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嚼食檳榔對睡眠剝奪者之有效視覺區之影響
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■ 成 果 報 告
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嚼食檳榔對睡眠剝奪者之有效視覺區之影響

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計畫主持人：何明洲
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中文摘要

許多研究發現睡眠剝奪嚴重影響視覺注意力。視覺注意力最重要的指標之一是有效視覺區。有效視覺區為一空間區域，此區域對正在進行的視覺作業是「有用」或者「有效」的。注意力資源分佈在此空間區域以進一步處理外來的視覺資訊。當有效視覺區縮小時，較少外來視覺資訊會被作更進一步的處理。研究發現有效視覺區的大小取決於資訊處理的速度，分割注意力的效率以及忽略不相關干擾物的能力。研究發現睡眠剝奪會影響上述這三個決定有效視覺區的因素，使得有效視覺區縮小。長久以來，由於檳榔所引起的種種生理作用（如精神提振、舒服感、流汗、唾液分泌、興奮、心跳加速、溫熱感），人們常以檳榔當作提神劑。嗜鉻細胞模型與感覺評估的結果顯示生理作用主要是檳榔鹼，三種生物鹼，和多酚類化合物所引起。我們發現睡眠剝奪會損害有效視覺區，而嚼檳榔會減緩有效視覺區因睡眠剝奪而導致的損害，而此檳榔嚼食效果只發生在習慣嚼食者。

關鍵字: 檳榔、睡眠剝奪、有效視覺區

英文摘要

Betel nut is a common refreshment in many countries, including Taiwan. However, few behavioral studies focusing on the betel nut chewing effects were reported. Two experiments examined the effects of betel nut chewing on the useful field of view (UFOV) under sleep deprivation. The UFOV refers to a spatial area that is functional or useful for the ongoing task(s). Attentional resources are allocated to this spatial area in order to process the incoming information. When the size of the UFOV shrinks, fewer stimuli within the UFOV are further processed. The size of the UFOV can be determined by the speed of information processing, proficiency in dividing attention, and ability to ignore irrelevant distractions. We reported that betel nut chewing could broaden the UFOV size for the habitual chewers, but not for the non-chewers. Specifically, betel nut chewing can facilitate the ability to ignore irrelevant distractions under sleep deprivation conditions for the habitual chewers.

Key Words: betel nut, areca, sleep deprivation, useful field of view

In Taiwan, the betel nut (also known as areca) is a common refreshment for people working at night. About 1.5 million Taiwanese are betel nuts users with about 30% of these users chewing betel nuts for refreshment (Directorate-General of Budget, Accounting and Statistic, 1999). People place a whole betel nut into their mouth and macerate it by biting for approximately two to three minutes; they then spit out the red chewing saliva of the betel nut.

A betel nut usually consists of three major ingredients: a raw areca nut, slaked lime, and piper betel flower. The slaked lime, which is handled in the form of a paste, is either white lime or red lime. Red lime betel nut, containing green areca fruit, piper betel inflorescence and red lime paste, is the main such product consumed in Taiwan (about 70% of all betel nut). The primary chemical ingredients in betel nuts are alkaloids (e.g., arecoline, arecaidine, guvaeoline, guvacine, and acolidine), polyphenolic compounds, safrole, eugenol, and hydroxychavicol.

Betel nut has long been chewed by people as a stimulant because of its physiological effects, which include: increased stamina, a general feeling of well-being (Nieschulz, 1967), sweating, salivation, stimulation, cardioacceleration, a slightly drunk feeling and warming of the body and mouth cavity (Hwang, Wang, & Kao, 1993). Many studies have shown that betel nut chewing can heighten the alertness state (e.g., Cawte, 1985; Chu, 1993, 1994a, 1994b, 2001; Chu & Chang, 1994; Haubrich, & Watson, 1972; Molinengo, Fundaro, & Cassone, 1988; Rinaldi, & Himwich, 1955; Wyatt, 1996); additionally, such effects occur only for habitual betel nut chewers. According to Chu and Chang's survey, the first three effects for the new chewers were dizziness, hot sensation, and palpitation. To the contrary, the first three effects for habitual chewers were: heightened alertness, hot sensation, and palpitation.

Evidence that supports the refreshment effect of betel nut chewing comes primarily from physiological studies. In general, the physiological effects of betel nut chewing may result from the chemical effects of the betel nut ingredients on the autonomic and central nervous systems (for a review, refer to Chu, 2001). Chu (1994a) conducted an electroencephalographic (EEG) study on the effects of betel nut chewing. Results showed an increase in both beta (associated with alertness) and alpha (associated with relaxation) activities and a decrease in theta (associated with drowsiness) activity. Both an increase in beta and a decrease in theta indicated an increase in alertness state, whereas an increase in alpha indicated a relaxation or calmness while chewing betel nut. In addition, these EEG changes were restricted mainly to posterior areas (particularly the occipital areas) for alpha activity, but were more widespread for theta and beta activities.

Contrary to the fruitful literatures on physiological effects of betel nut, very few studies focusing on the behavioral measures of betel nut chewing effects were reported. In addition to that, results of these behavioral studies are mixed (e.g., Chu, 1994b, Stricherz & Pratt, 1976; Wyatt, 1996). Stricherz and Pratt employed a simple reaction time task and found a lengthened reaction time (RT) within the initial five minutes of the ingestion of a betel nut. Chu investigated betel nut effects on both simple and choice RT tasks for the habitual betel nut chewers. Participants performed RT tasks before and during betel nut chewing. Only the choice RT was found to be shorter during the betel nut chewing than that before chewing. Wyatt investigated betel nut chewing effects on habitual chewers' performances on a variety of behavioral and physiological measures (the choice RT, eye-hand coordination, digit span, pulse rate and blood pressure). The pulse rate was the only measure reported to have increased after chewing betel nut.

In the current study, we do not intend to disentangle the mixed results of betel nut effects on behavioral measures. We focused on whether betel nut chewing could improve visual attention which deteriorated after sleep deprivation. To our knowledge, no studies have provided behavioral data on the refreshment effect of betel nut chewing under sleep deprivation. One of the important indexes of visual attention is the useful field of view (UFOV). The UFOV refers to a spatial area that is functional or useful for the ongoing task(s) (Sanders, 1970). Attentional resources are allocated to this spatial area in order to process the incoming information. Any stimuli within the UFOV would receive further processing; however, any stimuli falling outside of the UFOV would receive only basic preattentive processing (e.g., physical properties e.g. color and texture). That is, when the size of the UFOV shrinks, fewer stimuli within the UFOV are processed further.

Measures of the UFOV typically involve three well-documented components: speed of identifying a central target alone (hereafter *stimulus identification*), dividing attention between central and peripheral targets presented simultaneously (hereafter *divided attention*), and localization of a peripheral target embedded in distractors while identifying a central target (hereafter *selective attention*). The size of the UFOV varies across situations. The size of the UFOV is decreased by the processing of the central target (Ball, Beard, Miller & Roenker, 1987; Leibowitz & Appelle, 1969). Moreover, longer processing time for identifying a central target (e.g., identify a conjunction of color and shape) indicates an even smaller UFOV size. When the central task demand increases (Chan & Courtney, 1993, 1994; Sekuler & Ball, 1986; William, 1982), a peripheral target localization or detection is impaired, indicating a contracted UFOV size. The UFOV size deteriorates when the peripheral target is embedded in the background distractors (Drury & Clement, 1978; Scialfa, Kline, & Layman, 1987; Sekuler & Ball, 1986). Furthermore, when the similarity of a peripheral target and the background distractors increases, the size of UFOV is reduced even more (Bergen & Julesz, 1983; Treisman & Gelade, 1980).

The size of the UFOV also varies across individuals. Individuals with more impaired components of the UFOV (i.e., stimulus identification, divided attention and selective attention) suffer from more reduction of the UFOV size (Ball & Owsley, 1992). Many have shown that sleep deprivation reduces the components that determine the UFOV size (e.g., Pilcher & Huffcutt, 1996; Rogé, Pébayle, Hannachi & Muzet, 2003; Williamson & Feyer, 2000). Sleep deprivation decreases participant's ability to identify a critical signal in the central visual field (Williamson & Feyer, 2000). In addition, the divided attention task was impaired and reached levels equivalent to the maximum alcohol dose given to participants (Williamson & Feyer, 2000). Pilcher and Huffcutt (1996) reported a meta-analysis of 143 study coefficients and a total sample size of 1932 and suggested that sleep deprivation strongly reduces cognitive and motor functions.

Can betel nut chewing “refresh” the UFOV reduced size caused by sleep deprivation? Physiological studies have reported that the ingredients of betel nuts are able to increase stamina and alertness for the chewers (e.g., Chu, 2001). We hypothesize that under sleep deprivation condition, betel nut chewing can broaden the UFOV size measured in terms of the three well-developed components (stimulus identification, divided attention and selective attention). Further, such facilitation only occurs to the habitual betel nut chewers, rather than the non-chewers.

Experiment 1

In the current experiment, we tested whether betel nut chewing facilitates the UFOV size for the betel nut chewers with sleep deprivation.

Participants

Sixteen current betel nut chewers (one female) (mean age = 35 years old, SD = 10 years, range = 20-50 years old) participated in this experiment. Five participants reported at least one withdrawal symptom when they did not chew or when they reduced the amount of betel nuts. All participants had a low level of drowsiness (scores < 11) in daily life on the Epworth sleepiness scale (ESS; Johns, 1991, 1992). All participants were morning (two participants; scores between 59 and 86) or intermediate people (fourteen participants with one female; scores between 42 and 58) types on the Morning-Evening Questionnaire (MEQ; Horne & Ostberg, 1976). Average months of chewing betel nut were 46 (SD = 46, range = 10 - 120). Average days per week of chewing were 5 (SD = 2, range = 2 - 7). Average number of betel nuts chewed per day is 22 (SD = 15, range = 3 - 50).

Each participant has normal or corrected-to-normal vision. All had had a normal night’s sleep before the experiment. They had not used betel nut or any food or drink with alcohol or caffeine during the night in the laboratory before the UFOV test. None of them work on night shifts.

Apparatus

We used an IBM-compatible PC with a 17 inch touch screen CRT desktop monitor (refresh rate = 60 Hz). The UFOV was assessed by the UFOV software (Visual Awareness, Inc., Birmingham, AL), consisting of three subtests that measure the stimulus identification (Subtest 1), divided attention (Subtest 2) and selective attention (Subtest 3) respectively.

Briefly, in Subtest 1, participants were required to identify a single target among various presentation durations which appeared at the center of the monitor. This target was a silhouette of either a car or a truck. In Subtest 2, in addition to identifying the central target as Subtest 1, participants needed to detect a simultaneously presented peripheral target, always a silhouette of a car. This peripheral target appears randomly at one of eight different peripheral locations along eight radial spokes (4 cardinal and 4 oblique). The tasks in Subtest 3 are the same as those in Subtest 2 (i.e., central target identification and peripheral target detection tasks), however the peripheral target is embedded in 47 distractors (upside-down outlined triangles).

The UFOV test is not a RT test; rather, it is an accuracy test. For each subtest, the UFOV software adjusts the length of stimulus presentation in milliseconds if needed. The procedure of adjusting the perceptual threshold is continued until a stable estimate of 75% correct is calculated. Scores from the UFOV software are expressed in terms of stimulus presentation time. Longer stimulus presentation time (i.e., stimulus is shown on the screen for longer period of time for correct responses) indicate a more contracted UFOV size.

Design and Procedure

Each participant underwent two conditions of experiments (chewing gum and betel nut conditions), counterbalanced across participants. Half of the participants (one female) took part in the chewing gum condition first, and the remaining half participants took part in the betel nut condition first. The chewing gum condition was adopted in order to have a control for the effect of mere chewing. These two conditions were separated by about one week. The laboratory purchased the betel nuts and chewing gums so that all the participants chewed the same type of betel nuts and chewing gum.

In both the chewing gum and betel nut conditions, participants needed to stay awake all night in the company of the experimenter. Each participant arrived at the laboratory at 22h00, the night before the UFOV test. Participants could carry out quiet activities. After participants arrived at the laboratory, they needed to fill the Verran and Snyder-Halpern sleep scale (VSS; Simpson, Lee & Cameron, 1996; Snyder-Halpern & Verran, 1987) in order to evaluate their sleep quality the night before the experiment. In order to evaluate participants' sleepiness degree over night, the Stanford sleepiness scale (SSS; Hoddes, Zarcone, Smythe, Phillips, & Dement, 1973) was administered every hour from 22h00 to 7h00. In the next morning at 7h00, each participant chewed either the betel nut or chewing gum before the UFOV test. In either the betel nut or chewing gum condition, participants chewed one material (betel nut or chewing gum) for three minutes and then spit it out before they began the UFOV test. The UFOV test was administered in a dim room where each participant leaned his/her chin on the chin rest with a viewing distance of 50 cm from the monitor. Participants responded to the target by pressing the stimulus icon displayed on the touch monitor.

Results and Discussion

The VSS scores in both the chewing gum condition and betel nut condition were not significantly different (mean score = 94, $p = .978$) which indicated the same sleep qualities as the night before the experiment. Regression analysis showed that SSS scores increased as the hours that participants stayed awake in the laboratory increased in both conditions (in chewing gum condition, $\beta = .718$; in betel nut condition, $\beta = .694$; both p's $< .0001$). In both conditions, the mean SSS score was 1 ("feeling active and vital; alert; wide awake") at 22h00 and was 5 ("fogginess; beginning to lose interest in remaining awake; slow down") at 7h00.

The mean stimulus presentation times are shown in Table 1. To assess the betel nut chewing effect on the UFOV under sleep deprivation, we compared the mean stimulus presentation times between the betel nut condition and chewing gum conditions on each of three UFOV subtests (Figure 1). There were no significant stimulus presentation time differences between the betel nut condition and chewing gum conditions in Subtest 1 ($p = .15$, $\eta_p^2 = .133$) and Subtest 2 ($p = .067$, $\eta_p^2 = .206$). In other words, betel nut chewing did not facilitate chewers' performance in stimulus identification and divided attention.

Insert Table 1 about here

Insert Figure 1 about here

In Subtest 3, the stimulus presentation time was significantly reduced in the betel nut condition in comparison to that in the gum chewing condition ($t(15)= 2.27$, $p < .05$, $\eta_p^2 = .255$), indicating that betel nut chewing could facilitate selective attention. When participants chewed betel nut, they could quickly detect the peripheral target embedded in the distractors while identifying the central target. In other words, chewing betel nut can broaden the UFOV size to some extent and be sufficient enough so that they can detect the peripheral target efficiently.

Further, we examined whether habitual chewers with and without self-reported withdrawal symptoms performed differently on the UFOV subtests. For the habitual chewers without withdrawal symptoms (eleven participants), there were no significant stimulus presentation time differences between the betel nut and chewing gum conditions in all subtests (all p's $> .2$; Subtest 1: $\eta_p^2 = .130$; Subtest 2: $\eta_p^2 = .102$; Subtest 3: $\eta_p^2 = .133$). For the habitual chewers who reported withdrawal symptoms (five participants), the stimulus presentation time differences between the betel nut and chewing gum conditions were significant in Subtest 3 ($p < .05$, $\eta_p^2 = .766$) and marginally significant in Subtest 2 ($p = .057$, $\eta_p^2 = .638$). No such presentation time difference was observed in Subtest 1 ($p > .2$, $\eta_p^2 = .355$). To conclude, the betel nut chewing effect on the UFOV size was not homogeneously effective on the habitual chewers. It appears that the effect of betel nut chewing is more effective on the habitual chewers who are likely to be dependent on the betel nut physically and/or psychologically.

In next experiment, we tested whether betel nut chewing could affect the UFOV under sleep deprivation conditions for the non-chewers.

Experiment 2

Participants

Ten non-chewers (three females) (average age = 38 years old, SD = 14 years, range =

22 – 56 years old) participated this experiment. Half of the participants (three females) took part in the chewing gum condition first, and the remaining half participants took part in the betel nut condition first. All participants lacked drowsiness on ESS and were morning (three participants) or intermediate people (seven participants with three females) types on the MEQ. None of them had ever chewed betel nuts. Each participant had normal or corrected-to-normal vision. They had had a normal night's sleep before the experiment. They had not used betel nut or any food or drink with alcohol or caffeine during the night in the laboratory before the UFOV test. None of them work on night shifts.

Apparatus, Design and Procedure

Same as Experiment 1

Results and Discussion

The VSS score in betel nut condition was larger than that in chewing gum condition (mean score in betel nut condition = 102; mean score in chewing gum condition = 81, $p < .05$), indicating that the sleep qualities the night before the experiment in betel nut condition was better. Regression analysis showed that SSS increased as the hours that participants stayed awake in the laboratory increased in both conditions (in chewing gum condition, β= .745; in betel nut condition, β= .691; both p's < .0001). In betel nut condition, the mean SSS score was 1 ("feeling active and vital; alert; wide awake") at 22h00 and was 5 ("fogginess; beginning to lose interest in remaining awake; slow down") at 7h00. In chewing gum condition, the mean SSS score was 2 ("functioning at a high level, but not at peak; able to concentrate") at 22h00 and was 6 ("sleepiness; prefer to be lying down; fighting sleep; woozy") at 7h00.

The mean stimulus presentation times are shown in Table 2. We compared the mean stimulus presentation times between the betel nut condition and chewing gum conditions on the UFOV subtests where the VSS score was controlled by considering it as a covariate in the analysis. In all three subtests, the mean stimulus presentation times in the betel nut condition and chewing gum conditions were comparable (all p's > .3). That is, for non-chewers, betel nut chewing has little effects on the UFOV under sleep deprivation.

Insert Table 2 about here

General Discussion

We examined whether betel nut chewing could influence the UFOV size under sleep deprivation condition for both habitual chewers and non-chewers. Our results indicate that betel nut chewing could broaden the UFOV size for the habitual chewers, but not for the non-chewers.

The change of the UFOV size in the current study is better characterized by more successful inhibition of surrounding distractor interference (i.e., selective attention), rather than the more efficient processing of central target (i.e., stimulus identification) or of dividing attention from the single peripheral target (i.e., divided attention). In other words, the UFOV appeared to be broadened to some extent which was sufficient in inhibiting the peripheral distractors efficiently (Bergen & Julesz, 1983; Drury & Clement, 1978; Scialfa, Kline, & Layman, 1987; Sekuler & Ball, 1986; Treisman & Gelade, 1980). Although the effect of betel nut chewing on the stimulus identification and divided attention did not reach a significant level, our data showed better performances on both tests for habitual chewers when they chew betel nuts. That is, in Experiment 1, the stimulus presentation times in Subtests 1 and 2 were shorter in the betel nut condition than in the chewing gum condition, although not reaching a significant level. In the future, other well-developed tasks (e.g., rapid serial visual presentation paradigm, e.g., Raymond, Shapiro, & Arnell (1992)) might be adopted for further study into how betel nut chewing affects visual information processing.

Intriguingly, the betel nut chewing effect was more effective on the habitual chewers reporting withdrawal symptoms, more likely to be dependent on the betel nut physically and/or psychologically. That is, these habitual chewers performed better on the task requiring them to selectively attend to the peripheral target located among distractors. Some possibilities could account for the performance difference between habitual chewers with and without withdrawal symptoms. First, the expectancy effect of betel nut chewing may be larger in the chewers reporting withdrawal symptoms. In Taiwan, it is thought to be common sense that chewing betel nut has a refreshing effect. Possibly, the chewers with withdrawal symptoms are more anticipative of betel nut's refreshment effect, thus causing better performance while chewing betel nut. The current study is unable to discriminate whether the betel nut chewing effect is attributed to the physiological effect only (e.g., Hwang, Wang, & Kao, 1993; Hwang, Wang, Sheu, & Kao, 1992), expectancy effect only (e.g., Hull & Bond, 1986), or both. It is of importance to include a placebo control to examine how physiological effect alone, expectancy effect alone or their interaction influence on habitual chewers' or non-chewers' behavior. Second, after a short-term deprivation of betel nut (at least 9 hours), the performance of the habitual chewers reporting withdrawal symptoms may become enhanced when they start chewing betel nut. Studies from habitual smokers have shown a decrease in several perception and cognition tasks (e.g., Bell, Taylor, Singleton, Henningfield, & Heishman, 1999; Gross, Jarvik, & Rosenblatt, 1993); however, smokers abstinent for a brief period (at least 13 hours) demonstrated an enhanced inhibition ability of interference in Stroop task after smoking a single cigarette (e.g., Domier, et. al., 2007). The enhanced inhibition gained from betel nut chewing after a brief abstinence has important implications on the effectiveness of the betel nut abstinence programs.

The underlying mechanisms of performance difference for habitual chewers with or without self-reported withdrawal symptoms may be qualitatively different. When the chewers reporting withdrawal symptoms lack access to betel nut for a period of time, they may perform several perceptual and cognitive functions at a below average level. Once these chewers chew betel nuts, their performances are raised to an average level. In other words, the betel nut does not really "refresh" the chewers with withdrawal symptoms, but does "restore" them to their average level. On the other hand, when the chewers do not report withdrawal symptoms from chewing betel nut, their performances are likely to be elevated to the above-average level. In addition, because the effect of betel nut chewing is more effective on the chewers reporting withdrawal symptoms, the degree of performance elevation in the chewers not reporting withdrawal symptoms may be less significant.

For the non-chewers in Experiment 2, effect of betel nut chewing on the UFOV is negligible. Previous surveys have shown that the initial feelings of chewing betel nut are dizziness, hot sensations, and palpitation (Chu & Chang, 1994). Such uncomfortable feelings may result from an increase in systolic blood pressure after chewing betel nut but only for non-chewers, rather than habitual chewers (Chu, 1993). It is possible that the selective effect of betel nut chewing on blood pressure for non-chewers and habitual chewers results in different performances in both groups. Future study should examine the possible link between online physiological and behavioral measures.

In conclusion, sleep deprivation and, betel nut chewing could broaden the UFOV size sufficiently enough to reduce the interference from the surrounding distractors. However, such effect was found to occur only in the habitual chewers, especially for those reporting withdrawal symptoms. Many have shown that chewing huge amounts of betel nuts could result in serious health problems such as oral cavity cancer. Thus, for the people working nights, chewing betel nut is not the best way to prevent fatigue; other alternatives should be considered.

參考文獻

Adams, J.A., & Boulter, L.R. (1962). An evaluation of the activationist hypothesis of human vigilance. Journal of Experimental Psychology, 64, 495-504.

Ball, K.K., Beard, B.L., Miller, R.L., & Roenker, D.L. (1987). Mapping the useful field of view as a function of age. Gerontologist, 27, 166A.

Ball, K.K. & Owsley, C. (1992). The useful field of view test: A new technique for evaluating age-related declines in visual function. Journal of the American Optometric Association, 64, 71-79.

Bell, S.L., Taylor, R.C., Singleton, E.G., Henningfield, J.E., & Heishman, S.J. (1999). Smoking after nicotine deprivation enhances cognitive performance and decreases tobacco craving in drug abusers. Nicotine and Tobacco Research, 1, 45-52.

Bergen, J., & Julesz, B. (1983). Parallel versus serial processing in rapid pattern discrimination. Nature, 303, 696-698.

Cawte, J. (1985). Psychoactive substances of the South Seas: Betel, kava and pituri. Australian and New Zealand Journal of Psychiatry, 19, 83-87.

Chan, H.S., & Courtney, A.J. (1993). Effects of cognitive foveal load on a peripheral single-target detection task. Perceptual and Motor Skills, 77, 515-533.

Chu, N.S. (1993). Cardiovascular responses to betel chewing. Journal of Formosa Medical Association, 92, 835-837.

Chu, N.S. (1994a). Effects of betel chewing on electroencephalographic activity: Spectral analysis and topographic mapping. Journal of Formosa Medical Association, 93, 167-169.

Chu, N.S. (1994b). Effects of betel nut chewing on performance reaction time. Journal of Formosa Medical Association, 93, 343-345.

Chu, N.S. (2001). Effects of betel chewing on the central and autonomic nervous system. Journal of Biomedical Science, 8, 229-236.

Chu, N.S., & Chang, C.F. (1994). On the culture of betel chewing in Taiwan. Evergreen Monthly, 130, 78-81.

Directorate-General of Budget, Accounting and Statistics (1999). Survey on areca use in Taiwan. Taipei, Taiwan.

Domier, C.P., Monterosso, J.R., Brody, A.L., Simon , S.L., Mendrek, A., Olmstead, R., Jarvik, M.E., Cohen, M.S., & London, E.D. (2007). Effects of cigarette smoking and abstinence on Stroop task performance. Psychopharmacology, 195, 1-9.

Drury, C., & Clement, M. (1978). The effect of area, density, and number of background characters in visual search. Human Factors, 20, 597-602.

Gross, T.M., Jarvik, U.E., & Rosenblatt, M.R. (1993). Nicotine abstinence produces content-specific Stroop interference. Psychopharmacology, 110, 333-336.

Haubrich, D.R., & Watson, D.R. (1972). Effects of pilocarpine or arecoline administration on acetylcholine levels and serotonin turnover in rat brain. Journal of Pharmacology and Experimental Therapeutics, 181, 19-27.

Hoddes, E., Zarcone, V., Smythe, H., Phillips, R., & Dement, W.C. (1973). Quantification of sleepiness: a new approach. Psychophysiology, 10, 431-436.

Horne, J.A. & Ostberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. International Journal of Chronobiology, 4, 97-110.

Hull, J. G., & Bond, C. F. (1986). Social and behavioral consequences of alcohol consumption and expectancy: A meta-analysis. Psychological Bulletin, 99, 347-360.

Hwang, L.S., Wang, C. K., & Kao, L.S. (1993). Neuronal activity modulating components in betel quid. Symposium on Betel Quid Chewing and Its Health Effect, Kaohsiung, Taiwan.

Johns, M.W. (1991). A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. Sleep, 14, 540-545.

Johns, M.W. (1992). Reliability and factor analysis of the Epworth Sleepiness Scale. Sleep, 15, 376-381.

Leibowitz, H., & Appelle, S. (1969). The effect of a central task on luminance thresholds for peripherally presented stimulus. Human Factors, 11, 387-392.

Miró, E., Cano-Lozano, M.C., & Buela-Casal, G. (2002). Electrodermal activity during total sleep deprivation and its relationship with other activation and performance measures. Journal of Sleep Research, 11, 105-112.

Molinengo, L. Fundaro, A.M., & Cassone, M.C. (1988). Action of a chronic arecoline administration on mouse motility and on acetylcholine concentrations in the CNS. Journal of Pharmacy and Pharmacology, 40, 821-822.

Nieschulz, O. (1967). Pharmacology of the active principle of betel (I) central effects of arecoline. Arzneimmttel-Forschung, 17, 1292-1295.

Ogawa, Y., Kanbayashi, T., Saito, Y., Takahashi, Y., Kitajima, T., Takahashi, K., et al., (2003). Total sleep deprivation elevates blood pressure through arterial baroreflex resetting: a study with microneurographic technique. Sleep, 26, 986-989.

Pilcher, J.J. & Huffcutt, A.I. (1996). Effects of sleep deprivation on performance: A meta-analysis. Sleep, 19, 318-326.

Raymond, J.E., Shapiro, K.L., & Arnell, K.M. (1992). Temporary suppression of visual processing in an RSVP task: an attentional blink? Journal of Experimental Psychology: Human perception and performance, 18, 849-860.

Rinaldi, F., & Himwich H.E. (1955). Alerting responses and actions of atropine and cholinergic drugs. Archives of Neurology and Psychiatry, 73, 387-395.

Rogé, J., Pébayle, T., Hannachi, S.E., & Muzet, A. (2003). Effect of sleep deprivation and driving duration on the useful visual field in younger and older subjects during simulator driving. Vision Research, 43, 1465-1472.

Sanders, A.F. (1970). Some aspects of the selective process in the functional field of view. Ergonomics, 13, 101-117.

Scialfa, C., Kline, D., & Layman, B. (1987). Age differences on target identification as a function of retinal location and noise level: Examination of the useful field view. Psychology and Aging, 2, 14-19.

Sekuler, A.B., & Ball, K. (1986). Visual localization: Age and practice. Journal of the Optical Society of America A, 3, 864-867.

Sekuler, A.B., Bennett, P.J., & Mamelak, M. (2000). Effects of aging on the useful field of view. Experimental Aging Research, 26, 103-120.

Simpson, T., Lee, E. R., & Cameron, C. (1996). Relationships among sleep dimensions and factors that impair sleep after cardiac surgery. Research in Nursing & Health. 19, 213-223.

Snyder-Halpern, R., & Verran, J. A. (1987). Instrumentation to describe subjective sleep characteristics in healthy subjects. Research in Nursing & Health, 10, 155-163.

Stricherz, M., & Pratt, P. (1976). Betel quid and reaction time. Pharmacology, Biochemistry, and Behaviour, 4, 627-628.

Treisman, A., & Gelade, G. (1980). A feature-integration theory of attention. Cognitive Psychology, 12, 97-136.

Wang, C.K. & Hwang, L.S. (1997). Effect of betel quid on catecholamine secretion from adrenal chromaffin cells. Proceedings of the National Science Council, ROC Part B: Life Science, 21, 129-136.

Williams, L.J. (1982). Cognitive load and the functional field of view. Human Factors, 24, 684-692.

Williamson, A.M. & Feyer, A. (2000). Moderate sleep deprivation produces impairments in cognitive ad motor performance equivalent to legally prescribed levels of alcohol intoxication. Occupational and Environmental Medicine, 57, 649-655.

Wyatt, T.A. (1996). Betel nut chewing and selected psychophysiological variables. Psychological Reports, 79, 451-463.

表

Table 1: Mean stimulus presentation time (in ms) of three UFOV subtests in betel nut and chewing gum conditions in Experiment 1. Standard errors are shown in the parenthesis.

			Betel nut	Chewing gum
All participants		Subtest 1	19 (2)	50 (22)
		Subtest 2	55 (22)	125 (41)
		Subtest 3	134 (21)	194 (35)
Withdrawal symptom	Yes	Subtest 1	17 (.07)	37 (13)
		Subtest 2	18 (.8)	129 (42)
		Subtest 3	117 (22)	208 (20)
	No	Subtest 1	20 (3)	56 (32)
		Subtest 2	71 (30)	123 (57)
		Subtest 3	142 (29)	187 (50)

Table 2: Mean stimulus presentation time (in ms) for betel nut and chewing gum conditions in three subtests of the UFOV test in Experiment 2. Standard errors are shown in the parenthesis.

	UFOV test		
	Subtest 1	Subtest 2	Subtest 3
Betel nut	23 (5)	74 (30)	194 (45)
Chewing gum	24 (6)	43 (15)	182 (38)

圖

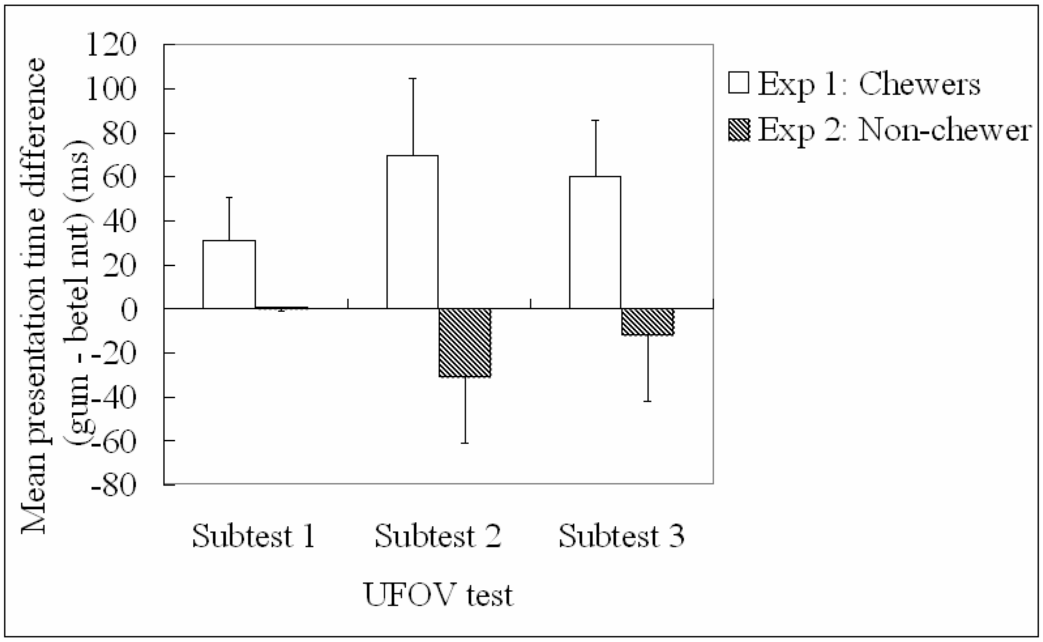

Figure 1: The mean stimulus presentation time difference between betel nut and chewing gum conditions (gum – betel nut) in three subtests of the UFOV test in Experiments 1 and 2. Error bars indicate the standard errors.

計畫成果自評

本研究已經依照計畫內容，完成三個實驗，已經達到預期目標。更進一步，計畫內容中的實驗二與實驗三已經寫成英文論文，投稿到 *Perception & Psychophysics*，已於最近收到審稿者意見，回函樂觀，編輯 Jeremy Wolfe 的意見節錄如下” I do hope that you will return to P&P with a stronger paper on this interesting topic. So, I would invite you to submit a revision if you feel that you can address the concerns raised by the reviewers and described in this letter.”。目前我們正在修改論文中，預計八月間可以將修改版投出。

本研究提供重要且缺乏的行為實證資料，來支持檳榔的提神效果（我們定義為有效視覺區的改變)。更進一步，我們發現有效視覺區的改變主要發生在習慣嚼食者，而非從未嚼食者。未來，我們希望能夠增加生理指標（例如血壓、心跳、皮膚電阻等）來客觀地量測嚼食檳榔所導致的生理改變以及其視覺注意力之改變（例如有效視覺區的改變等)。更宏觀地說，我們希望未來能夠探討嚼食檳榔對視覺注意力與視知覺各面向的影響。我們已經申請到 2008-2009 的國科會經費（嚼食檳榔對視覺訊息處理之影響，97-2410-H-040-010-），希望能更檢驗重要但沒有行為實證資料的議題。

參加 2008 年 International Congress of Psychology (ICP) 的三篇摘要

(「嚼食檳榔對睡眠剝奪者之有效視覺區之影響」已投稿到 2008 中華心理學年會，目前正在審稿中)

Anxiety and perceptual load modulate the degree of attentional resources required to process emotional bimorphemic words

Nien-Ying Yang, Ming-Chou Ho, Jia-Chi Pan, Hui-Tzu Chen, Yi-Chen Chu, Yi-Ling Liu, Shuo-Heng Li

Department of Psychology, Chung-Shan Medical University, Taichung, Taiwan

Whether the threat stimuli (e.g., fearful face) drives attention involuntarily without controlled attention is a long debate. We suggest that threat detection requires controlled attention and test two hypothesis. First, perceptual load (e.g., Lavie, 1995) could modulate the detection of the threat stimuli (Chinese bimorphemic words). Namely the performance of threat detection is better in low load condition than in high load condition. Second, load-modulated threat detection is less effective for individuals with high level of anxiety. In conclusion, this study shows that the selection of the threat stimuli requires controlled attention and anxiety modulates the detection of the threat stimuli.

Can attention shift between objects in a discrete mode?

Shuo-Heng Li, Ming-Chou Ho, Chen-Chia Hsu, Chung-Yang Kuo, Nien-Ying Yang, Hsiao-Heng Chen

Department of Psychology, Chung-Shan Medical University, Taichung, Taiwan

As early debate regarding the mode of attentional shift in space (i.e., analog vs. discrete), the mode of attentional shift between objects requires further investigation. We employed the same/different judgment task similar to Kwak, Dagenbach and Egeth (1991) to examine the mode debate. Participants judged two letters (TT, LL, or TL) that appear briefly on two of eight outlined squares with three different distances between these two squares. Result showed comparable judgment times across three distances (a discrete mode). Further, a horse racing model ensured a serial process in such task. This study has critical implications in object-based attention literature.

Object-based attention: a between-object cost or within-object benefit?

Ming-Chou Ho, Chi-Chung Hou, Ya-Ling Shin, Wan-Ru Huang, Hui-Tzu Kuo

Department of Psychology, Chung-Shan Medical University, Taichung, Taiwan

Object-based attention (OBA) is attributed to a between-object cost or

within-object benefit. Atchley and Ho (2001) added a spatial baseline to reaction time (RT)-based OBA paradigm and found that OBA is best described in terms of the cost to switch attention between objects. The accuracy (ACC) and RT measures reflect qualitatively different aspects of processing, attentional allocation vs. decision process. By employing the ACC measure and the similar design to Atchley and Ho, we found similar patterns of attentional allocation on a display when objects were present or absent. This result could shed some light on the debate of cost/benefit issue.

出席國際學術會議心得報告

第 29 屆國際心理學研討會（XXIX International Congress of Psychology）於 7 月 20 至 25 在柏林舉辦。此研討會為每四年舉辦一次，上次（2004）是在北京舉辦，下次（2012）將在南非舉辦。此研討會內容涵蓋心理學各個領域，從生理、社會、知覺，一直到諮商、臨床等。此研討會邀請超過 80 個演講者，以及超過 200 個 symposia，除了以上，尚有多個口頭以及海報場次，讓人目不暇給。歐洲為心理學發源地，尤其德國萊比錫大學（距柏林約一小時車程）更是實驗心理學之父 Wundt 的實驗室所在地，使得研討會在德國召開，更是意義非凡。

由於研討會資訊繁多，我主要挑選與我近來研究主軸相關的研究，來進一步瞭解，我的研究主軸主要在選擇性注意力、情緒與注意力以及短期記憶與注意力。短期記憶與注意力有十分密切的關係，許多研究發現兩者會彼此影響。短期記憶的容量也被視為智力高低的指標之一。由於個別差異為實驗心理學研究近年來的趨勢之一，研究記憶與注意力多年的大師 Vogel 檢驗個別的視覺短期記憶與注意力的關係。Vogel 實驗室以 ERP 技術來測量物體記憶表徵及其儲存容量（其結果與過去的行為研究一致），且此項技術對於視覺短期記憶的個別差異十分敏感。他們發現需被記憶的物體出現後大約 200ms，在與物體異側的電極記錄到極大的負波，且此負波在記憶維持時（retention）一直持續著，且此負波受到物體數量影響，在物體數量為 3~4 時，達到頂峰。Vogel 利用上述的 ERP 技術，檢驗短期記憶與注意力的關係。他們發現低記憶容量的參與者在需要注意力的作業上，表現得比高記憶容量的參與者差。關於視覺短期記憶的腦造影研究（特別是 ERP），也請參看加拿大學者 Rene Marois 以及 Pierre Jolicoeur 的研究。

威脅刺激會抓取（capture）視覺注意力已經是文獻中多次被驗證的現象，然而此種注意力抓取現象是否是自動化歷程，則有許多爭論。研究者 Ernst 檢驗威脅刺激吸引注意力的歷程，他們操弄遮蔽物與否，以及情緒刺激呈現時間，發現情緒刺激的確影響處理歷程，然而此影響並非自動化，也非無意識的歷程。此外他也進一步檢驗是否注意力偏誤減低（attentional bias reduction）可以降低注意力被威脅刺激吸引的機會，此議題之重要性在於許多研究發現焦慮症者容易被威脅刺激吸引，且此吸引會更加重其焦慮，而注意力偏誤減低被發現可以降低情緒反應（emotional reactivity）以及焦慮，所以值得加以探討。Ernst 發現注意力偏誤減低之法只影響威脅刺激歷程的晚期階段，而非早期階段。

視覺注意力與行動（action）的關係已經被眾多文獻所探討，主要的議題包含知覺表徵與行動表徵之間的關係，以及這些表徵與實際行動的關係。學者 Jane Riddoch 發現當同時呈現兩個在行動上有相關連的物體時，extinction 腦傷患者（無法辨認兩個同時出現的物體），相較於行動上無關連的物體，可以辨認這兩個關連物體。這種行動關連優勢（action relation advantage）會因為相關連的物體上下顛倒而減少，此外也會因為物體大小改變而減少。Riddoch 認為行動關連優勢是奠基於較高階的物體群聚（object grouping），物體在空間上的競爭（例如 biased competition）會因為這兩個物體在行動上有關連，而導致空間競爭減

少，所以使得患有 extinction 腦傷患者可以辨認這兩個物體。此外 covert attention 過去被認為與 ventral pathway 的知覺訊號增強有關，最近學者 Todd Handy 發現 covert attention 也跟行動相關歷程有關，而此歷程主要在 dorsal pathway。Handy 利用 ERP 發現視空間注意力（visualspatial attention）能夠被可抓取的物體快速攫取。此外他也發現視空間注意力能夠快速地被行動中刺激物的 heading point 所擷取。

出席國際學術會議心得報告

計畫編號	96-2413-H-040-001-
計畫名稱	嚼食檳榔對睡眠剝奪者之有效視覺區之影響
出國人員姓名 服務機關及職稱	何明洲 中山醫學大學心理系
會議時間地點	7 月 20 至 25 日柏林
會議名稱	XXIX International Congress of Psychology
發表論文題目	1. Anxiety and perceptual load modulate the degree of attentional resources required to process emotional bimorphemic words 2. Can attention shift between objects in a discrete mode? 3. Object-based attention: a between-object cost or within-object benefit?

一、參加會議經過

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二、與會心得

由於研討會資訊繁多，我主要挑選與我近來研究主軸相關的研究，來進一步瞭解，我的研究主軸主要在選擇性注意力、情緒與注意力以及短期記憶與注意力。短期記憶與注意力有十分密切的關係，許多研究發現兩者會彼此影響。短期記憶的容量也被視為智力高低的指標之一。由於個別差異為實驗心理學研究近年來的

趨勢之一，研究記憶與注意力多年的大師 Vogel 檢驗個別的視覺短期記憶與注意力的關係。Vogel 實驗室以 ERP 技術來測量物體記憶表徵及其儲存容量（其結果與過去的行為研究一致），且此項技術對於視覺短期記憶的個別差異十分敏感。他們發現需被記憶的物體出現後大約 200ms，在與物體異側的電極記錄到極大的負波，且此負波在記憶維持時（retention）一直持續著，且此負波受到物體數量影響，在物體數量為 3~4 時，達到頂峰。Vogel 利用上述的 ERP 技術，檢驗短期記憶與注意力的關係。他們發現低記憶容量的參與者在需要注意力的作業上，表現得比高記憶容量的參與者差。關於視覺短期記憶的腦造影研究（特別是 ERP），也請參看加拿大學者 Rene Marois 以及 Pierre Jolicoeur 的研究。

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