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# Ability of Managing and Regulating Emotion and Spacing Effects in Incidental Memory

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**Abstract**

Participants were presented targets on two occasions, and each time they were asked to generate a past episodes associated with the targets and to rate its degree of pleasantness of it in the orienting task, followed by unexpected recall tests. The difference of recall perfomance between massed and spaced presentation was negatively correlated with the score of participants' ability of managing and regulationg emotion (MR). Specifically, the spacing effect was big for participants with low MR ability and small for those with high MR ability. These results suggest that the level of MR ability was a factor suppressing the activation of emotional encodings elicited by targets.

**Key Words** : *emotional intelligence, managing and regulating emotion, incidental memory*

When each target was presented twice, the number of interpolated items between the two presentations of the target was critical to the recall performance. The spaced presentation that had interpolated items among repeated presentations led to a better recall rate than the massed presentation with no interpolated items. This advantage of the spaced presentation over the massed presentation is called "spacing effect". There have been a number of previous studies replicated the spacing effect in the memory of verbal materials; such as words (Kitao, 1983), text (Dempster, 1986), phrases (Glover & Corkill, 1987), and sentences (Rothcoff & Coke, 1966; Toyota & Kikuchi, 2004, 2005). Kitao (2002) has also reviewed many studies on encoding variability hypothesis (Martin,1968; Madigan, 1969; Gartman & Johnson, 1972; Glenberg, 1977; Kitao, 1983), which stating that spaced presentation facilitates encoding variability between the first presentation and the second presentation whereas the massed presentation did not. Although it is uncertain whether the encoding variability hypothesis is the most valid way to explain spacing effect (Kitao, 2002), we do know that spaced presentation facilitates the richness of the encoding (Toyota & Kikuchi, 2004, 2005).

Context has been used to produce many types of encodings. Warren, Chattin, Thompson, & Tomsky(1983) proposed the concept of autobiographical elaboration, which is an encoding of personal episodes on specific targets. Toyota (1997) compared the effect of autobiographical elaboration with that of semantic elaboration, which is the encoding of semantic information on incidental free recall. He found that autobiographical elaboration was more effective than semantic elaboration in incidental free recall. In another study, the effectiveness of autobiographical elaboration was determined by the emotional encoding of personal episodes on specific targets (Toyota & Kono, 2006). Specifically, targets associated with personal episodes that createed an emotional reaction (either pleasant or unpleasant), were recalled more often than those that did not create an emotional reaction.

Emotional encoding has recently become an important topic in memory research. In particular, many researches have reported that emotionally arousing events are recalled more often than neutral events. Talmi, Schimmack, Paterson, and Moscovitch (2007) termed this phenomenon emotionally enhanced memory (EEM). EEM has been explored in a number of studies using emotional words (D'Argrembeau & Ver der Linden, 2004; Hamann, 2001; Ken-singer, Brierley, Medford, Growdon, & Corkin, 2002; Nagae & Moscovitch, 2002), pictures (Bradley, Greenwald, Petry, & Lang, 1992) and stories (Cahill & McGaugh, 1995). Toyota(2011) examined the

relationship between emotional encoding and incidental recall, in a study in which emotional intelligence (EI) was used as an index of emotional encoding. EI is considered the ability to adequately process emotions and has been a topic of interest (Law, Wong, & Song, 2004). Salovey and Mayer (1990) suggested that EI was "the subset of social intelligence that involves the ability to monitor one's own and others' feelings and emotions, to discriminate among them, and to use this information to guide one's thinking and actions"(p.189). This definition has been adopted by many other researches (e.g. Davies, Stankov, & Roberts, 1998; Mayer, Caruso, & Salovey, 2000), albeit with minor alterations (Toyota, 2008).

Takšić (1998) developed the Emotional Intelligence Skills and Competence Questionnaire (ESCQ) , which was based on the definitions proposed by Salovey and Mayer (1990). The ESCQ has three subscales corresponding to three subabilities: the ability to express and label emotion (EL); the ability to perceive and understand emotion (PU); and the ability to manage and regulate emotion (MR). Toyota, Morita, and Takšić (2007) used the ESCQ as the basis for the Japanese version of the Emotional Intelligence Skills & Competence Questionnaire (J-ESCQ). Toyota (2011) used this scale as an index of EI, and regarded participants with high EI as individuals who could more effectively process or encode the emotion of an episode associated with a particular target than those with low EI. The results showed that participants with high EI recalled targets associated with pleasant, neutral and unpleasant episodes equally. However, participants with low EI recalled the targets with pleasant and unpleasant episodes more often than those with neutral ones. These results were interpreted as showing that EI determined the effectivenss of neutral episodes as retrieval cue for target words. However, Toyota (2011) has not addressed the important problem of which EI properties affect memory. Neshat-Doost, Dalgleish, and Golden (2008) using the Color Stroop task, found that self-regulation, which is a property of EI, has an effect on emotional-related autobiographical memory. In addition, Richards and Gross (2000, 2006) found that participants with a high expressive suppression, which is one activity related to emotional regulation, did not perform well in memory tasks. Taking these studies into consideration, it seems that MR might be a critical aspect for determining memory. Unfortunately, in Toyota (2011), a negative correlation between recall performance and MR score was not found. However, the spacing effect, namely the superiority of spaced presentation to massed presentation in recall performance, was not examined in that study.

According to the encoding variability hypothesis mentioned above, spaced presentation facilitates encoding variability between the first and the second presentations, whereas such encoding was not present in the massed presention. Namely, the richness of the encodings determined the recall performance in the repeated presentation of targets (Toyota & Kikuchi, 2004, 2005). Participants with high MR had a strong tendency to suppress emotions, suggesting that the emotional encodings associated with targets would be smaller for them than for participants with low MR. If suppressing emotions does indeed decrease the variability or richness of emotional encodings, it is predicted that the size of the spacing effects would be larger for participants with low MR than those with high MR. The purpose of the present study is to determine the validity of the above prediction.

## Method

### *Design*

A 2 x 2 design was used where the first factor was the level of MR (high and low), and the second factor (within-subjects) was the type of presentation (spaced vs. massed).

### *Participants*

Toyota (2011) used the J-ESCQ proposed by Toyota, et al. (2007) as a tool for selecting participants with high and low EI participants, and so I used it in the present study, as well. The participants were 111 undergraduates

**Table 1 Mean scores in subscales in J-ESCQ as a function of MR level**

| EI | Participants groups | | | | | |
|---|---|---|---|---|---|---|
| | Whole | | High MR | | Low MR | |
| Subscales | M | SD | M | SD | M | SD |
| MR | 24.70 | 5.05 | 30.78 | 3.12 | 24.21 | 3.02 |
| EL | 25.47 | 4.17 | 26.14 | 3.50 | 24.71 | 4.25 |
| PU | 28.11 | 9.97 | 24.92 | 3.76 | 25.71 | 4.28 |
| Total | 78.28 | 4.69 | 81.85 | 7.77 | 74.64 | 8.87 |

**Table 2 Targets (*kanji* words) for positive and negative word lists**

| Positive word list | | | | Negative word list | | | |
|---|---|---|---|---|---|---|---|
| 1 | 幸福 (happiness) | 8 | 昼寝 (forty winks) | 1 | 戦争 (war) | 8 | 毛虫 (caterpillar) |
| 2 | 休暇 (vacation) | 9 | 満足 (satisfaction) | 2 | 空腹 (hunger) | 9 | 苦痛 (pain) |
| 3 | 自然 (nature) | 10 | 旅行 (travel) | 3 | 軽蔑 (contempt) | 10 | 自殺 (suicide) |
| 4 | 勝利 (victory) | 11 | 愛情 (affection) | 4 | 試験 (examination) | 11 | 敗北 (defeat) |
| 5 | 親切 (kindness) | 12 | 希望 (hope) | 5 | 宿題 (homework) | 12 | 病気 (sickness) |
| 6 | 晴天 (fine weather) | 13 | 協力 (cooperation) | 6 | 束縛 (binding) | 13 | 腐敗 (decay) |
| 7 | 花火 (firework) | 14 | 太陽 (sun) | 7 | 満員 (being crowded) | 14 | 命令 (command) |

(52 males and 59 females), with a mean age of 18.91 years (range: 18.20 - 22.50). The J-ESCQ consisted of 24 items divided into three subscales: (1) PU (e. g., "I notice when somebody feels down."); (2) EL (e.g., "I am able to express my emotions well."); and (3) MR (e.g., "I try to keep up a good mood."). The participants were asked to rate on a 5-point scale ('never', 'seldom', 'occasionally', 'usually', and 'always') how often each of these statements applied to them. The mean scores of the three subscales in the J-ESCQ as a function of the level of EI (high MR and low MR) are shown in Table 1. I used a criterion of the mean±1SD of the J-ESCQ MR score to select two groups: a high MR group consisting of 7 males and 7 females, and a low MR group consisting of 7 males and 7 females. The mean age of these participants was 19.40 years (range: 18.2 - 22.30 ). The scores of each of the two groups are shown in the second and third entries of the table. The differences of scores between the high and low MR groups were clarified with t-tests using the J-ESCQ EL, PU and MR scores. These t-tests showed that the high MR group had a higher MR score than the low MR group ($t(26)=7.85$, $p<.001$), and that there were no differences between the two groups in terms of the EL($t=1.35$) or PU($t=-.71$) scores.

### *Materials*

The target words that were either positive (e.g., happiness) or negative (e.g., war), were selected from a normative set in a previous study (Hyodo, Takahashi, Suto, Yata, & Yasunaga, 2003). Table 2 lists all of the target words. Each target word was written in a Japanese Kanji character familiar to the participants. The words were divided into two lists: pleasant words and unpleasant words. In each list, 14 target words were presented twice, and two buffer slides were presented in the first and the last serial positions in the orienting list. The number of interpolated words was fixed at five for the spaced presentation, but there were no interpolated words in the massed presentation. Each target word was placed on its own page in a 30-pages booklet. Each participant was asked two orienting questions on each page. The first question was "Are there any episodes that you are reminded of by the above word?" and the second one was, "How does the episode that the word reminded you of make you feel?" The possible answers were "Yes" or "No" or the first question, and "1, 2, 3, 4, 5, or 6" for the second question a rating scale in which 1 indicates 'most unpleasant' and 6 indicates 'most pleasant'. For each list of target words, three different orders were constructed and counter-balanced.

### *Procedure*

The experiment was performed with the group of 28 participants under incidental memory conditions. First, both the high and low MR groups were told that the task was a pilot test to gather information about the Japanese language. The following experimental procedures were then used for both groups simultaneously.

*Orienting task* Each participant received a booklet, and the task was explained with an illustration of a booklet page displayed on a board at the front of the classroom. The participants were then given the following orienting instructions. "A familiar word is shown in the upper part of each page. There are two tasks on each page [pointing to the example on the white board]. The first task is to answer the question "Are there any episodes that you are reminded of by the word?" by circling 'Yes' or 'No'. Your second task is to answer the

question “How does the episode that the word reminds you of make you feel?” by rating it on a 6-point scale indicating the pleasantness. Participants were given 10 seconds per page to perform the task.

*Interpolated task* Following the orienting task, each participant was given an interpolated task for 3 minutes. A sheet of paper with Japanese words, printed in *hiragana*, was given to each participant, and the participant was then required to quickly circle as many of the nouns that contained more than three letters as they could.

*Free recall test* Following the interpolated task, the participants were required to recall, and write down as many of the targets as possible. Five minutes were allowed for this test.

## Results

Focus in the present study was in the different types of episodes (pleasant, neutral and unpleasant), so the ratings provided by each of the participants were grouped as follows. Episodes that were rated 1 or 2 were regarded as unpleasant episodes, those rated 3 or 4 as neutral, and those rated 5 or 6 as pleasant. All the participants remembered at least one episode associated with each target, but the number of episodes rated as unpleasant, neutral or pleasant differed for different lists and different participants. The mean numbers of all type of episodes are shown in the upper part of Table 3. Using these numbers, the percentage of targets correctly recalled were calculated. These percentages are shown in the middle part of Table 3 as a function of groups, the type of list, the type of presentation (spacing or massed) and the type of episodes (unpleasant, neutral or pleasant). These percentages of correct recall could not be analyzed all in one analysis of variance, due to the presence of blank cells. For example, none of the participants in the low MR group rated any targets in the pleasant list as 1 or 2.

**Table 3 Mean Number of Episodes and Percentages of Targets Recalled Correctly in Free Recall Test**

| | | Presentation | | | | | |
|---|---|---|---|---|---|---|---|
| | | Massed | | | Spaced | | |
| Groups | Type of episodes | Unpleasant 1·2 | Neutral 3·4 | Pleasant 5·6 | Unpleasant 1·2 | Neutral 3·4 | Pleasant 5·6 |
| Number of episodes | | | | | | | |
| High MR | Pleasant | | | | | | |
| | *M* | 0.44 | 1.67 | 4.89 | 0.22 | 1.17 | 5.61 |
| | *SD* | 0.50 | 1.15 | 1.29 | 0.42 | 1.13 | 1.39 |
| | Unpleasant | | | | | | |
| | *M* | 5.50 | 1.50 | 0.00 | 5.38 | 1.63 | 0.00 |
| | *SD* | 1.12 | 1.12 | 0.00 | 1.08 | 1.08 | 0.00 |
| Low MR | Pleasant | | | | | | |
| | *M* | 0.00 | 2.50 | 4.50 | 0.00 | 2.50 | 4.50 |
| | *SD* | 0.00 | 0.87 | 0.87 | 0.00 | 0.79 | 0.79 |
| | Unpleasant | | | | | | |
| | *M* | 5.50 | 1.41 | 0.09 | 5.68 | 1.32 | 0.00 |
| | *SD* | 1.58 | 1.64 | 0.29 | 1.01 | 1.01 | 0.00 |
| Recall of targets | | | | | | | |
| High MR | Pleasant | | | | | | |
| | *M* | .75 | .35 | .57 | 1.00 | .72 | .66 |
| | *SD* | .43 | .41 | .20 | 0.00 | .30 | .22 |
| | Unpleasant | | | | | | |
| | *M* | .47 | .50 | – | .84 | .96 | – |
| | *SD* | .10 | .41 | – | .12 | .06 | – |
| Low MR | Pleasant | | | | | | |
| | *M* | – | .50 | .33 | – | .81 | .71 |
| | *SD* | – | .50 | .16 | – | .19 | .18 |
| | Unpleasant | | | | | | |
| | *M* | .45 | .60 | 1.00 | .83 | .65 | – |
| | *SD* | .18 | .38 | 0.00 | .16 | .31 | – |
| Recall of targets effectively elaborated | | | | | | | |
| High MR | *M* | | .54 | | | .72 | |
| | *SD* | | .18 | | | .22 | |
| Low MR | *M* | | .40 | | | .79 | |
| | *SD* | | .18 | | | .18 | |

As the strong association between a target word and the rated pleasantness (or unpleasantness) of the episodes the target word conjured were critical to effective elaboration (Toyota, 1997), the targets rated 5 or 6 in the pleasant list and those rated 1 or 2 in the unpleasant list (i.e., targets that had a strong association with episodes) were assumed to be elaborated effectively. The percentages of targets correctly recalled in the above analyses are shown in the third entry in Table 3. The correlation between these recall performances and MR scores were calculated, and negative correlation was found (r= -.31). To clarify this relationship, a 2 (high vs. low MR group) x 2 (type of presentation) analysis of variance using inverse sine transformed scores showed that main effects of type of presentation (F1, 26= 30.86, p< .001, $\eta^2$ = .08) and the interac-tion between groups and type of presentation (F1, 26 = 3.89, p< .06, $\eta^2$ = .02) was significant.

Planned comparisons were performed for this interaction. The simple effect of the type of presentation was significant for the high MR group at the 5% level (F1, 26 = 6.42, p<.05), whereas for the low MR group this simple effect was significant at 0.1% level (F1, 26 = 28.34, p< .001). Additionally the simple effect of group was marginally significant in the massed presentation (F1, 52 = 2.88, p<.09), but not in the spaced presentation (F1, 52 = 1.02).

To compare the size of the spacing effect between the two groups, the difference of scores between the spaced and massed presentations was calculated and a t-test was performed on the scores. Results showed that the difference between the low MR group (M = .36) and the high MR group (M = .21) was not significant (t26 = 1.52).

## Discussion

The purpose of this study was to compare the size of the spacing effect between high and low MR groups in incidental memory. Although no significant difference was found, there was a marginally significant interaction between groups and type of presentation. As predicted, low MR led to a greater spacing effect than high MR. According to the encoding variability hypothesis (Martin,1968; Madigan, 1969; Gartman & Johnson, 1972; Glenberg, 1977; Kitao, 1983), the spaced presentation facilitated the encoding variability between the first presentation and the second presentation, whereas the massed presentation did not do such encoding. In this study, the participants were asked to rate the pleasantness of an episode elicited by each target, meaning that the participants would encode an emotion for each episode. The spaced presentation facilitates encoding variability for this emotional encoding between the first and second presentations. However, as the level of ability to managing and regulate emotion (MR) had a tendency to suppress the activation of emotional encoding elicited by each target, the participants in high MR group would have difficulty in activating such emotional encodings. The lower the activation in emotional encoding at the first presentation, the smaller the variability of emotional encoding at the second presentation. Therefore, the lower level of activation in emotional encoding in the high MR group led to a smaller spacing effect. In contrast, the participants in the low MR group could activate the emotional encoding at the first presentation, which resulted in a larger encoding variability of emotion after the second presentation.

Richards and Gross have previously (2000, 2006) indicated that participants with a high rate of expressive suppression, which is one form of regulating emotion, did not perform well in memory tasks. Toyota(2011) also investigated the relationship between the percentage of targets with neutral episodes and each EI score (PU, EL, and MR). He found that positive correlations between the recall performance and PU and EL were significant, but the correlation between recall performance and the MR score was not. These studies along with results of the present study suggest that MR level might be key aspect for determining memory; specifically, a higher MR might lead to a higher rate of expressive suppression, which could prevent the activation of emotional encoding on each target.

The present study also detected a marginally significant difference between the performance of the two groups in the massed presentation; the participants in the high MR group recalled targets more often than those in the low MR group. The participants in high MR group encoded the targets at the first and second presentations in a similar manner because they suppressed emotional encoding. Repeated encoding leads to a strong association between each target and its encoding, especially in the massed presentation that had no interval between the first and second presentations. Kitao (1983, 2002) stressed the importance of association between a target and its encoding. This difference in the strength of association

between a target and its emotional encoding is probably what caused the difference between the two groups.

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【日本語要旨】

# 情動の制御と調節能力と偶発記憶における分散効果

豊　田　弘　司　奈良教育大学学校教育講座（心理学）

単語を繰り返し提示する場合、連続して提示する集中提示よりも、一定の間隔を置いて提示する分散提示の方が学習や記憶成績が良い。この現象は分散効果と呼ばれている。本研究は、偶発記憶における分散効果が情動知能の下位能力である情動の制御と調節能力（ＭＲ）に水準によって変化するか否かを検討した。大学生111名に対して、情動知能尺度（J-ESCQ, Toyota et al., 2007）を実施し、ＭＲの得点が高い群（ＭＲ高群）と低い群（ＭＲ低群）を抽出した。これらの抽出された実験参加者に対して、偶発記憶手続きを用いた集団実験が実施された。方向づけ課題において参加者は、提示される単語から過去の出来事が想起されるか否かの回答を求められ、想起された場合にはその出来事に対する感情を不快から快までの６段階で評定するように求められた。挿入課題を行った後、偶発自由再生テストが実施され、提示された単語の書記再生が求められた。本研究で得られた最も重要な結果は、分散効果は、ＭＲ高群よりもＭＲ低群において大きいということであった。符号化変動性仮説によると、分散効果は分散提示された場合に時間間隔があるために符号化が変動して手がかりが多くなることによると考えられている。ＭＲ高群においては過去の出来事から喚起される情動を抑制する傾向があるが、ＭＲ低群はその傾向は弱いと考えられる。したがって、ＭＲ高群は、情動を抑制するので変動するための情動の符号化が乏しく、分散提示されても、その変動が少ないので、提示された単語を検索するための手がかりが少なくなったと考えられた。