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咀嚼口香糖对个体注意功能的影响

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【摘要】 目的：考察咀嚼口香糖对注意的影响。方法：基于性别、特质性焦虑水平、嚼口香糖习惯大小(H/L)、以及实验时是否嚼糖 (G/C)，采用平衡组间设计将 181 名健康的大学生被试分为：实验时嚼糖且有习惯(GH)、实验时嚼糖但无习惯(GL)，控制不嚼糖但有习惯(CH)、和控制不嚼糖且无习惯(CL)四个组，在实验室中进行连续操作测验(CPT-AX)和匹配搜索任务(CST)测验，用以评估持续性注意和选择性注意。结果：除实验中咀嚼口香糖对被试成绩有积极影响外，咀嚼口香糖的经验对成绩显示了更重要影响。结论：咀嚼口香糖对注意功能有积极影响，并且对口香糖的熟悉程度在此积极影响中起重要作用。

【关键词】 咀嚼口香糖；持续性注意；选择性注意

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A Study on the Effect of Gum Chewing on Attention

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【Abstract】 **Purpose**: To investigate the effect of gum chewing on the cognitive function of attention. **Methods**: Based on gum chewing habit, trait-anxiety variable, and different treatments (with or without gum chewing) during experiment, 181 college students with good health were assigned to four groups GH (with chewing gum treatment and habit), GL (with chewing gum treatment, no habit), CH (no treatment, has habit) and CL (no treatment, no habit). Two attention tasks: Continuous Performance Test (CPT-AX) and Conjunctive Search Task (CST) were performed by all subjects in the laboratory. **Results**: Chewing gum during experiment had positive effect on attention performance, and the habit of gum chewing played an important role. **Conclusion**: Gum chewing had positive effect on attention performance, suggesting the effects mainly came from the familiarity of gum-chewing.

【Key words】 Chewing gum; Sustained attention; Selective attention

1 Purpose

Attention is a fundamental and important cognitive function. Whenever we accomplish a task, more information come to our sense organs from the environment. In a visual task only information relevant to the task at hand can pass through our eyes, visual search filters out irrelevant information and makes it possible for the task to be done easily. According to a commonly used taxonomy, attention can be broken down into selective attention and sustained attention. Selective attention refers to the first stage of attention, to focus on the relevant information while effectively ignoring distracting information. Sustained attention refers to maintaining attention over a prolonged period of time in order to detect infrequent signals.

There are not many empirical studies related to the effect of gum chewing on cognitive functions such as learning and memory,, even less on attention. Wilkinson et al. found that gum chewing could improve episodic memory and working memory, but showed no improvement on attention[1], while Tucha et al. reported that gum chewing could not improve the subjects' memory functions, but differentially affect specific aspects of attention [2,3]. It improved sustained attention, but adversely affected alertness and flexibility.

From the above, the studies on the relationship between gum chewing and attention are not only quantitatively insufficient, moreover, inconsistency existed in experimental design and research findings. The present study aims to investigate the gum chewing effect on selective attention and sustained attention through two different experiments.

2 Research Method

2.1 Subjects

181 college students from two universities were recruited as subjects. The subjects are aged between 18 and 25 (Mean: 21.72, SD: 2.10); 79 male and 102 female. They all are in good health condition and met the following requirements. ①Being able to chew gum for at least 1 hour at a time; ②Presence of more than

10 maxillary and mandibular healthy teeth, without orthodontic bands or dental appliances; and ③Without physical and mental disorders which can affect cognitive function.

By using a balanced, between-group control experimental design, the subjects were asked to come to the laboratory twice. At the first trial, they were asked to provide registration information and filling out two questionnaires: one is STAI (State-trait Anxiety Inventory, Spielberger, 1983), the other is a simple questionnaire for gum chewing habit (Wrigley, HK. 2006). According to the gender, gum chewing habit and trait-anxiety variable, all subjects were divided into two balanced groups. Group G is the experimental group. First, some gums were given to the subjects of G group requesting them to chew the gum everyday during learning at least 2 pieces per day (not clear), after two weeks, they come to the laboratory to complete the two attention tasks, also with gum chewing while doing the attention tasks. Group C being the control group, its subjects do not have gum chewing before and during the experiment on the attention tasks, but after the experiment some chewing gums were given to them as reward. The demographic statistics of the two groups are shown in Table 1.

Table 1　Demographic statistics of the two groups of subjects

	Age(Years)	Number of subjects			Gum chewing Level	STAI
		Total	Male	Female		
Group C	21.51 ± 2.16	91	38	53	5.34 ± 2.26	42.98 ± 8.07
Group G	21.93 ± 2.03	90	41	49	5.23 ± 2.20	42.58 ± 7.88

2.2 Procedure and Tasks

There were two tests of attention in the experiment: Continuous Performance Test (CPT-AX) and Conjunctive Search Task (CST). The two groups differed in treatments of with and without gum chewing during the experiment. Under the gum chewing condition, subjects of G-group were asked to choose gums of their favourite flavour and start their chewing gum immediately, and they have to keep chewing gum during the whole experimental process till its end. To change gums during experiment was permitted.

All two attention tests were conducted on a PC set. Stimuli are shown on a 17 inch CRT monitor. The whole procedure lasted about 35 minutes. The three tests were as follows:

Continuous Performance Test AX (CPT-AX): Sustained attention were involved during the task performance. Single letters were presented sequentially at the center of the screen for 150 ms each, and the inter-stimulus interval (ISI) was 500ms. Subjects were asked to respond if they see an X following A. There were five 100-trial blocks, the target trail occurred with a high frequency of 70%. Before the experiment started, 10 trials were given for practice. Lee and Park provided detailed description of the task[4].

Conjunctive Search Task (CST): The task was to search for a target of "E" or "H" letter randomly appearing on the screen, among a number of displayed English letters. Some displays contained one of the targets: "E", some contained the other target: "H", other displays contained neither "E' nor "H". Each display remains for 2000ms, and the target letter would be masked with other letters randomly. The subjects were required to respond as fast and as accurately as possible with their right finger to the presence of "H" and left finger to the presence of "E". If the target letters do not appear, no pressing is necessary. There were a total of 500 formal trials in 10 blocks, preceded by 20 practice trials.

According to different treatments (Gum chewing-G or No gum-C during experiment) and subjects' different experience with chewing gum (high frequency-H and low frequency-L), the subjects can be divided into 4 sub-groups: GH, GL, CH and CL. The results of the experiments were recorded for frequency of hit and reaction time separately.

3 Results

3.1 The effect of chewing gum on sustained attention

There were four kinds of possible responses for subjects of different conditions in CPT-AX, which included Hit (with stimulus, response), Omission (with stimulus, no response), Commission (no stimulus but response), and Right Rejection (no stimulus, no response). The results of descriptive statistics and MANOVA are presented in Table 2 and Table 3.

In Table 2, we can see from the average number of Hit among the four sub-groups, CH has the most (163.26) and GL has the least (155.75) Hits. By further analysis of each group, GH >GL and CH >CL.

From Table 3, calculated by MANOVA, the effect of chewing experience is marginal significant, P=0.08. These results may suggest that daily experience of gum chewing (Habit-factor) has positive effect on performing attention tasks, it helps people to detect the pre-planed target. Also in Table 3, we can see the reaction time of G-group (GH+GL) as a whole was shorter than the C-group (CH+CL) for Hit, especially the reaction time of subgroup GH was the shortest (291.74ms). Calculated by MANOVA, the group effect on Hit also has marginal significance (P=0.081). Combining the two results, we may suggest that different treatments also affected the result of attention performance, e.g. chewing gum during the experiment has some positive effect on the attention task as well. However, it seems the effect of treatment is less strong in comparison with the effect of personal chewing experience.

From the results calculated by MANOVA, the group effect of reaction time on Commission was marginal significant (0.075), which may reflect the better alertness of subjects of G group, which caused the faster response. However, combining the results of Commission with that of Hit, we found that chewing gum during work benefits only the selective aspect of attention -the first stage of cognitive function, but the role of sustained attention in improving the clearness of cognition cannot be guaranteed.

Table 2 Descriptive statistics for frequency and reaction time in CPT-AX($\bar{x}\pm s$)

RESPONSE	GH	GL	CH	CL
Frequency				
Hit	159.22 ± 13.00	155.75 ± 17.64	163.26 ± 12.44	159.20 ± 13.83
Right Rejection	303.43 ± 11.78	304.14 ± 11.26	307.40 ± 11.70	304.18 ± 12.66
Commission	19.57 ± 11.78	18.86 ± 11.26	15.60 ± 11.70	18.82 ± 12.66
Omission	17.78 ± 13.00	21.25 ± 17.64	13.74 ± 12.44	17.80 ± 13.83
Reaction Time				
Hit	291.74 ± 49.64	309.39 ± 56.49	309.26 ± 51.17	309.48 ± 43.22
Commission	282.51 ± 45.99	268.94 ± 50.15	290.71 ± 53.74	287.15 ± 48.60

Table 3 MANOVA Results for CPT-AX

	Frequency			Reaction Time		
	MS	F	P	MS	F	P
Hit						
Treatment	634.036	3.074	0.081	3496.682	1.39	0.24
Experience	638.546	3.096	0.08	3603.034	1.433	0.233
Treat*Experience	3.931	0.019	0.89	3427.518	1.363	0.245
Rejection						
Treatment	181.979	1.289	0.258			
Experience	71.579	0.507	0.477			
Treat*Experience	173.507	1.229	0.269			
Commission						
Treatment				7868.422	3.201	0.075
Experience				3309.101	1.346	0.248
Treat*Experience				1129.379	0.459	0.499

Table 4 Descriptive statistics for frequency and reaction time(ms) in CST($\bar{x}\pm s$)

RESPONSE	GH	GL	CH	CL
Frequency				
Hit	154.51 ± 33.84	147.24 ± 34.60	167.33 ± 40.88	153.86 ± 47.57
Right Rejection	146.32 ± 28.06	149.67 ± 25.90	134.42 ± 33.91	145.89 ± 20.67
Commission	23.93 ± 16.62	24.63 ± 16.84	31.60 ± 20.19	22.82 ± 14.60
False Alarm	28.61 ± 24.25	24.55 ± 17.65	39.22 ± 34.15	28.09 ± 20.42
Omission	146.88 ± 36.94	153.98 ± 36.62	127.47 ± 46.17	149.41 ± 48.28
Reaction Time				
Hit	1230.27 ± 56.34	1228.86 ± 54.50	1206.98 ± 52.45	1234.26 ± 68.91
Commission	716.35 ± 266.23	754.00 ± 244.62	796.68 ± 219.56	782.40 ± 236.72
False Alarm	634.96 ± 317.35	613.35 ± 271.98	764.23 ± 315.24	697.52 ± 301.94

Table 5 MANOVA Results for CST

	Frequency			Reaction Time		
	MS	F	P	MS	F	P
Hit						
Experience	4791.45	3.06	0.082	11708.78	3.21	0.075
Treatment	4210.78	2.69	0.103	2096.24	0.58	0.449
Treat*Experience	428.64	0.27	0.602	6724.61	1.84	0.176
Rejection						
Experience	2447.39	3.23	0.074			
Treatment	2740.16	3.62	0.059			
Treat*Experience	732.45	0.97	0.327			
Commission						
Experience	726.72	2.46	0.119	4525.78	0.08	0.780
Treatment	382.45	1.29	0.257	134695.96	2.33	0.129
Treat*Experience	1002.98	3.39	0.067	31077.56	0.54	0.465
False Alarm						
Experience	2570.95	4.18	0.042	119000.28	1.31	0.254
Treatment	2231.69	3.63	0.059	500945.04	5.52	0.020
Treat*Experience	557.35	0.91	0.343	20315.08	0.22	0.637
Omission						
Experience	9399.13	5.26	0.023			
Treatment	6408.29	3.58	0.060			
Treat*Experience	2454.12	1.37	0.243			

3.2 The effect of chewing gum on selective attention

There were five kinds of response for each subject to different stimulus conditions in CST, which included three types of positive responses: Hit (with stimulus, response), Commission (with stimulus, response) and False Alarm (no stimulus, response); and two types of negative response: Omission (with stimulus, no response) and Right Rejection (no stimulus, no response). The results of descriptive statistics and MANOVA are presented in Table 4 and Table 5.

From Table 4, we can see from the average number of Hit among the four sub-groups, CH has the most (167.33) and GL has the least (147.24). By further analysis of each group: GH>GL and CH>CL. The MANOVA result showed that there is no significant difference in number of Hitx for subjects with different treatments (GH+GL vs. CH+CL), but for subjects with different degrees of experience (GH+CH>GL+CL) it was of marginal significance (P=0.082) (Table 5). It suggests that experience of gum chewing is a rather effective factor for the Hit result. Looking at the number of Hits among the four sub-groups in Table 4, CH has the most_167.33 and GL has the

least_147.24. It seems that this is another evidence for the positive effect of chewing experience on mental alertness. The reaction time of Hit: GH+CH<GL+CL, P=0.075 also showed the same result, and among the four sub-groups CH has the shortest reaction time (1206.98ms).

The MANOVA result on Omission displayed a marginal significant treatment effect (G group omitted more than that of C group, P=0.06), and also a significant effect of gum-chewing experience: subjects (GH+CH) made fewer omissions than that of (GL+CL), P=0.023. We also found in Table 2 that within the C group CH has far less number in Omission (127.47) than other three sub-groups. In addition, the MANOVA result did show similar phenomena in the cases of Commission and False Alarm, but Table 4 shows, comparing with the corresponding Mean, a large SD, so the results are not calculated.

Summing up the above data, we may indicate that the daily experience of gum chewing may have caused the subjects to be easily activated by the stimulus before making further differentiation of details.

4 Discussion

From the results of both experiments CPT and CST, gum chewing has positive effects on performance of attention tasks, in that gum chewing can improve the level of alertness, the subjects react faster and detected more targets than those who do not do gum chewing.

However, after dividing all subjects into 4 sub-groups according to two factors: gum-chewing experience in daily life and gum-chewing at the time of performing attention tasks, a more detailed analysis of the results showed that the different effects of gum-chewing are rather complicated, the final result depends on the combination of contemporary chewing condition and the past experience of chewing gum. In the Experiment of CST, MANOVA analysis clearly showed that chewing gum at the time of doing attention task is less effective than having the habit of gum-chewing. This may indicate that the daily experience of gum-chewing is a more effective factor which benefits the accomplishment of attention task.

We may ask, what is the reason that gum-chewing during detecting task of G-group is less effective than the control group without gum-chewing (GH<CH and GL<CL in Hit)? The explanation can be as follows: The amount of effect of chewing gum depends on both the external condition, i.e., gum chewing at the time of work, and the person's internal condition, i.e., the gum chewing experience or habit of gum chewing. The amount of positive effect of chewing gum on attention mainly depends on the degree of familiarity of gum-chewing, through reducing stress and keeping a calm mental status for work, it helps the mind to focus on the main target in performing a task. However, chewing gum is not so popular in China as in other developed countries. According to the result of a questionnaire on using frequency of chewing gum developed by Wrigley-Hong Kong, for the question "By average, how often do you consume chew gum usually ?" the average answer of all the subjects is only 3.25/month. Thus we can see factually our subjects were not having much experience of gum-chewing. Asking them to chew the gum during target detecting was sometimes similar to giving a distracter on the main task, which may reduce some positive effect of gum-chewing. As a special case, it does not weaken the fact of gum chewing's positive effect on attention.

Based on the findings of this study, the following conclusions can be made: ①In general, gum chewing has positive effects on the performance of attention tasks, including selective attention and sustained attention. ② The amount of effect of gum chewing depends on both the external condition (gum chewing at the time of work) and the subject's internal condition (a person's gum chewing experience or habit). The familiarity of gum chewing is more important for gaining benefits from chewing gum during work.

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