Nl à Nh	leave (problem) to (Max)
Nh	abandonner	Nl à Nh	leave (right) to (Max)
Nh	abandonner	0	give up
Nh	s' abandonner	0	let -self go
Nh	s' abandonner	à Na	give way to (despair)
Nh	s' abandonner	à V O	go so far as to V O
Na	abusourdir	Nh	dumbfound
Na	abasourdir	Nh	deafen
N	abatardir	Nh	mongrelize Nh
N	abattre	Nh	kill
N	abattre	Ni	slaughter (cow)
N	abattre	Nc	demolish (house)
N	abattre	Ng	lay down (spade king)

Nh	abattre	Na	zip thru (work)
N	abattre	Ne de, sur Nc	cut off (pear) from (tree)
N	abattre	Ny de Na	cut off (lf) from (taxes)
Nh	s' abattre	0	become depressed
Na	s' abattre	0 (wind, heat...)	subside
Nc	s' abattre	0 (bomb, pole)	crash down
Nh,Ni	s' abattre	sur Ni (Max,dog)	pounce on (cat)
Na	s' abattre	sur Nh (insults)	sweep down on
Nw	s' abattre	sur Nh,Nc (storm)	sweep down on
Nh	abdiquer	0+Nq	abdicate (0+crown,throne)
Nh	abdiquer	Na devant Nh	renounce (right) before Nh
N	abîmer	Nc	ruin (house)
N	abîmer	Na	ruin (work)
Na	abîmer	Nh	overwhelm (Max)
Nh	abîmer	Nh de Na	overwhelm Nh with (insults)
Nb	s' abîmer	0 (boat)	sink
Nc	s' abîmer	0 (coat, house)	get ruined
Nh	s' abîmer	dans Na	be sunk in (grief)
Nh	abonner	Nh à Nt	take out a subscription to Nt for Nh
Nh	abonner	Nh à V Nt	subscribe Nh to receive Nt
Nh	s' abonner	à Nt	subscribe to Nt
Nh	s' abonner	à Nq	install Nq (gas, electr.)
N	aborder	à, en Nc	reach (river; China)
Nh	aborder	Nb	board (ship)
Nb	aborder	Nb	collide with (ship)
Nh	aborder	Nh	accost (Mary)
Nh	aborder	Na	tackle (subject)
Nh	aborder	Nq (virage)	take (a turn)
Nh	aborder	Nb au quai	berth (ship)
N	abréger	Na	shorten Na
N	abréger	Nt	abbreviate Nt
pour	abréger	Nt de Nt	to be brief
	abréger	Na de Nu	shorten Nt by Nt
N	abréger	Nt en Nt	shorten (life) by (year)
Nh	abroger	Nal	repeal (law)
Nh,Ne	actionner	Ne, Nf	activate (tool, machine)
Nh	s' actionner	0	bestir -self
		actionné	par driven by
Nh	administrer	Na, Nh	administer (business)
Nh	administrer	Nxb à Nh	administer (drug) to Nh
Nh	affréter	Nv à Nh	hire out Nv from Nh
Nh	amidonner	Nz (de Nx)	starch (shirt) with