# 工作记忆、意思相对频率与汉语歧义句的加工*

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**摘 要** 本研究选取高、低工作记忆能量两组被试,通过两个实验,考察了歧义句多种解释的相对使用频率和被试工作记忆能量在歧义句加工中的作用。结果表明:(1)意思相对频率在歧义句加工中有显著效应,主要意思比次要意思更易于提取;(2)工作记忆能量对歧义句的加工仅表现出一定程度的影响,材料难度增加时,该效应达到边缘性显著的水平。

**关键词**:工作记忆 句子歧义 歧义消解 意思相对频率

## 1 前言

歧义是自然语言中一种普遍存在的现象。歧义现象可从不同的角度分为不同类型:根据歧义发生的水平可分为词汇歧义和句法结构歧义;根据句中有无解歧信息出现可分为局部歧义句和整体歧义句。关于句法歧义的认知加工,主要有四种基本观点[1]:(1)系列加工即单表征模型。认为遇到句法歧义时,一次只建立一种可能的解释,若后继解歧信息与该解释不一致,就放弃原解释并搜索另一种可能的解释[2];(2)并行加工即多表征模型。认为遇到歧义时,同时生成多种可能的解释,再根据解歧信息和相对使用频率来选择一种最佳解释[3];(3)延迟模型或最小约束模型。认为遇到歧义时,不立即做出确定解释,而是到解歧信息出现时才开始对歧义进行分析[4];(4)混合模型。认为不同情况下句法歧义解决的策略也不同,如资源充足,就进行并行加工,但如资源不足便使用系列加工策略[5]。

汉语中的歧义现象也十分普遍。句子水平的歧义(属整体歧义)有两种情况:一是同形但层次不同,即词和词序相同但在结构上可以作多种层次的切分,如"羽毛球拍卖完了";另一类是同形且层次相同,即不能作多种层次切分,如"他的发理得好"。国内对汉语歧义认知加工的研究刚刚起步,曾有学者对此进行初步探讨[6]。本研究以同形且层次相同的汉语歧义句为实验材料,通过两个实验考察在无语境条件下歧义句多种解释的相对频率和被试的工作记忆能量在歧义句认知加工中的作用。

## 2 实验一

### 2.1 方法

**2.1.1 被试** 采用国内自编的"句子—尾词"测量程序[7],从工科大学本科一、二年级学生中筛选出高工作记忆能量者24名(男、女各半),其工作记忆能量测分平均为4.98;低工作记忆能量者24名(男、女各半),其工作记忆能量测分平均为2.06。

**2.1.2 实验材料** 从有关语言学文献中收集了28个有两种意思的歧义句作为实验句[8-9],另外28个与实验句结构类似的句子作为干扰句,这样就构成了共有56个刺激句的实验材料。经适当调整,所有句子均由12个字组成。实验前,先由不参加本实验的23名大学生和研究生,用五级评定量

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表(从"1"到"5"分别表示从"最少用"、"较少用"、"中等"、"较常用"、"最常用")对实验句的两种可能意思的相对使用频率进行评定,以确定其主要意思和次要意思。评定结果为:主要意思的平均等级为 4.45,次要意思的平均等级为 2.98。实验采用句子验证任务,即在每个刺激句呈现后接着呈现一个测试句,要求被试尽可能迅速而正确地判断测试句的意思与刺激句是否一致。实验句的测试句一半与其主要意思一致,另一半与其次要意思一致,正确反应均为"是";干扰句的测试句与之意思不一致,正确反应为"否"。实验句与干扰句混合在一起,随机呈现。

**表 1　实验一所用实验句的样例**

| 实验句 | 测试句 |
|---|---|
| 除了小李我也特别喜欢老王。 | (1)主要意思:老王和小李俩个我都很喜欢。 |
| | (2)次要意思:我和小李俩人都很喜欢老王。 |

每个实验句的两种意思均得到测试,因此构成了两套实验材料。测试句与刺激句呈现之间的延迟间隔有 100ms 和 1000ms 两种情况。所以,本实验为 2(主要意思和次要意思)×2(工作记忆高与低)×2(100ms 和 1000ms 的延迟间隔)的三因素混合实验设计。其中意思相对频率为组内因素,延迟间隔与工作记忆为组间因素。

2.1.3　实验仪器和步骤　实验在 IBM—286PC 机上进行。实验开始时,伴随着声音信号在屏幕中上方给出一个提示信号"＊",持续 750ms。提示信号消失后即以系列一同时呈现的方式逐字呈现刺激句(即呈现后一字时,前面已呈现的各个字仍保留在屏幕上)。各字之间的间隔 350ms。当刺激句的最后一个字符——句号出现后,立刻清屏并接着呈现一个相应的测试句。测试句与刺激句呈现位置相同,间隔 100ms 或 1000ms。要求被试判断测试句与刺激句的意思是否一致,若一致,则用右手食指按"Y"键(即 INS 键),若不一致,则用右手中指按"N"键(即 DEL 键)。测试句在屏幕上最多滞留 5 秒,超过这个时间不反应则系统自动认为是错误反应,每次反应后在屏幕底部给出一个反馈信息。

2.2　结果和分析　本实验不同条件下被试的平均反应时和错误率见表 2。

**表 2　实验一中被试的平均反应时与错误率**

| 反应指标 | 工作记忆 | 延迟间隔 100ms | | 延迟间隔 1000ms | |
|---|---|---|---|---|---|
| | | 主要意思 | 次要意思 | 主要意思 | 次要意思 |
| RT(ms) | 高 | 790.14 | 843.63 | 928.22 | 947.97 |
| | 低 | 982.09 | 1046.89 | 969.72 | 1028.17 |
| ER(%) | 高 | 11.91 | 26.79 | 14.88 | 28.57 |
| | 低 | 18.45 | 19.64 | 9.52 | 25 |

重复测量的方差分析(MANOVA)结果表明,对主要意思的平均反应时(RT＝917.54ms)显著低于对次要意思的平均反应时(RT＝966.67ms)($F(1,44)=6.64$,$P<0.05$);对主要意思的平均反应错误率(ER＝13.69%)显著低于对次要意思的平均反应错误率(ER＝25%)($F(1,44)=25.56$,$P<0.001$)。高工作记忆组的平均反应速度(RT＝877.49ms)比低工作记忆组的平均反应速度(RT＝1006.72ms)明显较快,但未达到显著水平($F(1,44)=3.57$,$P=0.066$);两组被试的平均反应错误率(分别为 20.54%与 18.15%)无显著差异。100ms 与 1000ms 延迟条件下的平均反应时(分别为 915.69ms 和 968.52ms)和平均反应错误率(分别为 19.2%与 19.5%)均无显著差异。两次交互作用与三次交互作用均不显著。

上述结果表明,歧义句相对使用频率不同的意思的可提取性不等,主要意思比次要意思更易于提取;工作记忆与延迟间隔对无语境简单歧义句的加工未表现出明显的效应。

## 3 实验二

### 3.1 方法

3.1.1 被试 同实验一。

3.1.2 实验材料 从有关语言学文献中收集了16个有三种意思的歧义句作为实验句[8-9],另外编选了16个与实验句形式类似的句子作为干扰句,这样构成了由32个刺激句组成的实验材料。经适当调整,所有句子均由12个字组成。对实验句各解释的相对使用频率的评定方式同实验一。结果为:各歧义句相对使用频率最高的意思的平均等级为4.62,作为歧义句的主要意思;相对使用频率最低的意思的平均等级为1.98,作为歧义句的次要意思。可见,本实验中歧义句的主要意思与次要意思在相对频率上的差异大于实验一,主要表现为次要意思的相对使用频率即其熟悉度更低,因而本实验的材料比实验一的难度更大。材料构成方式和实验设计方法均同实验一。

3.1.3 实验仪器和步骤 实验流程与呈现方法均同实验一。

### 3.2 结果和分析

实验二中被试的平均反应时与错误率见表3。

表3 实验二中被试的平均反应时与错误率

| 反应指标 | 工作记忆 | 延迟间隔100ms | | 延迟间隔1000ms | |
|---|---|---|---|---|---|
| | | 主要意思 | 次要意思 | 主要意思 | 次要意思 |
| RT(ms) | 高 | 865.33 | 1049.56 | 754.59 | 924.9 |
| | 低 | 899.08 | 1074.46 | 899.2 | 1058.62 |
| ER(%) | 高 | 10.42 | 43.75 | 5.21 | 40.63 |
| | 低 | 10.42 | 50.00 | 21.88 | 41.92 |

重复测量的方差分析结果表明,对主要意思的平均反应时(RT=854.55ms)显著低于对次要意思的平均反应时(RT=1026.89ms)($F(1,44)=51.71$,$P<0.001$);对主要意思的平均反应错误率(ER=11.98%)显著低于对次要意思的平均反应错误率(ER=45.58%)($F(1,44)=124.10$,$P<0.001$)。高工作记忆组的平均反应速度(RT=898.60ms)比低工作记忆组的平均反应速度(RT=982.84ms)明显较快,但差异未达到显著水平($F(1,44)=1.25$,$P>0.05$);高、低工作记忆组的平均反应错误率(分别为ER=25%和ER=32.56%)之间的差异达到边缘性显著水平($F(1,44)=3.93$,$P=0.05$)。100ms与1000ms延迟条件下的平均反应时(分别为972.11ms和909.33ms)和平均反应错误率(分别为28.65%与28.91%)均无显著差异。两次交互作用与三次交互作用均不显著。

上述结果表明,对于难度较大的三种意思的歧义句,主要意思比次要意思更易于提取,验证了实验一的频率主效应;两种间隔时间对歧义句的解析仍没有明显影响;工作记忆对于难度较大歧义句的加工有一定的制约作用,高工作记忆者略优于低工作记忆者。

## 4 讨论

以上两个实验的结果表明:意思相对频率在歧义句的加工中起重要作用;工作记忆能量对无语境简单歧义句的解析没有明显影响,只在难度增大时表现出一定的制约效应。

歧义句的主要意思比次要意思更易于提取。这是因为主要意思是在日常生活中常用的人们比较熟悉的命题含义,在语义网络中得到了更多更精细的加工,与其它命题联系更为密切,因而在加工时很容易激活和提取;而次要意思因在日常生活中较少用,得到的加工较少,可提取性也相应较低。在被试读到测试句时,歧义句的主要意思已经被提取,如测试句指向主要意思,则可迅速匹配作出反应,如测试句指向次要意思,则需放弃当前的表征重新构建歧义句的意义表征,然后再匹配。所

以对主要意思的反应显著快于对次要意思的反应,而且错误显著较少。这与陈永明等关于汉语歧义句加工的研究结果相一致[6]。

国外关于工作记忆制约歧义句加工的研究,多用自控速阅读或眼动等实时(on-line)实验范式,发现在遇到歧义时读者最初形成了多种表征,工作记忆能量限制了对表征的保持。能量高者可同时保持多个表征较长一段时间,因而在解歧信息出现时能更有效的解决歧义;而能量低者因资源有限,很快就转而只保持了一种最可能的表征[10]。工作记忆也影响对使用频率和语境限制的敏感性,能量高者更敏感于并更好地利用了这些限制对歧义句进行加工[11]。但这些研究所采用的歧义句都是含解歧语境信息的局部句法歧义句。已有研究表明,工作记忆的制约作用表现于整合句子或课文的信息以作出推理的能力上[12],因而,工作记忆对歧义句加工的影响可能依赖于解歧语境信息,高工作记忆者可更好地整合解歧信息,所以可更有效地加工歧义句。另有一些利用句子验证或句子完成实验范式对歧义句进行的研究结果并不支持多表征理论,认为句子边界是放弃其它表征而形成一种解释的触发点[13-14]。本研究材料为整体歧义句,采用了延时(off-line)的句子验证实验范式,在句中没有提供任何解歧信息,所有被试在句子结束处必须仅依赖于频率信息形成一种最可能的表征,因而工作记忆的制约效应不明显。在对实验二中难度较大的歧义句进行加工时,工作记忆开始表现边缘性显著的影响。这与 Just 和 Carpenter(1991)的研究结果相符合[15],表明任务难度越大,对工作记忆能量的需求就越高,受工作记忆的限制就越明显。

陈永明等人的研究发现,歧义句多重解释的激活有一个时间进程。而本实验结果并未表现出这种效应。这可能是因为:首先,选取被试的方法不同。以前研究是随机取样,本实验以工作记忆测量选择了高、低工作记忆两端的被试,即被试的选择不是随机的。其次,所用材料不同。本实验在以前研究的基础上,对歧义句的各种可能解释的相对使用频率进行了评定,使用频率最低的解释,其平均频率等级为 1.98。这种极低的相对使用频率可能在 1000ms 的延迟间隔时仍不能激活。因而可推论,歧义句多重解释激活与提取的时间进程可能受到被试特征与材料性质的影响。

## 5　结论

综合上面两个实验的结果,可以得出以下几点结论:

(1)歧义句多种解释的相对使用频率是影响其解析的重要因素,在无语境汉语歧义句的加工中,使用频率较高的主要意思比使用频率较低的次要意思更易于被激活和提取。

(2)工作记忆能量对无解歧语境的歧义句的加工未表现出明显的制约效应。

(3)工作记忆能量效应与任务难度有关。能量越低,在任务难度增加时成绩受损越大。

(4)歧义句多种解释激活与提取的时间进程可能受到被试特征与材料性质的影响。

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IOR). The main experimental variable was the temporal interval between the cue and the target (SOA). A computer was used in presenting stimuli and recording subject's reaction time. 14 students served as subjects. The experiment showed that IOR occurred when SOA was 700ms and diminished when SOA was 900ms. This result was different from previous experiments which found IOR occurred when SOA was about 300ms in detecting light spot. However, this result was similar to that of the discrimination task on IOR. This result was considered an effect of task difficulty on the temporal dynamics of IOR.

Key words: selective attention, inhibition of return, location, temporal dynamics , task difficulty.

## THE FIVE—FACTOR MODEL (FFM) AND THE ANALYSIS OF PERSONALITY STRUCTUREIN PERSONNEL SELECTION

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390 adults subjects, all applicants for international company positions, were given a set of psychological tests as a part of the recruitment procedure. The 18 dimensions of CPI sub—scales scores were factor—analysed for personality structure. The results showed that the 5—factor sturcture was a common structure in personality. The results were silmilar to the Five—Factor Model(FFM).

Key words: personnel selection, personality analysis, five factormodel.

## RADICAL PROCESSING IN CHINESE CHARACTER RECOGNITION: EVIDENCE FROMILLUSORY CONJUNCTION

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An illusory conjunction paradigm was adopted to investigatepossible effects of radical processing in Chinese character recognition. In each trial, two stimulus characters were displayed briefly, afterwhich a probe character was presented for recognition. Two experimentsdemonstrated that when a probe (e. g., "她") was formed by radicals fromthe two source characters (e. g., "姓","地"), the participants tended tomisjudge it as one of the preceding characters. The error ratedecreased with the increase of character frequency and radicalfreeequency. Furthermore, the effects of character and radicalfrequency were no longer detectable when the consistency between theinternal structure and external organization of characters was reduced. Overall, the results revealed the significance of character frequencyand spacial organizational factors in character recognition. Theyfurther indicated the importance of radical factors in the processingof characters.

Key words: character recognition, illusory conjunction, radicalfrequency, character frequecy.

## A RESEARCH ON THE RELATIONSHIP BETWEEN STUDENTS' SELF—EXPECTED ANDTEACHER—ENCOURAGED MENTAL TRAITS

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A test was made on 662 middle school students and 86 teachers to investigate the difference between self — expected and teacher — encoruaged mental traits. The result showed that there existed significant differences, expecially in creativity, curiosity and adventure.

Key words: self—expected, mental traits, self—fulfilling prophecy.

## WORKING MEMORY, RELATIVE MEANING FREQUENCY AND THE PROCESSING OFCHINESE AMBIGUOUS SENTENCES

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Two experiments were conducted to examine the role of working memory and meaning—freequency in the processing of Chinese ambiguous sentences. Each sentence in Experiment 1 had two possible interpretations and three possible interpretations in Experiment 2. The Reading Span Test was used to select 24 subjects who formed the high working memory (Hwm) group and 24 subjects who formed the low working memory ( Lwm) group. In the experiments, a sentence verification task was assigned. Working Memory (high,low) and Interval between the stimulus and target (100ms, 1000ms) were used as between—subject—factors. Meaning—Frequency was used as a within—subject—factor. The results indicated: 1)Without a context which provides unambiguous information, working memory had no effect on the processing of ambiguous sentences. 2) The main idea of an ambiguous sentence was more speedily accessed than the mi-

nor idea. 3) When the difficulty of the material increased, the Hwm group began processing a little better than the Lwm group.

Key words: working memory, sentence ambiguity, disambiguity, relativemeaning frequency.

## AN EXPERIMENTAL STUDY OF EYE — MOVEMENT CHARACTERISTICS IN SCIENTIFICARTICLE READING

*Yan Guoli*
(Department of Education, Tianjin Normal University)

A Model 4200R eye tracker was used to study the eye movement characteristics while the subjects were reading scientific articles. The subjects were fifth — year primary school pupils, junior high school students and college students with normal sights. The results are as follows: 1)When reading key parts of the article the older subjects could change their scanning strategy accordingly. 2) The older subjectstended to use selective regression while reading.

Key words: eyemovement, reading regression, selective regression.

## A COMMENT ON THREE THEORETICAL MODELS OF TRANSFER WITHIN THE FRAMEWORKOF KNOWLEDGE CLASSIFICATION

*Zhu Yan*
(East China Normal University)

This paper deals with three theoretical models of transfer within the framework of knowledge classification: the cognitive structure theory of transfer, the production theory of transfer and the metacognition theory of transfer.

Key words: declarative knowledge, procedural knowledge, cognitivesturcture, production, metacognition.

## A COMPARATIVE STUDY OF TWO TECHNIQUES OF COPING WITH COMPETITIVESTATE ANXIETY

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(East China Normal University)

This study examined the effect of Cognitive Affection Stress Management Training Program(SMT) and bio — feedback relaxation ( BFB — R) used in coping with competitive anxiety. 31 shooters of Shanghai Shooting Team took part in this experiment. The result showed: 1) In the laboratory condition, SMT and BFB — R could help shooters to develop the ability of relaxation and imagination; 2) The experimental subjects showed lower somatic anxiety and higher self — confidence than the control subjects; 3) The subjects of SMT got better performance than BFB—R.

Key words: competitive state anxiety, Cognitive Affect StressManagement Training Program (SMT), biofeedback—relaxation(BFB—R).

## THE BOOK OF CHANGES: A CLASSIC INTERPRETATION OF THE SCIENTIFIC AND AESTHETIC MODES OF THINKING OF HUMAN BEINGS

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The Book of Changes, an ancient Chinese book which made its first appearance five thousand years ago, embodies the profound logical principles in modern mathematical and physical science and the logical principles in aethetic appreciation. The book interprets the two incompatiable fields as well as their respective characteristic modes of thinking as a perfect unity. Viewing The Book of Changes from such a perspective may be helpful to the present — day psychological circles in blazing a new trail in the research on thinking modes and logical problems.

Key words: element combination, mathematical, Aesthetic logic, Modes of thinking.