The effect of stimulus discriminability on the mere exposure effect: Why more variability in the design of cigarette health warnings is needed.

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The mere exposure effect refers to the observation that repeated, unreinforced exposure to a stimulus increases affective evaluations of that stimulus. An abundance of previous mere exposure research has utilised neutral, meaningless stimuli, with few studies using emotional stimuli. However, it is highly plausible that the stimuli used in these studies were not truly emotional. Therefore, the aim of this study was to examine the effect of repeated exposure on liking ratings of images which had inherent emotional properties, namely valence and arousal. Three experiments took place. Experiment 1 used neutral yet meaningful images to obtain a baseline but surprisingly, no significant mere exposure effect was found. Experiment 2 then used images differing in valence and arousal in which a significant effect was found for the negative high arousal images only. Guided by these findings, Experiment 3 then used negative high arousal images that have greater societal application, namely cigarette health warning images. Strikingly, a significant mere exposure effect was again found. It is argued that stimulus discriminability played a vital role in the occurrence of the mere exposure effect, such that a significant effect was found only when the stimuli were of similar content to one another. Recommendations were made that the design of cigarette health warnings need to have more variability in the content that is depicted to prevent increases in affective evaluations from occurring.

Keywords: The mere exposure effect, Stimulus discriminability, International Affective Picture System, Health warnings images

1. Introduction

In his seminal monograph, Zajonc (1968) presented the findings of four experiments which indicated that repeated, unreinforced exposure to a stimulus leads to greater familiarity with that stimulus which consequently, leads to enhanced affective evaluations of that stimulus. This relationship between familiarity and liking has been termed the mere exposure effect. The findings of Zajonc sparked a great deal of interest into the mere exposure effect, with over 200 studies taking place and largely finding support for the preference enhancing effect by the time of Bornstein’s (1989) review twenty years later. Thus, the mere exposure effect has been identified as a robust and reliable phenomenon.

A typical mere exposure experiment in a laboratory setting has two phases: an exposure phase and a test phase. In the exposure phase, participants are presented with the target stimuli in succession, at varying exposure frequencies. In the test phase, participants are presented with the stimuli again, together with similar, but never-before-seen equivalents. Within this phase, participants are required to rate all the stimuli which they have seen. Evidence of the mere exposure effect is
found when participants ascribe higher affective evaluations to the frequently exposed stimuli from the exposure phase than the infrequently stimuli encountered in the test phase only.

To investigate the mere exposure effect, many studies have utilised neutral, meaningless stimuli such as line drawings of optical illusions (Bornstein, Kale, & Cornell, 1990), Chinese characters (to non-Chinese-readers) (Harrison, 1968; Saegert & Jellison, 1970; Zajonc, 1968) and trigrams (Zajonc, Shaver, Tavris, & Van Kreveld, 1972), and have found significant exposure effects. However, even though it is advantageous to use neutral, meaningless stimuli because prior exposure is unlikely (Hekkert, Thurgood, & Whitfield, 2013), this stimulus type is not representative of what people generally encounter in the real-world and as such, restricts the validity of the mere exposure effect to laboratory settings.

Other studies, although relatively limited, have claimed to have used affectively valenced stimuli, however the findings of these studies are somewhat mixed. Although there is a general consensus that the attitude enhancing effect of repeated exposure is robust for not only neutral stimuli but for positive stimuli as well (e.g., Brickman, Redfield, Harrison, & Crandall, 1972, Experiment 3; Bukoff & Elman, 1979; Burgess & Sales, 1971, Experiment 2), only some studies have found this to occur when using negative stimuli (Bukoff & Elman; Zajonc, Markus, & Wilson, 1974), with other studies finding a decrease in affect following repeated exposure (Brickman et al.; Burgess & Sales, 1971; Grush, 1976; Perlman & Oskamp, 1971). One likely possibility accounting for the discrepancy in findings concerns the nature of the stimuli used to denote the affective conditions. For example, Burgess and Sales (1971) paired non-sense words with either positive or negative meaningful words, and Grush (1976) used pre-rated infrequent positive words (e.g., gardenia) and infrequent negative words (e.g., corrosive). Hence, it is plausible that the stimuli used in past mere exposure research were not truly emotional.

In addition, even though emotional stimuli are known to differ in terms of valence (i.e., ranging from unpleasant to pleasant) and arousal (ranging from calm [low arousal] to exciting [high arousal]; Lang, Bradley, & Cuthbert, 2008; Osgood, 1957), studies such as those conducted by Burgess and Sales (1971) and Grush (1976) have only attempted to focus on the role of stimulus valence in the mere exposure effect; leaving the equally important role of stimulus arousal unexplored. The current study, therefore, examines the mere exposure effect with stimuli that have inherent emotional properties that vary on both valence and arousal. One way to ensure that the stimuli are truly emotional is to use the International Affective Picture System (IAPS) (Lang et al.). The IAPS is a large database of images that depict a wide range of semantic categories and contains standardised ratings of valence and arousal for each image that have been validated across cultures.

This paper begins with a mere exposure study which used neutral stimuli to obtain a baseline (Experiment 1). However, unlike the abundance of mere exposure studies that have used neutral, meaningless stimuli such as optical illusions (Bornstein et al., 1990), this study used neutral stimuli that were more meaningful, for instance, photographs of common objects. Next, Experiment 2 investigated the mere exposure effect to emotional stimuli. Following this, the next logical step was to investigate the mere exposure effect using emotional stimuli which have greater social utility (Experiment 3). Of interest to this research were the health warnings found on cigarette packets as
they have been deliberately designed to be highly aversive and are also particularly salient in today’s society.

2. Experiment 1

Experiment 1 was designed to investigate the effect of controlled repeated exposure on liking ratings of neutral, yet meaningful images.

2.1 Method

The sample comprised 48 participants, 21 of whom were male ($M = 44.43$ years, $SD = 15.08$ years) and 27 of whom were female ($M = 46.07$ years, $SD = 12.99$ years). The materials consisted of seven neutral images from the IAPS database (Lang et al., 2008; refer Aimers, 2005 for a detailed description of the selection process) and the study questionnaire which comprised basic demographics. The procedure had two phases; an exposure phase and a test phase. Within the exposure phase, the seven neutral images were presented centrally on a computer screen. Each image was displayed at one of seven exposure frequencies (i.e., 0, 1, 2, 5, 10, 20, and 25 exposures) equally often across participants. For example, one image was displayed once, another image was displayed twice, another image was displayed five times etc. All images were presented in a random, heterogeneous exposure sequence for 1 second. Each image was preceded by a central black fixation cross on a white background for 2 seconds and was then followed by a blank black screen for 1 second. The presentation and timing of the images was controlled by the software package DirectRT (Empirisoft, 2006). Next, in the test phase, participants were informed that their task was to rate each image for liking, and that this would occur through the use of a 9-point Likert scale. The liking scale was anchored 1 = *strongly dislike* to 9 = *strongly like* and was worded “to what extent do you like the image?” The same images that were presented in the exposure phase were presented again in the test phase, together with one never-before-seen equivalent. However, in contrast to the exposure phase where the images were shown multiple times, each image was only displayed once. All images were presented in a random, heterogeneous exposure sequence for 1 second. Each image was preceded by a central black fixation cross on a white background for 2 seconds, which was then followed by the self-paced liking rating scale.

2.2 Results

Participant liking ratings were analysed using a repeated measures ANOVA, with exposure frequency (0, 1, 2, 5, 10, 20, 25 times) as the within-subjects variable. The findings indicated that liking ratings did not differ across the frequency levels, $F(6, 282) = .542$, $p = .776$, observed power = .22. Therefore, no mere exposure effect was found for the neutral IAPS images.

2.3 Discussion

Experiment 1 was designed to investigate the effect of repeated exposure on liking ratings of neutral, but meaningful stimuli, namely images from the IAPS. The failure to find a mere exposure effect was surprising given that an abundance of previous mere exposure research have found significant

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1 Permission to use the IAPS was obtained from the NIMH Centre for Emotion and Attention (CSEA) at the University of Florida via e-mail on the 28/07/11.

2 Stimuli in the zero frequency condition were excluded from the exposure phase. That is, the stimuli were presented in the test phase only.
exposure effects using neutral, meaningless stimuli such as polygons. One plausible explanation for
why the effect failed to eventuate was because of the lack of similarity among items in the stimulus
set. Specifically, the neutral IAPS images in the current study depicted a range of different objects
such as a suitcase and a drill. However, in previous mere exposure studies, the stimuli used have all
been of similar content; e.g. all polygons (e.g., Newell & Shanks, 2007) or all trigrams (e.g., Zajonc et
al., 1972). Thus, the current findings suggest that the effect of repeated exposure can be inhibited
when different stimulus categories are used, and are partially consistent with those of Zajonc et al.,
who suggested that stimulus discriminability (i.e., the degree to which stimuli can be distinguished
between) can reduce the magnitude of the mere exposure effect, but only when painting stimuli are
used. Participants in the current study were exposed to stimuli other than paintings, suggesting that
the effect of stimulus discriminability on the mere exposure effect is more widespread. This possibility
will be further explored in Experiment 2.

3. Experiment 2
Experiment 2 was designed to investigate the effect of controlled repeated exposure on affect ratings
of emotional images. Because emotional stimuli differ in both valence (i.e., negative and positive) and
arousal (i.e., low and high), the effect of repeated exposure to four image types was investigated:
negative low arousal, negative high arousal, positive low arousal, and positive high arousal.

3.1 Method
The sample comprised 186 participants, 85 of whom were male (M = 47.77 years, SD = 17.37 years)
and 101 of whom were female (M = 42.41 years, SD = 17.18 years). The materials consisted of a total
of 28 images from the IAPS database (7 images for each image group). To ensure that any
differences in liking ratings could be attributed to exposure frequency and not to differences in the
intensity of emotional content within image type groups (e.g. negative low arousal), images were
chosen that had a comparable level of valence intensity (i.e., degree of unpleasantness and
pleasantness) and arousal intensity (i.e., degree of calmness and excitability). Refer Aimers (2005),
for a detailed description of this selection process. All other aspects of the method were the same as
Experiment 1 (i.e., the study questionnaire, exposure phase and test phase).

3.2 Results
Participant liking ratings were analysed using a 4 (Image Group: Negative Low Arousal, Positive Low
Arousal, Negative High Arousal and Positive High Arousal) x 7 (Exposure Frequency: 0, 1, 2, 5, 10,
20, 25) mixed design ANOVA, with the image group as between-subjects factor and exposure
frequency as the within-subjects factor. In cases yielding significant effects, post-hoc, pairwise
comparisons were conducted to identify the point at which affect ratings changed significantly from
the “0” exposure frequency condition (i.e., baseline; stimuli shown in test phase only).

3.2.1 Liking
The ANOVA revealed that the Image Group x Exposure Frequency interaction was highly significant,
$F(15.38, 932.85) = 3.65, p = <.001, \, partial \eta^2 = .057$. This indicated that there was a difference in
liking ratings across the exposure frequency levels among the image groups. Therefore, separate
repeated measures ANOVAs with exposure frequency as the within-subjects variable were conducted
for each image group.
The effect of exposure frequency on liking ratings was highly significant for the negative high arousal image group, \( F(2.16, 94.96) = 27.33, p < .001, \ \text{partial } \eta^2 = .383 \). This suggested that the liking ratings of negative high arousal images varied significantly across the frequency levels. Post-hoc tests using Bonferroni adjusted alpha levels of .007 per pairwise comparison (.05/7) indicated that liking ratings first increased significantly from 0 (i.e., baseline; stimuli shown in test phase only) after only 1 exposure \( (p < .001) \). The effect of exposure frequency on liking ratings was not significant for the other image groups.

### 3.2 Discussion

Experiment 2 was designed to establish the effect of controlled repeated exposure on liking ratings of stimuli that were inherently emotional, namely images from the IAPS. The findings revealed that a mere exposure effect only occurred for the negative high arousal images. Partially consistent with the explanation provided in Experiment 1 (refer p. 3), it is plausible that stimulus discriminability again limited the occurrence of a mere exposure effect, particularly for the low arousal conditions.

Inspection of the images used in the negative and positive low arousal conditions revealed that there was a lack of similarity among stimuli used in each set. The negative low arousal IAPS images depicted a variety of different scenes of poverty, pollution etc. and the positive low arousal IAPS images depicted a range of scenes of nature, animals etc. In contrast, the images used within negative and positive high arousal conditions were more similar to each other. Specifically, in the negative high arousal condition, the majority of the IAPS images were of dangerous animals (e.g., a shark, a snake etc.) and in the positive high arousal condition, the majority of the IAPS images were of extreme sports (e.g., mountain climbing, hang gliding etc.). While a mere exposure effect failed to eventuate in the positive high arousal condition, the effect of exposure frequency on liking ratings was approaching significance.

The implications of the finding that negative high arousal stimuli are susceptible to the attitude-enhancing effect of repeated exposure are alarming, especially because this stimulus type is often deliberately used to increase risk perceptions, and hence, decrease affective evaluations (Kessels & Ruiter, 2012). One salient example of this is the graphic health warning images found on cigarette packets, which currently depict the severe health consequences of smoking. The warning images all depict scenes of a similar content (e.g. diseased body parts or organs and/or fatal medical/health conditions) with the intention of deliberately bombarding smokers, or potential smokers, with threatening information in an attempt to decrease affective evaluations directed towards them. However, if based on the findings of the current study, the mere exposure effect is likely to occur in conditions where stimulus discriminability is attenuated, this suggests that liking ratings could actually increase to frequently exposed cigarette health warnings.

### 4. Experiment 3

Graphic health warning images found on cigarette packets have become the key “battleground in the war against smoking” (Harris, Mabott, & Napper, 2007, p.437). The warnings on cigarette packets are highly visible and are considered as an important medium for communicating the health risks associated with tobacco use to consumers (Hammond, 2011). Even though a smoker is more likely to encounter these health warnings more regularly than a non-smoker, people in general are still
repeatedly exposed to these stimuli. Hence, the conditions of mere exposure are simulated in the real-world in an un-meticulous way. That is, people are naturally but deliberately subjected to repeated, unreinforced exposure to the health warning images in an effort to discourage them from engaging in the “risky behaviour” of smoking. However, in light of the findings of the previous study, it is possible that repeated exposure to this type of negative high arousal stimulus may actually serve to increase liking and thus, may be counterintuitive to their specifically designed purpose of deterrence.

Therefore, the aim of the current study was to apply the mere exposure paradigm and explore the effect of repeated exposure on liking ratings for the graphic health warning images found on cigarette packets. Because it is important to ensure that prior exposure to these warnings is reduced, health warnings from different countries, namely Malaysia and Thailand, were selected to serve as stimuli. The health warning images used in this experiment were based on a pilot study which identified and selected the seven most unpleasant and arousing foreign health warning images (refer Aimers, 2015 for a detailed review).

4.1 Method
The final sample consisted of 47 participants, 25 of whom were male ($M = 46.88$ years, $SD = 12.37$ years) and 22 of whom were female ($M = 47.00$ years, $SD = 13.80$ years). Apart from the seven health warnings images (which were selected in a pilot study, see above), all other aspects of the method (i.e., the study questionnaire, exposure phase and test phase) were identical to the previous experiments.

4.2 Results
Participant liking ratings were analysed using a repeated measures ANOVA, with exposure frequency (0, 1, 2, 5, 10, 20, 25 times) as the within-subjects variable. In cases yielding significant effects, post-hoc, pairwise comparisons were conducted to identify the point at which liking ratings changed significantly from the “0” exposure frequency condition (i.e., baseline; stimuli shown in test phase only).

4.3.1 Liking
The repeated measures ANOVA outlined above indicated that the effect of exposure frequency was highly significant, $F(2.51, 115.57) = 7.19, \ p < .001$, partial $\eta^2 = .135$. This indicated that the liking ratings of the health warning images varied significantly across the frequency levels. Post-hoc tests using Bonferroni adjusted alpha levels of .007 per pairwise comparison (.05/7) indicated that liking ratings first increased significantly from 0 (i.e., baseline; stimuli shown in test phase only) at 5 exposures ($p = .006$), continued increasing through to 10 exposures, and then gradually declined.

4.4 Discussion
The aim of the current study was to investigate the effect of repeated exposure on liking ratings of cigarette health warning images. A strong mere exposure effect occurred at lower exposure frequencies followed by a decline in liking at higher exposure frequencies. The findings of the previous experiments of this study (Experiments 1 and 2), suggested that stimulus discriminability is likely to be a significant factor in the mere exposure effect, with strong mere exposure effects obtained in conditions wherein the emotional stimuli were of similar content to one another, and, conversely, no exposure effects obtained when the stimuli were distinctly different from one another.
Thus, given that the health warnings all depicted similar content to one another (i.e., the adverse health consequences of smoking; diseased body parts or organs and/or fatal medical/health conditions) and significant effects of repeated exposure were obtained, the findings of the current study are again consistent with the notion that the occurrence of a mere exposure effect depends upon the degree of discriminability among the stimulus set.

5. General Discussion

The findings across all studies indicated that the occurrence of a mere exposure effect depended upon stimulus discriminability, or the degree of similarity between the stimuli. The more similar the images were in each image group, the higher the likelihood that a mere exposure effect would occur for that image group. Zajonc et al. (1972) explained the effect of stimulus discriminability on the mere exposure effect in terms of the response competition hypothesis. In short, this theory posits that when an individual encounters a novel stimulus, the degree of similarity that stimulus has with a previously encountered stimulus will determine the intensity and the number of generalized responses that are activated at the time of the first exposure. The greater the similarity, the greater the number of responses that are elicited which, in turn, leads to greater response competition; an adverse state. Subsequent exposure to the stimulus is believed to eliminate some of the responses, which, therefore, will reduce the response competition. Consequently, liking towards the stimulus is increased.

However, while Zajonc et al., (1972) used the response competition hypothesis to explain why weaker exposure effects were obtained for easily discriminable paintings, it is unlikely that this explanation entirely accounts for the underlying mechanisms of stimulus discriminability, at least in the current study. This theory appears to assume that negative affect and positive affect are dependent upon one another which, as identified by Watson and Clark (1997) is not the case. Rather, negative affect and positive affect are believed to be orthogonal constructs and as such, “variations in positive and negative affect are independent of one another” (Watson & Clark, p. 270).

An alternative explanation for why stimulus discriminability can limit the occurrence of a mere exposure effect relates to participant preferences. Specifically, because participants were exposed to meaningful images which, in the low arousal conditions (including neutral), were more distinct from one another, it is highly plausible that personal preferences were able to resonate. For example, in the positive low arousal condition, the image depicting a misty paddock with grazing horses may have been more personally relevant to a participant in comparison to the image of baby elephants because it might convey more realistic memories of the participant’s childhood. As a consequence, higher liking ratings may have been ascribed to this stimulus because of this personal attachment; an effect that might go above and beyond those of repeated exposure alone. Thus, it is plausible that in these conditions, the familiarity that is typically generated by repeated exposure as a source of affect is overridden by the participant’s personal attachment to the stimulus content. A stimulus of greater personal significance will be preferred to others of equal emotional valence, regardless of how many times the other stimuli were exposed.

Of great concern was the finding that liking ratings of the health warning images increased with repeated exposure, at least initially. The implementation of the graphic warnings relies upon the effect
of repeated exposure to convey an avoidance or quit message every time a person reaches for a cigarette (Department of Health, 2012). Thus, the finding that liking ratings actually increased, is counterproductive to the reasons why health warning images exist, namely to deter or motivate people not to smoke. Guided by the findings of the low arousal conditions of this study and the possible role that stimulus discriminability played in limiting the occurrence of a mere exposure effect, it is recommended that, to prevent liking ratings from increasing, the design of health warnings should include images that are more discriminable from one another and thus, do not solely depict the health consequences of smoking. Other negative consequences that could be conveyed are the financial costs associated with smoking and the effect that smoking has on significant others. This additional variability in the content depicted could potentially prevent the attitude enhancing effects of repeated exposure from occurring (the mere exposure effect). This research provides the first steps towards examining the effects of repeated exposure to health warning images in a controlled setting, and opens up avenues for further research aimed at examining the efficacy of other types of warnings to which people are repeatedly exposed.

6. References

