

Language, images and artificial intelligence

语言、图像与人工智能

主 编 徐雪涛

副主编 赵雄 张艳



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主 编 徐雪涛

副主编 赵 雄 张 艳

参 编 张艳丽 龙佳红

饶玉芳 黄 浩

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Preface

It is only in comparatively recent years that linguistics has begun to be studied and taught. Because it is a comparative newly-emerged science, there is a tendency to regard it as a difficult and esoteric subject. Linguistics, defined as the scientific study of language, is intricately to analyse and to study, because language is associated with human Intelligence; Human Intelligence is based on language and language on concepts. Only when the way how concepts come into being and function in human brain have been revealed, can we nearly be able to announce that the mystery of human Intelligence is revealed.

Artificial Intelligence (AI) is to help machines find solutions to complex problems in a more human-like fashion. This generally involves imitating human intelligence, and applying them as algorithms in a computer friendly way. Although AI links with a lot of fields such as: Psychology, Cognition, Biology and Philosophy, etc., but we believe, it mainly links with linguistics, more specifically, the concepts of language. We are not having no good computer programmers, but having no good linguistic theories.

Computer is fundamentally well suited to performing mechanical computations, using fixed programmed rules. Computers can perform simple monotonous tasks efficiently, which humans are ill-suited to. For more complex problems, things get more difficult... Unlike humans, computers have trouble understanding specific situations, and adapting to new situations. Artificial Intelligence aims to improve machine behaviour in tackling such complex tasks.

linguistics study is allowing us to understand our intelligence. Humans have an unequalled capability to problem-solving, based on abstract thought and conceptual reasoning. Artificial Intelligence can recreate this process. But to date, all the traits of human intelligence have not been captured and applied to spawn intelligent artificial creatures.

The potential applications of Artificial Intelligence are abundant. They stretch from the military for auto-control and target identification, to the entertainment industry from computer games to robotic pets.

Devoting to research on linguistics and to understand the nature of language intelligence can help to remould computers that exhibit true intelligence. A truly

intelligent computer would be more flexible and would engage in the kind of “thinking” that people really do. An example is vision. A array of sensors combined with systems for interpreting the data may produce the kind of pattern recognition that we take for granted as seeing and understanding what we see. In fact, writing software that can recognize subtle differences in objects (such as those we perceive in the faces of two people) is very difficult. Actually, differences between faces of two people that we can perceive without deliberate effort, we believe, owes much to our integrated proportional judgement among mutli-cognitive domains of faces comparison rather than to massive amounts of data of faces and careful guidelines for a system of artificial intelligence to recognize. Computer tries to imitate true intelligence, you can’t copy intelligence it if you don’t know how language works.

Several editors have made contributions to the publication of this book. The selection from publications is a group of effort. Though we aimed to present a comprehensive volume of introductory reading on the relationships between linguistics and artificial intelligence, the lack of sources for choice to the area of study covered by this book. So this book is open for suggestions and criticism we hope to hear from the readers of this book.

Xu Xuetao

October, 11, 2015

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Unit

1

Language Defined

This is an excerpt from *Language: An Introduction to the Study of speech* by Edward Sapir (1884—1939), an American linguist. With his student Benjamin Lee Whorf (1897—1941) developed the Sapir-Whorf hypothesis, arguing that the limits of Language restrict the scope of possible thought and that every language recognizes peculiar sets of distinctions—e. g. Eskimo and its rich vocabulary for different kinds of snow. In this excerpt, he, having distinguished speech from other functions of man (such as walking) and from mere imitation of things, tries to give a serviceable definition of language. He also discusses the nature of speech, and the relation between language and thought.

Speech is so familiar a feature of daily life that we rarely pause to define it. It seems as natural to man as walking, and only less so than breathing. Yet it needs but a moment's reflection to convince us that this naturalness of speech is but an illusory feeling. walking is an inherent, biological function of man. Not so language. The process of acquiring speech is, in sober fact, a different sort of thing from the process of learning to walk.

Walking is an organic, an instinctive, function (not, of course, itself an instinct); speech is a non-instinctive, acquired, "cultural" function. It is a purely historic heritage of the group, the product of long-continued social usage. It varies as all creative effort varies.

Therefore, language is a human and non-instinctive method of communica-



ting ideas, emotions, and desires by means of a system of voluntarily produced symbols. These symbols are, in the first instance, auditory and produced by organs of speech. There is no discernible instinctive basis in human speech as such, however much instinctive expressions and the natural environment may

serve as a stimulus for the development of certain elements of speech, however much instinctive tendencies, motor and other, may give a predetermined range or mold to linguistic expression. Such human or animal communication, if "communication" it may be called, as is brought about by involuntary, instinctive cries is not, in our sense, language at all.

I have just referred to the "organs of speech," and it would seem at first blush that this is tantamount to an admission that speech itself is an instinctive, biologically predetermined activity. We must not be misled by the mere term. There are, properly speaking, no organs of speech; there are only organs that are incidentally useful in the production of speech sounds. The lungs, the larynx, the palate, the nose, the tongue, the teeth, and the lips, are all so utilized, but they are no more to be thought of as primary organs of speech than are the fingers to be considered as essentially organs of piano-playing. Speech is not a simple activity that is carried on by one or more organs biologically adapted to the purpose. It is an extremely complex and ever-shifting network of adjustments—in the brain, in the nervous system, in the articulating and auditory organs—tending towards the desired end of communication. The lungs developed, roughly speaking, in connection with the necessary biological function known as breathing; the nose, as an organ of smell, the teeth, as organs useful in breaking up food. If, then, these and other organs are being constantly utilized in speech, it is only because any organ, once existent and in so far as it is subject to voluntary control, can be utilized by man for secondary purposes. Physiologically, speech is a group of overlaid functions. It gets what service it can out of organs and functions, nervous and muscular, that have come into being and are maintained for very different ends than its own.

It is true that physiological psychologists speak of the localization of speech in the brain. This can only mean that the sounds of speech are localized in the au-

ditory tract of the brain, or in some circumscribed portion of it, precisely as other classes of sounds are localized, and that the motor processes involved in speech are localized in the motor tract precisely as are all other impulses to special motor activities. In the same way control is lodged in the visual tract of the brain over all those processes of visual recognition involved in reading. Naturally the particular points or clusters of points of localization in the several tracts that refer to any element of language are connected in the brain by paths of association, so that the outward, or psycho—physical, aspect of language is of a vast network of associated localizations in the brain and lower nervous tracts, the auditory localizations being without doubt the most fundamental of all for speech. However, a speech—sound localized in the brain, even when associated with the particular movements of the “speech organs” that are required to produce it, is very far from being an element of language. It must be further associated with some element or group of elements of experience, say a visual image or a class of visual images or a feeling of relation, before it has even rudimentary linguistic significance. This “element” of experience is the content or “meaning” of the linguistic unit; the associated auditory, motor, and other cerebral processes that lie immediately back of the act of speaking and the act of bearing speech are merely a complicated symbol of or signal for these “meanings”, of which more anon. We see therefore at once that language as such is not and can’t be definitely localized, for it consists of a peculiar symbolic relation—physiologically an arbitrary one—between all possible elements of consciousness on the one hand and certain selected elements localized in the auditory, motor, and other cerebral and nervous tracts on the other. If language can be said to be definitely “localized” in the brain, it is only in that general and rather useless sense in which all aspects of consciousness, all human interest and activity, may be said to be “in the brain.” Hence, we have no recourse but to accept language as a fully formed functional system within man’s psychic or “spiritual” constitution. We cannot define it as an entity in psycho—physical terms alone, however much the psycho—physical basis is essential to its functioning in the individual.

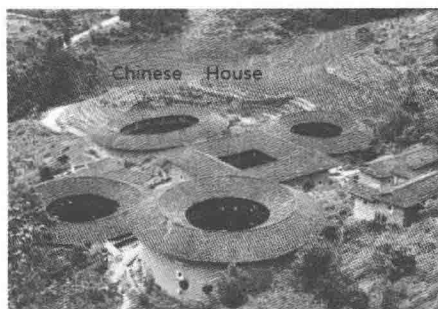
From the psychologist’s point of view we may seem to be making an unwarrantable abstraction in desiring to handle the subject of speech without constant and explicit reference to that basis. However, such an abstraction is justifiable. We can profitably discuss the intention, the form, and the history of speech, precisely

as we discuss the nature of any other phase of human culture—say art or—religion as an institutional or cultural entity, leaving the organic and psychological mechanisms back of it as something to be taken for granted. Accordingly, it must be clearly understood that this introduction to the study of speech is not concerned with those aspects of physiology and of physiological psychology that underlie speech. Our study of language is not to be one of the genesis and operation of a concrete mechanism; it is, rather, to be an inquiry into the function and form of the arbitrary systems of symbolism that we term languages.

I have already pointed out that the essence of language consists in the assigning of conventional, voluntarily articulated, sounds, or of their equivalents, to the diverse elements of experience. The word "house", is not a linguistic fact if by it is meant merely the acoustic effect produced on the ear by its constituent consonants and vowels, pronounced in a certain order; nor the motor processes and tactile feelings which make up the articulation of the word; nor the visual perception on the part of the hearer of this articulation; nor the visual perception of the word "house" on the written or printed page; nor the motor processes and tactile feelings which enter into the writing of the word; nor the memory of any or all of these experiences. It is only when these, and possibly still other, associated experiences are automatically associated with the image of a house that they begin to take on the nature of a symbol, a word, an element of language. But the mere fact of such an association is not enough. One might have heard a particular word spoken in an individual house under such impressive circumstances that neither the word nor the image of the house ever recur in consciousness without the other becoming present at the same time. This type of association does not constitute speech. The association must be a purely symbolic one; in other words, the word must denote, tag off, the image, must have no other significance than to serve as a counter to refer to it whenever it is necessary or convenient to do so. Such an association, voluntary and, in a sense, arbitrary as it is, demands a considerable exercise of self-conscious attention. At least to begin with, for habit soon makes the association nearly as automatic as any and more rapid than most.

But we have traveled a little too fast. Were the symbol "house",—whether an auditory, motor, or visual experience or image—attached but to the single image of a particular house once seen, it might perhaps by an indulgent criticism, be termed an element of speech, yet it is obvious at the outset that speech so consti-

tuted would have little or no value for purposes of communication. The world of our experiences must be enormously simplified and generalized before it is possible to make a symbolic inventory of all our experiences of things and relations and this inventory is imperative before we can convey ideas. The elements of language, the symbols that ticket off experience, must therefore be associated with whole groups, delimited classes, of experience rather than with the single experiences themselves. Only so is communication possible. To be communicated it needs to be referred to a class which is tacitly accepted by the community as an identity. Thus, the single impression which I have had of a particular house must be identified with all my other impressions of it. The particular experience that we started with has now been widened so as to embrace all possible impressions or images that sentient beings have formed or may form of the house in question. This first simplification of experience is at the bottom of a large number of elements of speech, the so-called proper nouns or names of objects. It is, essentially, the type of simplification which underlies, or forms the crude subject of, history and art. But we can't be content with this measure of reduction of the infinity of experience. We must cut to the bone of things, we must more or less arbitrarily throw whole masses of experience together as similar enough to warrant their being looked upon—mistakenly, but conveniently—as identical. This house and that house and thousands of other phenomena of like character are thought of as having enough in common, in spite of obvious differences of detail, to be classed under the same heading. In other words, the speech element "house" is the symbol, first and foremost, not of a single perception, nor even of the notion of a particular object, but of a "concept"—of a convenient capsule of thought that embraces thousands of distinct experiences and that is ready to take in thousands more. If the significant elements of speech are the symbols of concepts, the actual flow of speech may be interpreted as a record of the setting of these concepts into mutual relations.



Words and Expressions

sober ['səʊbə]

heritage ['heritɪdʒ]

circumscribed ['sɜ:kəmskraɪbd]

variability [ˌvæəriəbɪləti]

involuntary [ɪn'vɒləntəri]

assignable [ə'saɪnəbəl]

discernible [dɪ'sɜ:nəbəl]

predetermined [ˌpri:dɪ'tɜ:mɪnd]

at first blush

tantamount ['tæntəmaʊnt]

larynx ['lærɪŋks]

palate ['pælət]

articulating [ɑ:'tɪkjulɪtɪŋ]

physiological [fɪzɪələdʒɪkl]

psychologist [saɪkələdʒɪsts]

lodge [lɒdʒ]

rudimentary [ˌru:dɪ'mentri]

anon [ə'nɒn]

unwarrantable [ʌn'wɒrəntəbl]

adj. 头脑清醒的, 冷静的, 严肃的;
朴素的, 素净的

n. 遗产; 继承物; 传统; 文化遗产; 传承

adj. [医] 局限的; 受限于有限空间的

v. 在...周围画线; 划定...范围; 限制;
限定

n. 变化性, 易变, 变化的倾向; 变率

adj. 非故意的; 非自愿的, 不随意的; 不
由自主的; 无意识的; 偶然的

adj. 可分配的, 可指定的; 不可忽视, 可
转让的

adj. 可识别的; 可辨别的

v. 预先确定的 (predetermine 的过去
式和过去分词)

adj. 形容词预定的; 预先确定的; 预先决
定的

猛一看, 乍看

adj. 相等的, 相当的, 等值的; 等价的;

n. 喉; 喉头; 咽喉; 喉部

n. 〈解〉腭; 味觉, 嗜好; 审美眼光, 鉴
赏力

n. 表达, 表述 v. 清楚地表

adj. 生理学的; 生理的

n. 心理学研究者, 心理学家

v. 存放, 暂住, 埋入, (权利、权威等)
归属

adj. 基本的, 初步的, 发育全的, 未成熟
的, 退化的

adv. 不久以后

adj. 无正当理由的; 无法辩解的; 无法律
依据的; 不合法的, 不允许的; 不能

explicit [ɪk'splɪt]	adj.	保证的; 不能承认的; 毫无道理 明确的, 清楚的; 直言的; 详述的; 不隐瞒的
justifiable [ˈdʒʌstɪfəbəl]	adj.	有理由的; 正当的; 人情入理; 说得过去
institutional [ɪnstɪ'tjuːʃənəl]	adj.	由来已久的; 习以为常的; 公共机构的;
entity [ˈentəti]	n.	实体; 实际存在物; 本质
indulgent [ɪndʌldʒənt]	adj.	放纵的, 纵容的; 宽容的; 任性的
perception [pə'sepʃn]	n.	知觉; 觉察(力), 观念, (农作物)收获, 感知

Questions for Discussion and Review

1. What is the basic difference between speech and other forms of functions of man like walking?
2. How do you understand "house" as a symbol?
3. Does concepts build on the basis of similarities or on the basis of differences?
4. Similarity and Difference, which one is absolutely, which one is relatively? Why?
5. Similarity, Difference and Diversity, what are their differences?

Language and Thought

The question has often been raised whether thought is possible without speech; further, if speech and thought be not but two facets of the same psychic process. The question is all the more difficult because it has been hedged about by misunderstanding.

In the first place, it is well to observe that whether or not thought necessitates symbolism, that is speech, the flow of language itself is not always indicative of thought. We have seen that the typical linguistic element labels a concept. It does not follow from this that the use to which language is put is always or even mainly conceptual. In ordinary life, we are not so much concerned with concepts as such as with concrete particularities and specific relations. When I say, for instance, "I had a good breakfast this morning," it is clear that I am not in the throes of laborious thought, that what I have to transmit is hardly more than a pleasurable memory symbolically rendered in the grooves of habitual expression. Each element in the sentence defines a separate concept or conceptual relation or both combined, but the sentence as a whole has no conceptual significance whatever. It is somewhat as though a dynamo capable of generating enough power to run an elevator were operated almost exclusively to feed an electric doorbell. The parallel is more suggestive than at first sight appears. Language may be looked upon as an instrument capable of running a gamut of psychic uses. Its flow not only parallels that of the inner content of consciousness, but parallels it on different levels, ranging from the state of mind that is dominated by particular images to that in which abstract concepts and their relations are alone at the focus of atten-

tion and which is ordinarily termed reasoning. Thus the outward form only of language is constant; its inner meaning, its psychic value or intensity, varies freely with attention or the selective interest of the mind, also, needless to say, with the mind's general development. From the point of view of language, thought may be defined as the highest latent or potential content of speech, the content that is obtained by interpreting each of the elements in the flow of language as possessed of its very fullest conceptual value. From this it follows at once that language and thought are not strictly coterminous. At best language can but be the outward facet of thought on the highest, most generalized, level of symbolic expression. To put our viewpoint somewhat differently, language is primarily a prerational function. It humbly works up to the thought that is latent in, that may eventually be read into, its classifications and its forms; it is not, as is generally but naively assumed, the final label put upon the finished thought.

Most people, asked if they can think without speech, would probably answer, "Yes, but it is not easy for me to do so. Still I know it can be done." Language is but a garment!

But what if language is not so much a garment as a prepared road or groove? It is, indeed, in the highest degree likely that language is an instrument originally put to uses lower than the conceptual plane and that thought arises as a refined interpretation of its content. The product grows, in other words, with the instrument, and thought may be no more conceivable, in its genesis and daily practice, without speech than is mathematical reasoning practicable without the lever of an appropriate mathematical symbolism. No one believes that even the most difficult mathematical proposition is inherently dependent on an arbitrary set of symbols, but it is impossible to suppose that the human mind is capable of arriving at or holding such a proposition without the symbolism. The writer, for one, is strongly of the opinion that the feeling entertained by so many that they can think, without language is an illusion. The illusion seems to be due to a number of factors. The simplest of these is the failure to distinguish between imagery and thought. As a matter of fact, no sooner do we try to put an image into conscious relation with another than we find ourselves slipping into a silent flow of words. Thought may be a natural domain apart from the artificial one of speech, but speech would seem to be the only road we know of that leads to it.

A still more fruitful source of the illusive feeling that language may be dis-

pensed with in thought is the common failure to realize that language is not identical with its auditory symbolism. The auditory symbolism may be replaced, point for point, by a motor or by a visual symbolism (many people can read, for instance, in a purely visual sense, that is, without the intermediating link of an inner flow of the auditory images that correspond to the printed or written words) or by still other, more subtle and elusive, types of transfer that are not so easy to define. Hence the contention that one thinks without language merely because he is not aware of a coexisting auditory imagery is very far indeed from being a valid one. One may go so far as to suspect that the symbolic expression of thought may in some cases run along outside the fringe of the conscious mind, so that the feeling of a free, non-linguistic stream of thought is for minds of a certain type a relatively, but only a relatively, justified one. Psycho-physically, this would mean that the auditory or equivalent visual or motor centers in the brain, together with the appropriate paths of association, that are the cerebral equivalent of speech, are touched off so lightly during the process of thought as not to rise into consciousness at all. This would be a limiting case—thought riding lightly on the submerged crests of speech, instead of jogging along with it, hand in hand. The modern psychology has shown us how powerfully symbolism is at work in the unconscious mind. It is therefore easier to understand at the present time than it would have been twenty years ago that the most rarefied thought may be but the conscious counterpart of an unconscious linguistic symbolism.



One word more as to the relation between language and thought. The point of view that we have developed does not by any means preclude the possibility of the growth of speech being in a high degree dependent on the development of thought. We may assume that language arose pre-rationally—just how and on what precise level of mental activity

we do not know—but we must not imagine that a highly developed system of speech symbols worked itself out before the genesis of distinct concepts and of thinking, the handling of concepts. We must rather imagine that thought processes set in, as a kind of psychic overflow, almost at the beginning of linguistic expression; further, that the concept, once defined, necessarily reacted on the life of its linguistic symbol, further linguistic growth. We see this complex process of

the interaction of language and thought actually taking place under our eyes. The instrument makes possible the product, the product refines the instrument. The birth of a new concept is invariably foreshadowed by a more or less strained or extended use of old linguistic material; the concept does not attain to individual and independent life until it has found a distinctive linguistic embodiment. In most cases the new symbol is but a thing wrought from linguistic material already in existence in ways mapped out by crushingly despotic precedents. As soon as the word is at hand, we instinctively feel, with something of a sigh of relief, that the concept is ours for the handling. Not until we own the symbol do we feel that we hold a key to the immediate knowledge or understanding of the concept. Would we be so ready to die for "liberty," to struggle for "ideals," if the words themselves were not ringing within us? And the word, as we know, is not only a key; it may also be a fetter.

Language is primarily an auditory system of symbols. The motor aspect of speech is clearly secondary to the auditory. In normal individuals the impulse to speech first takes effect in the sphere of auditory imagery and is then transmitted to the motor nerves that control the organs of speech. The motor processes and the accompanying motor feelings are not, however, the end. They are merely a means and a control leading to auditory perception in both speaker and hearer. Communication is successfully effected only when the hearer's auditory perceptions are translated into the appropriate and intended thought. Hence the cycle of speech begins and ends in the realm of sounds. The concordance between the initial auditory imagery and the final auditory perceptions is the warrant of the successful issue of the process. Therefore, the typical of this process may undergo endless modifications or transfers into equivalent systems without thereby losing its essential formal characteristics.

The most important of these modifications is the abbreviation of the speech process involved in thinking. This has doubtless many forms, according to the structural or functional peculiarities of the individual mind.

The least modified form is that known as "talking to one's self." Here the speaker and the hearer are identified in a single person. More significant is the still further abbreviated form in which the sounds of speech are not articulated at all. To this belong all the varieties of silent speech, silent reading and of normal thinking. The auditory centers alone may be excited; or the impulse to linguistic