

脑信息状态对数字加工的影响*

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Effects of brain-information state on number processing

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Abstract

AIM: To compare the effects of different brain-information state on number processing.

METHODS: Twenty-four post-graduates and undergraduates, who were right handed, normal in selection vision or corrected vision and had neither diseases in auditory system nor histories of mental diseases from October 2004 to December 2005 were selected and paid. All the subjects were placed in an shielding and quiet room and given of auditory stimulus by wearing telephone headset. The auditory stimulus were randomized and presented a female voice of Chinese putonghua: one, two, three, four, six, seven, eight and nine, each of them presenting 300 ms. At 100 cm away from the testing eyes, there was a computer display unit, which sent out the visual stimulus, that is, pictures of white numbers on black ground presenting in the center of display, and the numbers were numbers of one, two, three, four, six, seven, eight and nine in Arabic and simplified characters (thickened in song of 48 size) respectively. S1-S2 was adopted. Subjects were required to judge whether numbers of S1 and S2 were the same, and whether they were greater than 5. The programming of software was conducted with E-PRIME1.1 and correct reaction time and rate were recorded. Multiple-factor repetitive measurement and analysis of variance were performed.

RESULTS: The minimum and maximum were rejected, and the reaction time less than 300 ms or greater than 1 200 ms were excluded, which accounting for 3.20% of the data. ① Under matching state and non-matching state of number stimulus, the correct rate in response of subjects were the same, and there were no significant differences [98.97±0.011% , 99.19±0.008% $t_{(46)}=-0.790 P=0.319$]. The average reaction time was shorter under non-matching state than under matching state, and the differences were remarkable [(739.90±16.24) , (783.35±19.90) ms $t_{(46)}=-2.042 P < 0.05$]. ② Under matching state, the main effects and linear fitted main effects in distance of the Arabic numbers, Chinese simplified characters and numbers in auditory Chinese putonghua were significant, and the correct rate of reaction was enhanced with the increased number-distance. Under non-matching state, the main effects were significant, while linear fitted main effects were not marked. The correct rate did not ascend with the enlargement of number distance. ③ Under matching state, the main effects and linear fitted main effects in distance of the Arabic numbers, Chinese simplified characters and numbers in auditory Chinese putonghua were significant, while the reaction time was prolonged with the increased number distance. Under non-matching state, the main effects were

significant, while linear fitted main effects were not marked, and the reaction time was not prolonged with the increased number distance.

CONCLUSION: Correct reaction time is shortened with the increased number distance under matching state, and there are significant main effects of number distance, while under non-matching state, there are no significant main effects of number distance. The conflicting state of brain information will affect the number processing, and cause the disappearance of number distance.

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摘要

目的:比较不同脑信息状态对数字加工的影响。

方法:于2004-10/2005-12选择视力或者矫正视力正常,听力正常,无听觉系统病史,右利手,无精神神经疾病史的在校大学本科和研究生24名作为有偿被试。被试置于屏蔽安静室内,头戴耳机给出听觉刺激,听觉刺激为双耳随机同时呈现女声汉语普通话数字壹,贰,叁,肆,陆,柒,捌,玖,每个刺激每次呈现300 ms。距离被试双眼100 cm处放置计算机显示器给出视觉刺激,视觉刺激为计算机屏幕中央呈现写有数字的黑底白字图片,数字分别为阿拉伯数字1,2,3,4,6,7,8和9及中文简写数字一,二,三,四,六,七,八和九(仿宋体加粗48号)。采用S1-S2模式。要求被试判断数字对(S1,S2)是否相同,并对S2数字做“与5相比”判断大小的任务。利用E-PRIME1.1软件编程并记录正确反应时和反应率。进行多因素重复测量方差分析。

结果:将数据剔除极值,所有反应时小于300 ms或大于1 200 ms的数据被剔除,剔除数据占全部数据的3.20%。①前后数字刺激对匹配状态下和非匹配状态下,被试反应正确率接近,差异无显著性意义 [98.97±0.011% , 99.19±0.008% $t_{(46)}=-0.790 P=0.319$];匹配状态下平均反应时低于非匹配状态下,差异有显著性意义 [(739.90±16.24) , (783.35±19.90) ms $t_{(46)}=-2.042 P < 0.05$]. ②在匹配状态下,阿拉伯数字、中文简写数字、听觉汉语普通话数字距离主效应显著,线性拟合主效应显著,反应正确率随数字距离增加而递增。在非匹配状态下,距离主效应显著,线性拟合主效应不显著,反应正确率不随数字距离增加而递增。③在匹配状态下,阿拉伯数字、中文简写数字、听觉汉语普通话数字距离主效应显著,线性拟合主效应显著,反应时随数字距离增加而递减。在非匹配状态下,距离主效应显著,线性拟合主效应不显著,反应时不随数字距离增加而递减。

结论:在匹配状态下正确反应时均随数字距离的增加而缩短,存在数字距离主效应显著性,在非匹配状态下不存在数字距离主效应显著性。脑信息冲突状态会对数字加工产生影响,数字距离效应消失。

主题词:脑;心理现象和过程;认知

0 引言

目前在数字认知加工领域,长期存在着两种主要假设争论。McCloskey^[1-4]基于患者神经病理学的研究,提出了抽象内在表征模型。认为任何输入数字必须被转换成一种抽象内部表征。数字加工领域的另一权威Dehaene^[5,6]则支持从一种数字形式转换为另一数字形式的过程是直接的,提出了三重编码模型。认为存在3种数字系统,即听觉语言文字编码、视觉阿拉伯数字编码和模拟数量编码。事物间存在的差异对大脑来说是信息冲突。大脑接受外界的刺激,与大脑工作记忆中的

信息相互比较,当外界进入脑内的信息与脑内的内源性信息相互矛盾、不一致时,利用事件相关电位技术可以在头皮表面记录到一个负波 N270^[7,8]。在较多的数字比较任务实验中均可以普遍观察到数字距离效应的存在^[9,10]。依据数字加工作业任务难度的不同,数字距离效应出现的时程不同。脑本身处于比较状态时,脑信息发生了冲突——脑信息冲突状态。其诱发出 N270 具有相对稳定的时间特性,是否会影响数字认知的心理表征,对数字距离效应产生影响?为此,本实验从行为学实验角度,采用 3 种数字材料具体到每一数字距离进行考察。

1 对象和方法

设计:多因素重复测量。

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对象:于 2004-10/2005-12 选择在校大学本科生和研究生为有偿被试。均视力或矫正视力正常,听力正常,无听觉系统病史,右利手,无精神神经疾病史。纳入 24 名,男女各半,年龄 20~29 岁,平均年龄 23.4 岁。

设计、实施、评估者:设计为第一作者,具体实施为第一、二、三作者,评估为第四作者。

方法:

听觉刺激:户外型耳挂式耳机 DJ-301MV 呈现听觉刺激,音量控制在中等强度。双耳随机同时呈现女声汉语普通话数字壹,贰,叁,肆,陆,柒,捌,玖,每个刺激每次呈现 300 ms。声音刺激由录音编辑处理软件 WaveCN1.70 录制编辑。每个数字声音录制成一个独立的文件,音频格式为 PCM,平均数据速率 44 100 kb/s,采样速率 22.50 kHz,音频采样大小 16 位,单声频道。

视觉刺激:实验刺激呈现在奔腾 400 兼容机上,显示器为飞利浦 17 寸彩色显示器,刷新频率 60 Hz,分辨率 600×800。计算机屏幕中央呈现写有数字的黑底白字图片,图片大小 500 mm×500 mm。数字分别为阿拉伯数字 1 2 3 4 6 7 8 和 9 及中文简写数字一、二、三、四、六、七、八和九(仿宋体加粗 48 号)。所有图片由 Photoshop7.0 编辑。

实验程序:实验程序用 E-PRIME1.1 编制。计算机屏幕中央首先呈现一个黑底白字的“十”字预警信号(1 000 ms),随后出现第一个刺激(S1),间隔 1 000 ms 后出现第二个刺激(S2),间隔 1 600 ms 后自动再出现 S1,期间等待被试反应。3 种 S1 的每个数字均分别随机出现 30 次,S2 的每个数字刺激也均随机呈现,一共出现 720 对刺激。S1 有 3 种情况:①视觉呈现的阿拉伯数字(1 2 3 4 6 7 8 9)。②视觉呈现的中文数字(一,二,三,四,六,七,八,九)。③听觉呈现的汉语语

音数字(yi, er, san, si, liu, qi, ba, jiu) S2 为听觉呈现女声汉语普通话数字(yi, er, san, si, liu, qi, ba, jiu)。实验程序见图 1。



图 1 实验程序

实验任务:被试置于屏蔽安静室内,头戴耳机给出听觉刺激,距离被试双眼 100 cm 处放置计算机显示器给出视觉刺激。在整个实验中,被试房间使用日光灯照明。被试任务是判断数字对(S1、S2)是否相同,并对 S2 数字做“与 5 相比”判断大小的任务。如数字对相同,用右手;不同,用左手。比 5 大用示指按键,比 5 小用中指按键,或比 5 大用中指按键,比 5 小用示指按键。示指置于键盘 J 或 F 键上,中指置于键盘 K 或 D 键上。被试需尽快尽准确按键。左右手及手指按键顺序在被试间进行平衡。

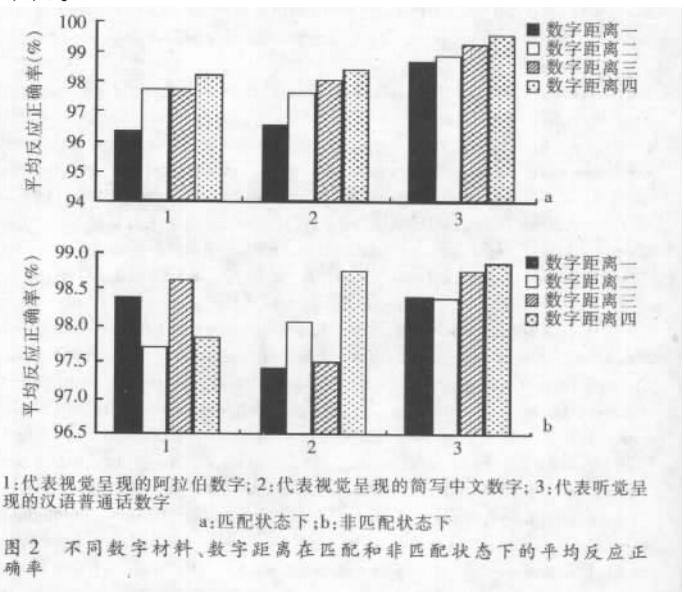
主要观察指标:被试的平均反应正确率和平均反应时及其主效应和交互作用。

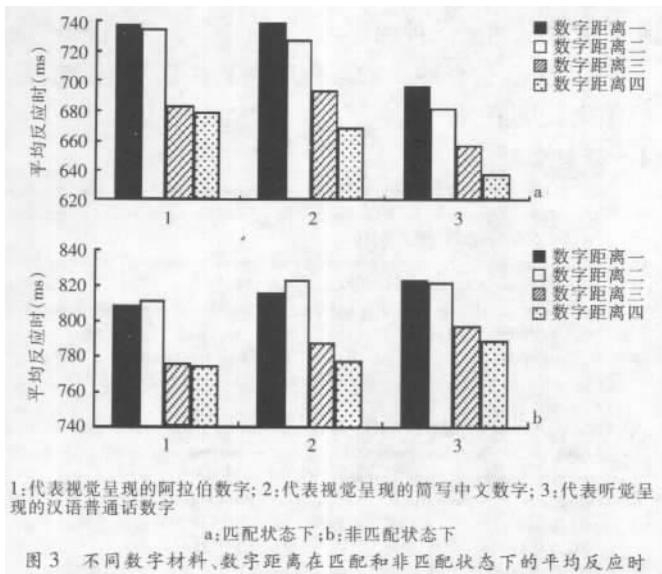
统计学分析:由第一作者采用 SPSS 11.0 对数据进行重复测量方差分析。

2 结果

2.1 描述性统计 将数据剔除极值,所有反应时小于 300 ms 或大于 1 200 ms 的数据被剔除,剔除数据占全部数据的 3.20%。

2.2 被试的平均反应正确率和平均反应时结果 被试的平均反应正确率 匹配状态和非匹配状态下,被试反应正确率接近,差异无显著性意义[98.97 ± 0.011 %], 99.19 ± 0.008 % $t_{(46)} = -0.790$ $P = 0.319$];匹配状态下平均反应时低于非匹配状态下,差异有显著性意义[739.90 ± 16.24], (783.35 ± 19.90) ms $t_{(46)} = -2.042$ $P < 0.05$]。被试的平均反应正确率,见图 2。被试的平均反应时,见图 3。





2.3 被试的平均反应正确率和平均反应时的主效应和交互作用 对数字距离效应的考察参考 Dehaene 等^[1]的方法,对不同数字材料、不同脑信息状态下的反应数据进行 3 (数字材料) × 2 (脑信息状态) × 4 (数字距离) ANOVA 分析后,着重对数字距离的主效应显著性进行考察,距离主效应显著性说明不同距离的数字存在差异,线性拟合显著说明这种差异是线性变化的。

2.3.1 对反应正确率进行 3 × 2 × 4 重复测量的方差分析 见表 1。

表 1 各自变量在反应正确率上显著的主效应及其交互作用

变异来源	df	MS	F
材料	2	7.105 × 10 ⁻³	10.03 ^b
冲突	1	2.641 × 10 ⁻⁴	0.409
距离	3	2.424 × 10 ⁻³	2.834 ^a
材料 × 冲突	2	1.575 × 10 ⁻³	2.339
材料 × 距离	6	3.435 × 10 ⁻⁴	0.417
冲突 × 距离	3	8.733 × 10 ⁻⁴	1.22
材料 × 冲突 × 距离	6	4.697 × 10 ⁻⁴	0.710

^aP < 0.05; ^bP < 0.001

在匹配状态下,阿拉伯数字距离主效应显著: $F_{(3,69)} = 7.685, P < 0.001, MSE = 884.56$; 线性拟合主效应显著: $F_{(1,23)} = 11.254, P < 0.001, MSE = 965.35$, 反应正确率随数字距离增加而递增。中文简写数字距离主效应显著: $F_{(3,69)} = 15.142, P < 0.001, MSE = 789.42$; 线性拟合主效应显著: $F_{(1,23)} = 31.158, P < 0.001, MSE = 985.14$, 反应正确率随数字距离增加而递增。听觉汉语普通话数字距离主效应显著: $F_{(3,69)} = 9.875, P < 0.001, MSE = 895.16$; 线性拟合主效应显著: $F_{(1,23)} = 28.254, P < 0.001, MSE = 825.14$, 反应正确率随数字距离增加而递增。

在非匹配状态下,阿拉伯数字距离主效应显著: $F_{(3,69)} = 6.481, P < 0.01, MSE = 897.23$; 线性拟合主效应不显著: $F_{(1,23)} = 1.576, P = 0.16, MSE = 928.13$, 反应正确率不随数字距离增加而递增。中文简写数字距离主效应显著: $F_{(3,69)} = 7.470, P < 0.01, MSE = 932.57$; 线性拟合主效应不显著: $F_{(1,23)} = 1.458, P = 0.18, MSE = 989.36$, 反应正确率不随数字距离增加而递增。听觉汉语普通话数字距

离主效应显著: $F_{(3,69)} = 4.973, P < 0.01, MSE = 897.01$; 线性拟合主效应不显著: $F_{(1,23)} = 1.518, P = 0.20, MSE = 896.37$, 反应正确率不随数字距离增加而递增。

2.3.2 对平均反应时进行 3 × 2 × 4 重复测量的方差分析 见表 2。

表 2 各自变量在反应时上显著的主效应及其交互作用

变异来源	df	MS	F
材料	2	13 972.19	4.579 ^a
冲突	1	1 608 910.44	32.330 ^b
距离	3	85 575.68	37.030 ^b
材料 × 冲突	2	42 129.20	17.540 ^b
材料 × 距离	6	1 027.68	0.607
冲突 × 距离	3	4 633.27	2.436
材料 × 冲突 × 距离	6	228.65	0.145

^aP < 0.05; ^bP < 0.001

在匹配状态下,阿拉伯数字距离主效应显著: $F_{(3,69)} = 8.386, P < 0.001, MSE = 758.25$; 线性拟合主效应显著: $F_{(1,23)} = 12.623, P < 0.001, MSE = 586.63$, 反应时随数字距离增加而递减。中文简写数字距离主效应显著: $F_{(3,69)} = 12.393, P < 0.001, MSE = 895.39$; 线性拟合主效应显著: $F_{(1,23)} = 29.828, P < 0.001, MSE = 768.25$, 反应时随数字距离增加而递减。听觉汉语普通话数字距离主效应显著: $F_{(3,69)} = 10.991, P < 0.001, MSE = 698.32$; 线性拟合主效应显著: $F_{(1,23)} = 26.366, P < 0.001, MSE = 784.12$, 反应时随数字距离增加而递减。

在非匹配状态下,阿拉伯数字距离主效应显著: $F_{(3,69)} = 6.481, P < 0.01, MSE = 456.35$; 线性拟合主效应不显著: $F_{(1,23)} = 2.576, P = 0.15, MSE = 963.25$, 反应时不随数字距离增加而递减。中文简写数字距离主效应显著: $F_{(3,69)} = 7.470, P < 0.01, MSE = 931.42$; 线性拟合主效应不显著: $F_{(1,23)} = 2.831, P = 0.20, MSE = 689.57$, 反应时不随数字距离增加而递减。听觉汉语普通话数字距离主效应显著: $F_{(3,69)} = 4.973, P < 0.01, MSE = 897.68$; 线性拟合主效应不显著: $F_{(1,23)} = 1.545, P = 0.26, MSE = 110.25$, 反应时不随数字距离增加而递减。

3 讨论

前后呈现的数字刺激对的数值相同或相异,正常人脑予以识别,产生不同的脑信息状态^[8]。在前后刺激相同的匹配情况下与在前后刺激不同的非匹配情况下相比,虽然前者的平均正确反应率较后者稍低,但二者不存在显著性差异;而在匹配情况下,大脑对数字比较任务的完成较迅速,反应时较短,与在非匹配情况下存在显著性差异。反应时的显著性差异说明本实验设计造成了两种不同的脑信息状态。

进一步分析可见,在匹配情况下,各种数字材料对数字比较任务完成的平均反应时均随着数字距离的递增而递减,体现出数字距离效应;每种数字材料各自的正确反应率也随着数字距离的递增而递增,同样体现出数字距离效应。在非匹配情况下,各种数字材料对数字比较任务完成的平均反应时及正确反应率随数字距

离变化的规律性不再存在。因此完成数字比较任务时,数字距离效应会受到脑功能状态的影响,非匹配情况下的脑冲突状态会影响数字距离效应的表达而消失。

实验中前一个刺激有3种数字材料,分别随机呈现视觉阿拉伯数字、简写中文数字和听觉汉语普通话数字,这3种数字材料是日常生活中母语为汉语者最普遍接触到的数字形式。受到广泛关注的Dehaene^[5,6]的三重编码模型的假设认为,数字有3种不同的心理表征编码,一是听觉语言文字编码,二是视觉阿拉伯数字编码,三是模拟数量编码。本实验三种数字材料在同种脑功能状态下的平均反应时存在材料主效应的显著性差异,也支持数字心理表征的多重编码学说。

在前后数字对匹配的情况下,任务作业中,听觉呈现的汉语普通话数字比视觉呈现的阿拉伯和中文简写数字的平均反应时均短,这可能暗示因为后一个刺激为听觉通道的语音刺激,同样存在着通道是否匹配的不同脑功能状态。非匹配情况下的脑功能冲突状态,将影响反应速度,反应时延长。

数字距离效应是数字加工认知活动普遍存在的基本效应,它受到认知状态的影响。刘超等^[12,13]进行的多项视觉通道行为学实验数据,雷军等^[14]进行的视听跨通道事件相关电位的实验研究均支持数字的数字

距离效应受注意条件的影响。

总之,脑信息冲突状态会对数字加工产生影响,数字距离效应消失。

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·临床研究·

老年抑郁症患者住院治疗特点的回溯性调查☆

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Retrospective investigation on the characteristics of treatment for the elderly with depression in hospitalization

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Abstract

AIM: To retrospectively explore the clinical treatment situation of the el-

derly with depression in hospitalization.

METHODS: One hundred and thirty-one elderly inpatients with depression in the Shanghai Mental Health Center were selected. Their clinical records were collected from the medical record library to fill the related data into the designed questionnaires for retrospective analysis of the main symptoms, body state and treatment state. Hamilton depression scale (HAMD) was used for comparison of the effect of the patients with different antidepressants before and after treatment. The scale used 0-4 score, 5 grades rating; 0 score meant no symptom of this item, 4 score as very serious degree. The incidence rates of adverse effect between patients treated with selective serotonin reuptake inhibitors (SSRIs) and cyclic antidepressants (TCA) were compared with the adverse effect scale (0-4 score rating; 0 score meant no symptom of this item, 4 score as very serious) after treatment, and the results of blood analysis, liver function, electrocardiogram before and after treatment. Self-designed brief psychiatric symptoms inventory for elderly patients was used to compare the psychiatric symptom of the patients after modified electroconvulsive therapy (MECT) or without MECT.

RESULTS: All the 131 elderly inpatients entered the result analysis. ① Comparison of antidepressants efficacy: Both SSRIs and TCA had good effect on elderly patients with depression and their changes of HAMD scores before and after treatment were similar. ② Comparison of antidepressants side effects: SSRIs had fewer side effects than the TCA, and there were significant differences in the incidence number except sweating, losing ap-