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Computer terminology in Japanese: the need for analogy, figuration and semantic transparency

Yukio Tsuji

1. Introduction

One of the major strategies for constructing new knowledge is the utilization of analogical thought and figurative languages. (Gentner 1988, Lakoff 1987) Analogy is a cognitive process that is typically embodied in linguistic representations, especially in figurative expressions. Metaphor, for example, is more than merely either a certain type of figure of speech expressing a perceived similarity or a rhetorical device (Tsuji 1990), it is also a manifestation of analogy based on relational similarities. (Gentner 1983, Gentner and Jesiarski 1993, Gibbs 1994, Vosniadou and Ortony 1989) It is also a matter of cognitive interface between linguistic and conceptual knowledge and processing. (Tsuji 1996b) Likewise, metonymy and synecdoche also play important roles in forming mental models that lead to systematically structured conceptual webs.

In this brief note, computer terminology, mainly Japanese, will be discussed with special reference to its 'semantic transparency' or intelligibility. A need for analogy and figuration as a means to improve man-machine interface will be argued; the need is urgent because there has been a long-standing difficulty in handling computer terms in

Japanese, a difficulty which seems to be getting more serious.

2. Types of Japanese computer terminology

The Japanese technical terms in computer and information science, and in man-machine interface may be roughly classified into the following four types in terms of their semantic understandability and their formations:

(A) Japanese words or loan words comprehensively translated from foreign languages into a Japanese equivalent, that is, words that can be represented by Kanji characters:

> 計算機 (computer), 中央演算処理装置 (Central Processing Unit), 分散処理 (Distributed Processing), 浮動小数点演算 (floating point arithmetic), 書体 (font), 書式 (format), 初期化 (initialization), 入出力 (input and output), 集積回路 (Integrated Circuit), 知識表現 (knowledge representation), 改行 (line feed), 下位互換性 (lower compatibility), 最適化 (optimization), 置換機能 (replacement function), 端末 (terminal), 仮想現実 (virtual reality), etc.

(B) Loan words adapted for Japanese phonemic and written systems, that is, words represented by Katakana:

> アクセス (access), アプリケーション (application), クリック (click), コンピュータ (computer), コンパイル (compile), カット・アンド・ペースト (cut and paste), ディレクトリ (directory), ハードディスク (hard disk),

ホームページ (home page), インストール (install), キーボード (keyboard), モデム (modem), ネットワーク (network), プリンタドライバ (printer driver), スクロール (scroll), サーバ (server), シェアウェア (shareware), シェル (shell), テキスト・ファイル (text file), ユーザ (user), etc.

(C) English words in their original, mostly acronymic forms (although with Japanese pronunciation):

CD-ROM (Compact Disc Read Only Memory), CPU (Central Processing Unit), HD (Hard Disk Drive), IC (Integrated Circuit), ID (IDentification), JPEG (Joint Photographic Experts Group), MIME (Multipurpose Internet Mail Extensions), OS (Operating System), PPP (Point-to-Point Protocol), SCSI (Small Computer System Interface), etc.

(D) Japanese-made English or English-like words (again, with Japanese pronunciation):

ATOK (Automatic Transfer Of Kana-Kanji, *one of the most common input method editor program*), EGWord (*the name of a word-processor program*), EPWING (*the standardized format of electronic books*), LHA (*the name of an archiver program*), TRON (The Real-time Operating System), WX-III (*the name of an input method editor program*), etc.

The above four categories seem to make the fundamental types, however, numerous compounds of words from different types may be found very easily as:

> AT互換機 (IBM PC/AT compatibles), ATコマンド・モデム (AT command modem), バッチ処理 (batch processing), インライン変換 (in-line translation), IPアドレス (Internet Protocol address), 漢字TrueType (Kanji TrueType), レイアウト表示 ((layout) display (function), オブジェクト指向プログラミング (object oriented programming), page layout view), PCカード (PC Card), RAMディスク (Random Access Memory disk), レジューム機能 ((preemptive) resume, restoring, undo/redo function), シフトJISコード (shift(ed) Japanese Industrial Standard code), etc.

The terms that belong to type (A) are the most easily accessible to computer users (especially novices who do not have the related English knowledge) even if they do not have prior knowledge of the specific usage-based meanings of those terms. Compared to Katakana's transcriptional features observed in the words in type (B), those which belong to type (A) have more semantic transparency or intelligibility because explicitly conveyed meanings are intrinsic to Kanji characters, which are, thus easy to understand at a glance. Many terms in type (B) have assimilated into Japanese lexicon quite naturally but still they maintain their Katakana features. A great number of these terms are hardly recognizable unless computer users learn their specific meanings. This applies to the terms in type (C) in a more complex manner. Users often need to figure out what the acronyms stand for, and what is worse, they often have to translate their meanings into

Japanese. And then they are required to access what the words actually mean. This makes the Japanese environment of man-machine interface more complex and difficult to deal with than the English, and so discourages novices from going further.

But thanks to the recent development of GUI (Graphical User Interface), beginners may find it easier and may feel more comfortable in handling their machines. (Tsuji 1996a) What they (unless experts) need here are good analogies and both linguistic and visual figurations in the interface. This is why metaphors and other figurations are essential. They need firm analogical foundation, based on the user's knowledge or experience. This aspect will be discussed in the next section, in terms of how analogy and figuration are at work—or how they may not be at work—in relation to these.

3. Analogy and figuration found in computer terminology and some related problems

Analogy and figuration are indispensable in forming a knowledge system. When users are faced with a new term, in order for it to form a part of the representation of the target domain, they need to activate some relevant knowledge that will serve as the source domain. The users also need to connect the two domains, by mapping the structural knowledge of the source domain to the target domain. Once the mapping is verified, they will grasp the meaning of the term and fit it into their existing knowledge system. This process, the structural network of concepts, underlies much of our acquisition of word meanings. Some of the basic analogies typically found in computer science may be schematized as the mapping from a human brain to the computer's processing units: (e.g. Johnson-Laird 1988, Lakoff 1987, Leary 1990)

Source/base domain		*Target domain*
HUMANS		COMPUTER
(1) human brain	--------->	processing units
(its structure, function, and process)		(CPU, ROM, RAM, OS, etc.)

The above analogies can be systematically represented by the computer terminology shown in (1)′. The chart illustrates some analogical models through metaphorical uses of existing words in the lexicon. These metaphors are widely used in the cognitive science fields including the research on artificial intelligence.

(1)′ cerebrum	CPU, ROM, RAM and other processing units
long-term memory	data on a hard disk or ROM
working memory	data on RAM
thinking	processing, calculation
neuron	a processing unit called 'a cell'
a network of nerve cells	a neural network system as in connectionists' or PDP (Parallel Distributed Processing) models
natural language	artificial language
learning	registration in memory
understand	follow the instructions
(bio) feedback	(electro-) feedback

Another analogical model may be found in (2) with the relevant terms listed in (2′).

(2) human (manual) activities------> operations and processes

(2)′	cut and paste	cut and paste
	drag	drag
	copy	copy
	click	click
	communicate	communicate
	does not work	does not function
	does not move or think	freeze, hang or crash

The terms in (2)′ might seem to display more of the extended usage of the source words. In most of the cases the same forms are retained in the transferred usage. But note that you do not, for instance, 'cut' anything in the way you do in the real world using scissors. They are semantically mapped structurally from the source to the target domain. This makes it easy for users to understand what they are doing on the display even in an environment which lacks iconic graphical user interface. If users, whether learners or advanced, are able to activate the analogies properly, then they will readily understand the terms even if they have not encountered them before.

The extended usage of conventional word meanings can be found in the terms used in word processing or editor programs such as 'styles', 'format', 'deletion', 'line', 'insertion', 'page', 'outline', 'footnote', etc. These are the terms systematically transferred from the source domain 'conventional writing activity,' to the target domain, 'electronic writing activity'. Other terms like 'calculation', and 'making data base', also involve domain to domain transfer, supported by analogy and metaphorical expressions. It is recognizable here that semantic and conceptual knowledge are efficiently extended through the cognitive process of categorization. (Tsuji 1991)

At this point metonymy and synecdoche are also important. 'Pen', 'eraser' and 'paper', for instance, are prototypical instruments in the conventional writing system. Indeed they are utilized metonymically in the instruction menus on various interfaces. Instead of technical commands, the words and the icons depicting these referents may be used to express the writing process on the computer. They not only embody 'domain-to-domain' metaphorical transfer that users can readily understand but also represent users' existing knowledge structures and experience. Good metonymical representations, which still require the application of analogical reasoning, minimize the inference process that users might need to go through. Synecdoche also play an important role similar to that of metonymy. 'A painting brush' both in its linguistic and iconic representations are often used to denote drawing activities as a whole on the interface. (cf. Kusumi 1995) If it refers to a particular instruction, then it is a case of metonymy.

Difficulties arise when users are not capable of activating the analogies, or rather, when they cannot form proper mental models in order to produce new knowledge structures. This phenomenon could be observed in the recent development of the 'internet', where apart from some cases such as 'organismic viruses, versus computer viruses' and 'conventional mail system versus electronic mail system'. The multifarious new terms being coined do not fit into existing analogies. Even computer specialists are sometimes unfamiliar with terms outside their own particular field because of the rapid and uncontrolled expansion in neologisms which lack analogy and good figuration. Many users find it difficult to make good mental models in order to connect the new terms to their existing knowledge. They do not have to access and utilize the conceptual networks that they maintain in their long-term memory. These are admittedly cases where metaphors prove in helpful both to novices and experts ; they might, for example, rather disturb the appropriate learning process, if they are not grounded on a proper analogy. (Rumelhart and Norman 1981) There is nevertheless sufficient empirical evidence to show that beginners find it easier to learn even abbreviated commands if they are given felicitous metaphors.

Another crucial factor for Japanese, however, lies in a different aspect. This is the excessive prevalence of terms classified as types (B) and (C) and their compounds (D) explicated in the preceding section. Those words now possibly account for more than 60 % of the whole relevant terminology, and are not semantically 'transparent'. Again, this causes users some serious difficulty in grasping the proper meanings that these words convey. This tendency is expected to continue. Even native speakers of English often find English operating systems unmanageable, the difficulties facing Japanese speakers hardly need saying.

This indicates a weakness which the disorganization which characteriges flexibly but neatly structured knowledge and multidimensionally connected lexical networks may exacerbate. Any user will find it difficult to acquire the specific meanings of a series of newly coined terms. The situation will not be eased by the fact that no user is required to possess every single word knowledge they encounter or supposed to use every function that computers may perform. In principle, users can collaborate with each other in a complementary way in order to achieve computer-related tasks beyond the capacity of any one of them ; in practice, they often end up fumbling in isolation, hopelessly constrained. Actually, some of my colleagues, regardless their different language backgrounds, are reluctant to use computers despite the fact that scholars of the same disciplines have effectively used computers and other related networks. It is, of course, up to individual preference whether one uses computers or not. Utilization of computers in principle has nothing to do with the validity of research, and it is also true that what one can do with computers is quite limited. Yet, it seems to me that the reason why at least some of the cyberphobe hate using computers is because they do not want to spend their times in memorizing a set of abbreviated command-based instructions. The point here, then, is that a large part of Japanese computer terminology has been spawned anomalously, without the semantic transparency that Japanese words have, and thus do not activate the appropriate analogical thought and figuration that will lead to the comprehension and construction of structural knowledge.

4. Summary

We should of course distinguish between computer specialists whose interests reside in computers themselvers, or professionals who work extensively with computers, and those who only need computers for ancillary purposes. However, many businessmen and students, for example, have to learn an increasing amount about computers, and so about interface terminology, regardless of their preferences. As I mentioned at the beginning of this paper, analogical thought and figuration are the main strategies by which we learn or produce new conceptual structures. In order to acquire efficient knowledge networks, we need to extend our range of analogies and figuration ; this will enable us to form proper mental models. Terminology too needs to be carefully selected to suit the end-users. It is not always necessary for general users to share with professionals the same terminology and rule-governed command abbreviations. Thus, besides analogy and figuration, on-line help programs on the interface and more visually discernible information, in the from of as appropriate 'icons', are required. These also are required to fit into our existing mental framework as closely as possible.

Unfortunately Japanese are in a difficult situation in that they must inevitably deal with the semantically unintelligible vocabulary of 'English-based computer architecture', as listed above. On the one hand, using English on the computer is the most straight forward way to participate in the highly globalized 'cyber-environment'. Yet it is also necessary to construct better Japanese environment on the computer interface. After all, the language the users speak is less important than the relation of terminology within it, and the user-friendliness of the interface—the extent, that is, to which it reflects human lerning strategies. It is hoped that cognitive scientists and the interface specialists work more serious in order to improve the present situation; otherwise it might get worse. What we need is to fit computers to us, and not vice versa.

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