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原著

Development and Testing of a New Indirect Attitude Measure for Pictorial Objects

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Measuring attitudes in an indirect way has become indispensable in recent social psychological studies. Nevertheless, it is difficult to claim that social psychology has developed an effective indirect method to measure attitudes toward large pictorial attitudinal objects. The present study proposed a new indirect method, the Serial Evaluative Conversion Task (SECT), to measure participants' attitudes toward various 15cm×20cm full-color pictorial objects that appeared on a monitor. The purpose of the present study was to demonstrate the principle and assumed underlying psychological measurement theory of the SECT. The validity and reliability of the method was examined in three experiments. Results showed that attitude scores obtained using the SECT significantly discriminated between the evaluative valence of emotionally positive, neutral, and negative target pictures. These results indicated that the SECT at least showed minimum validity. The SECT showed very high reliability for an indirect attitude measure; the reliability coefficient (ρ) obtained via split-half test ranged from .64 to .75.

Key Words : attitude, picture, indirect measure, Serial Evaluative Conversion Task

Defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993), attitude is one of the central concepts of social psychology. Several social psychology researchers have attempted to measure participants' attitudes toward attitudinal objects to test their hypotheses. The most popular means of measuring attitudes are self-report measures that utilize Likert-type scales and semantic differential scales. However, in self-report measures, participants do not always report their attitudes truthfully, and even tend to disguise them, particularly when the attitudinal object is related to a socially delicate matter. Therefore, measuring attitudes in an indirect way has become indispensable.

Developed by A. G. Greenwald and colleagues (Greenwald, McGhee, & Schwarts, 1998), the computer-based Implicit Association Test (IAT) is the most frequently used indirect attitude measure. The IAT has typically been used to measure participants' relative attitudes toward paired concepts. In a typical IAT task, two categorical labels (e.g., "flower" and "pleasant") appear in the upper-left area of a monitor, another two categorical labels (e.g., "insect" and "unpleasant") appear in the upper-right area, and exemplars (e.g., "lily," "mantis," "happy," "sad") belonging to those four categories appear in the center of the screen individually and in random order. Participants judge whether each exemplar belongs to the categorical labels on the left or right as quickly and precisely as possible, and communicate their decision by pressing the left or right key. An IAT task consists of two separate blocks displaying four categorical labels; the difference in participants' average response latencies for these blocks is representative of their relative attitude scores toward the target categories. For example, the average response latency for a block that has "flower/pleasant" on the left and "insect/unpleasant" on the right tends to be shorter than the average response latency for a block that has

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"insect/pleasant" on the left and "flower/unpleasant" on the right. The difference between the two average response latencies represents the participant's relative attitude toward flowers and insects.

The prominent feature of the IAT is that participants do not report their attitudes directly; therefore, it is difficult for them to distort their attitudes with the IAT. For example, Banse, Seise, and Zerbes (2001) reported that participants instructed to disguise themselves as having positive attitudes toward homosexuality showed more positive attitude scores toward homosexuality on a self-report measure relative to a control group, but they showed attitudes toward homosexuality almost equal to the control group in the IAT. Similarly, Kim (2003) reported that participants instructed to disguise their attitudes on two IAT measures showed attitude scores almost identical to those of control participants. These reports imply that the IAT is resistant to social desirability bias to some extent.

The IAT is limited in that it is used to measure relative attitudes toward two target *concepts*, not toward specific and concrete attitudinal objects. For example, the IAT measures attitudes toward concepts such as "flower," but cannot measure attitudes toward a picture of a flower appearing before a participant. In this regard, an emotional priming paradigm has been used to measure participants' attitudes toward specific words and small pictures. In an experimental trial of typical emotional priming, a prime stimulus appears on a screen for 200 ms. Following an interval of 100 ms, an emotionally positive or negative word appears on a monitor. Participants judge the emotional valence of the target (positive or negative) and press the correct key as quickly and precisely as possible; their response latencies for the target stimuli are recorded in ms. Many researchers have reported that average response latencies on trials in which the prime and the target have the same emotional valence are significantly shorter than on trials in which the prime and the target have inconsistent emotional valence (Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 1994). Therefore, by assigning a picture of a concrete attitudinal object as the prime stimulus, the paradigm could be used as a measure of indirect attitudes toward that picture. That is, the priming score, obtained by subtracting response latencies for a positive target following a prime stimulus from response latencies for a negative target following the same prime stimulus, is considered to be representative of indirect attitudes toward the prime stimulus (Fazio, Jackson, Dunton, & Williams, 1995; Hayashi, 2007; Hermans, Vansteenwegen, Crombez, & Baeyens, 2002).

However, it would be difficult to measure attitudes using an emotional priming paradigm when the attitudinal object is a complicated picture covering a large proportion of a participant's visual field. In such cases, the entire picture may not be projected onto the participant's central fovea under a short presentation duration of 200 ms. In particular, when important components are located in a peripheral area of the picture, measuring attitudes using an emotional priming paradigm would be difficult. Therefore, prime pictures used in the emotional priming paradigm have been limited to relatively small pictures of faces and words. In addition to this problem, the emotional priming paradigm is known to demonstrate extremely low reliability scores. Olson and Fazio (2003) reported that the emotional priming paradigm as an indirect attitude measure showed $r = .06$ on a split-half test. This is apparently lower than the reliability of IAT tests, which have an internal consistency coefficient of nearly .7 (e.g., Bosson, Swann, & Pennebaker, 2000).

Thus, it is difficult to claim that social psychology has developed an effective indirect method to measure attitudes toward various pictorial stimuli. Meanwhile, measuring attitudes toward pictorial stimuli using a reliable method that is unaffected by social desirability biases would be useful, particularly when research is related to delicate social matters.

Filtering Unconscious Matching of Implicit Emotions (FUMIE) Test

The present study proposes two methods with which to measure attitudes toward pictures, and compares the reliability and validity of the measure in Experiment 1. The first method is to apply the Filtering Unconscious Matching of Implicit Emotions (FUMIE) test to pictorial objects (Mori, Uchida, & Imada, 2008). Although the original FUMIE test is a paper-and-pencil task implemented in collective form to measure attitudes toward a single target word, the present study used a version of the original FUMIE test modified to measure attitudes toward a target picture. In a manner identical to Mori et al. (2008), the FUMIE test in Experiment 1 contains two types of experimental block, positive and negative, to measure attitudes toward a target picture. In each block, a target picture, two emotionally positive filler pictures, and two emotionally negative filler pictures appear individually several times in random order. The participants' task is to judge the emotional valence of the pictures as they appear, then indicate their choices by pressing the L key for positive and the S key for negative pictures as quickly and precisely as possible; response latencies for the pictures are recorded in ms. In addition, in the instructions for each block, participants are asked to press the L key (positive key) for the target picture on positive blocks and the S key (negative key) for the target picture on negative blocks, regardless of the original emotional valence of the target picture. That is, participants have to convert the emotional valence of the target picture according to block type. If a participant has a positive attitude toward a target picture, the response latency for the target on positive blocks would be shorter than the response latency for the target on negative blocks. Since inconsistency in a participant's original attitude and converted response toward the target on negative blocks is expected to make participants behave cautiously throughout the block, participants would respond slowly toward filler pictures as well as the target. Therefore, the difference in average response latencies for positive and negative blocks is expected to reflect the participant's attitude toward the target.

However, the FUMIE test may not be effective at measuring attitudes toward a picture. As noted, participants in the present experiment are tested individually in front of a monitor; it is possible to expect that such conditions prompt participants to be more focused on the task compared with participants in the original FUMIE test, carried out in a collective pencil-and-paper manner. Such intensified concentration makes the conversion of the valence of the target easier; thus, the difference between the average response latencies for positive and negative blocks is expected to be smaller.

The Serial Evaluative Conversion Task (SECT) and its Underlying Processes

Therefore, the present study proposes a second method, the Serial Evaluative Conversion Task (SECT), to measure attitudes toward a target picture. As shown in Figure 1, in a task trial, two different emotional pictures appear on the screen in succession. The Participant's task is to judge the consistency of the emotional valence of these two pictures and press the correct key (corresponding to "consistent" or "inconsistent") as quickly and precisely as possible. The first picture in a trial remains on the monitor for 1 s, and the second picture remains on the screen until participants press the correct key. The key presses and response latencies (in ms) for the second picture are recorded. Trials included in a block are categorized as filler (50% of all trials) or target trials (50% of all trials). In filler trials, extremely positive or negative filler pictures appear in succession. In target trials, a filler picture appears as the first picture and a target picture appears as the second picture (Figure 1). As in the FUMIE test, this task has positive and negative blocks to measure attitudes toward a target picture. In positive blocks, participants are to respond as if the target picture is positive, irrespective of its original valence; in negative blocks, participants are to respond as if the target picture is negative, irrespective of its original valence (Figure 1). As in the

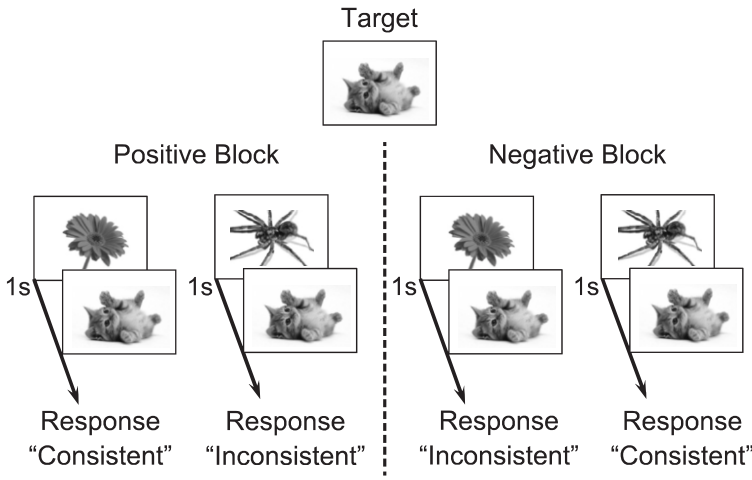

Figure 1. Schematic illustration of target trials on SECT (Serial Evaluative Conversion Task). Participants evaluate the consistency of the emotional valence of two pictures in a trial. In positive blocks, participants convert the emotional valence of the target to positive. In negative blocks, participants convert the emotional valence of the target to negative.

FUMIE test, differences in average response latencies between positive and negative blocks produce scores representing attitudes toward the target picture.

This task has two potential underlying processes that enlarge the differences in response latencies for the two block types: positive and negative. At first, participants have to retain the valence of the first (filler) picture in their working memory while they convert the valence of the target picture. This dual task condition is expected to limit participants' cognitive resources for the conversion of the target's valence. Such a cognitive load is known to make it more difficult to disguise attitudinal responses (e.g., Koole, Dijksterhuis, & van Knippenberg, 2001) ; therefore, it is expected that, in a block that presents an inconsistency between the target's converted and original valence, participants in the SECT will exhibit longer response latencies relative to those in the FUMIE test. Because of this feature, the SECT is expected to be a better attitude measure than the FUMIE test when measuring attitudes toward pictures.

Furthermore, there is another potential process underlying the SECT that increases the response latency in a block that presents inconsistency between a target's converted and original valence. Some previous studies have insisted that participants have a strong automatic tendency to judge the emotional consistency (and inconsistency) of two emotional stimuli that appear within a short period of time. For example, in emotional priming experiments using a lexical judgment task (word-nonword judgment) for target stimuli, the average response latencies for participants' affirmative responses to target stimuli is longer with inconsistent emotional valence of the prime and target (e.g., Wentura, 2000). On interpreting this phenomenon, Wentura (2000) suggested that participants have an automatic tendency to judge the emotional consistency (and inconsistency) of the prime and the target. He also posited that emotional inconsistency between the prime and the target activates a negative response tendency, so that emotional inconsistency interferes with affirmative responses to the target and increases response latency. A similar process was also proposed by Klauer and Stern (1992). As noted, the SECT also uses two emotional pictures, and a participant's response is "consistent (affirmative)" or "inconsistent (negative)." Therefore, in a block of the SECT where there is inconsistency between the target's converted and original valence,

participants are thought to have difficulty in responding correctly because of an automatic tendency to respond in the affirmative to emotional consistency and in the negative to emotional inconsistency.

In sum, there are two potential processes underlying the SECT that increase response latencies in a block in which there is inconsistency between the target's converted and original valence: cognitive load and the automatic tendency to judge emotional consistency. For this reason, it is expected that the SECT is a better method with which to measure attitudes toward pictures than the FUMIE test.

The Purpose of the Present Study

Experiment 1 measured attitudes toward a positive picture, a neutral picture, and a negative picture using the two methods mentioned above, and compared the resultant attitude scores. The emotional valence of the three target pictures used was confirmed in previous studies. Therefore, if the new indirect measures proposed in the present study measure attitudes toward these three pictures appropriately, the three attitude scores obtained will differ from each other. Additionally, Experiment 1 compared the efficiency of the SECT and the FUMIE test by comparing the three attitude scores obtained.

Experiment 1

Method

Participants. As a part of an experimental psychology laboratory course, 13 Japanese university students (five men, eight women, average age=20 years, age range: 19–23) participated in the experiment.

Materials. An emotionally positive picture, an emotionally neutral picture, and an emotionally negative picture were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) and used as target pictures for indirect measures. Another two emotionally positive pictures and two emotionally negative pictures were selected from the IAPS and used as filler pictures for indirect measures. These seven pictures were not related to socially delicate matters. The appendix shows slide numbers, mean emotional valence, and contents for the seven pictures from the IAPS (Lang et al., 2005).

Apparatus. Seven personal computer systems were set up in a soundproofed room. Each computer system consisted of an Apple personal computer (Apple Inc., CA), a 17 in. color LCD monitor, and a full-sized keyboard. Each system was separated by partitions.

Procedure. Five to seven participants were tested at one time. The procedure was separated into three parts. The first part measured attitudes toward three target pictures using the FUMIE test. The second measured attitudes toward three target pictures using the SECT. Half of the participants were tested using the FUMIE test and then the SECT; the other half were tested in the opposite order. The third part of the procedure entailed rating the pleasantness of the three target and four filler pictures on a nine-point scale ranging from 1 (*unpleasant*) to 9 (*pleasant*).

FUMIE test. Participants were seated in front of a monitor with an observation distance of approxi-

Table 1
Summary of Main Blocks of FUMIE Test and SECT in Experiment 1

Block	Original valence of target	Converted valence of target
1	Positive	Positive
2		Negative
3	Neutral	Positive
4		Negative
5	Negative	Positive
6		Negative

Note. The order of these six blocks was randomized for each participant.

mately 45 cm from the monitor. The experimenter instructed participants to press the L key with their right index finger upon the appearance of emotionally positive pictures and to press the S key with their left index finger upon the appearance of emotionally negative pictures. The need for speed and accuracy in responding was stressed. Following instruction, a practice block consisting of 16 trials began, in which each of the four filler pictures appeared individually four times in random order. Each picture remained on the monitor until participants pressed the correct key.

Following completion of the practice block, six main blocks began, as shown in Table 1. Prior to the start of each of the six blocks, the target picture for the block appeared on the monitor. The experimenter instructed participants to respond to pictures as they had in the practice block, with the exception of the target picture. That is, they were to ignore the original emotional valence of the target picture in the following block and regard the target picture as a positive or negative picture throughout the block. The original and converted valence of the target in each block are shown in Table 1. For example, in the instructions for Block 2, participants were instructed to ignore the original positive valence of the target picture (the emotionally positive picture of a kitten) and treat the target picture as an emotionally negative picture throughout Block 2 trials. Thus, participants were to press the S key (negative key) upon the appearance of the target picture that originally had positive emotional valence. The experimenter instructed participants to memorize the target picture and its converted valence, then start the main block by pressing the space key immediately after memorizing the target. In each main block, a target picture appeared 10 times, and each of the four filler pictures appeared four times. Therefore, each main block consisted of 26 trials. The order of the 26 trials was randomized for each participant with the restriction that identical pictures did not appear in succession. On each trial, pictures remained on the monitor until participants pressed the correct key; key presses and response latencies were recorded in ms. The inter-trial interval was 500 ms, and there were 20-s intervals between main trials. Participants completed all six main blocks according to the instructions that appeared on the monitor.

SECT. Participants were seated in front of a monitor in an identical manner to the FUMIE test. The experimenter informed participants that for each trial, two pictures would appear on the monitor individually and in succession. The experimenter instructed participants to judge the emotional consistency of the two pictures and press the L key in consistent cases and the S key in inconsistent cases. The need for speed and accuracy in responding was stressed. The practice block began shortly after the instruction and comprised 16 trials consisting of two filler pictures. On each practice block trial, a filler picture appeared on the monitor as the first picture and remained on the screen for 1 s, followed by a different filler picture that appeared as the second picture, which remained on the monitor until participants pressed the correct key. Participants judged the emotional consistency of the two pictures and pressed the L or S key as quickly and precisely as possible. The emotional valence of the first and second pictures was consistent in eight trials and inconsistent in eight trials. Each of the four filler pictures appeared eight times. The presentation of the 16 practice blocks was randomized for each participant. Inter-trial intervals were 250 ms.

The main blocks started shortly after the end of the practice block. As in the main blocks of the FUMIE test, there were six main blocks (Table 1). Before the start of each block, the target picture for the block appeared on the monitor. For each main block, the experimenter instructed participants to judge the emotional consistency of the two pictures in the same manner as they had in the practice block, with the exception of the target picture. As in the main blocks of the FUMIE test, the experimenter instructed participants to convert the emotional valence of the target picture (to positive or negative, as directed). The original and converted valence of the target in each main block are shown in Table 1. Participants began each main block by

pressing the space key, having memorized the target picture and its converted valence. Each main block consisted of 32 trials. Since half were identical to the 16 trials in the practice block, the first picture and second picture were filler pictures that differed from each other (filler trials). In contrast, on the other 16 trials, one of the filler pictures appeared as the first picture and the target picture for the block appeared as the second picture (target trials). On target trials, each of the four filler pictures appeared as the first picture four times. On each main block, the presentation of the 32 main trials was randomized for each participant. The participant's task was identical to the practice block of the SECT, with the exception of converting the original valence of the target picture according to the instructions for the block. There were 20-s intervals between main trials. Participants completed all six main blocks according to the instructions that appeared on the monitor.

Self-report measure. After completing the two indirect measures, participants rated the pleasantness of three target pictures and four filler pictures, which appeared on the screen individually in random order. Participants rated each picture on a nine-point scale ranging from 1 (*unpleasant*) to 9 (*pleasant*) and pressed the corresponding numerical key. The entire experimental procedure took approximately 30 min.

Results

FUMIE test. Erroneous responses were excluded from the analysis (3.80% of all observations). Additionally, responses with short latencies of below 300 ms and long latencies of over 1500 ms were excluded as outliers (0.74% of all observations). Table 2 shows the mean response latency and number of errors for each of the six main blocks. For each participant, three attitude scores pertaining to three target pictures were obtained by subtracting the mean response latency for the positive block from the mean response latency for the negative block (Table 2). Magnitude relationships for the three attitude scores obtained were matched with the prediction. However, a one-way within-participants ANOVA with attitude scores as the dependent variable revealed that there was no significant main effect ($F(2, 24)=3.20$, *n.s*, $\eta^2=.17$). This indicates that the FUMIE test did not differentiate significantly between the three different target pictures.

In order to investigate the split-half reliability of the FUMIE test, 26 trials included in each main block were divided evenly into two parts. For each participant, two attitude scores were obtained for each target picture, the correlation coefficient for those two attitude scores was calculated, and an average of the three correlation coefficients taken. Finally, as an adjusted reliability coefficient, $\rho=.83$ was obtained by applying Spearman-Brown correction to the average of the three correlation coefficients.

SECT. Erroneous responses were excluded from the analysis (8.49% of all observations). Additionally, responses with short latencies of below 300 ms and long latencies of over 1500 ms were excluded as outliers (3.21% of all observations). Table 3 shows

Table 2
Average Response Latencies (ms), Number of Errors, and Attitude Scores for FUMIE in Experiment 1

Block	Original valence of target	Converted valence of target	Response latency	Number of errors	Attitude score for target
1	Positive	Positive	499 (72)	.92 (.95)	65
2		Negative	564(115)	1.15(1.28)	
3	Neutral	Positive	514 (77)	.77 (.83)	10
4		Negative	524 (81)	.92(1.12)	
5	Negative	Positive	545 (71)	1.38(1.80)	-26
6		Negative	519(125)	.77 (.93)	

Note. Attitude score represents the difference in average response latencies between two blocks.
Digits in parentheses are standard deviations.

Table 3
Average Response Latencies (ms), Number of Errors, and Attitude Scores for SECT in Experiment 1

Block	Original valence of target	Converted valence of target	Response latency	Number of errors	Attitude score for target
1	Positive	Positive	679(105)	2.31(2.06)	61
2		Negative	740(106)	2.54(2.22)	
3	Neutral	Positive	703(112)	3.46(2.54)	3
4		Negative	706(107)	3.15(2.48)	
5	Negative	Positive	780(118)	3.08(2.43)	-83
6		Negative	697 (86)	1.77(2.17)	

Note. Attitude score represents the difference in average response latencies between two blocks. Digits in parentheses are standard deviations.

the mean response latency and number of errors for each of the six main blocks. For each participant, three attitude scores pertaining to three target pictures were obtained by subtracting the mean response latency for the positive block from the mean response latency for the negative block, as in the FUMIE test (Table 3). Magnitude relationships of the three attitude scores obtained were matched with the prediction. A one-way within-participants ANOVA with attitude score as the dependent variable revealed a significant main effect ($F(2, 24)=10.64$, $p<.001$, $\eta^2=.18$). Multiple comparisons using Ryan's method revealed a significant difference between the three attitude scores with the exception of the comparison between originally positive and originally neutral targets.

In order to investigate the split-half reliability of the SECT, 32 trials included in each main block were divided evenly into two parts and an adjusted reliability coefficient was calculated as in the FUMIE test, which revealed that the SECT showed lower reliability ($\rho=.64$) than the FUMIE test, but was sufficient as an indirect attitude score measure using response latencies.

Table 4
Average of Participants' Ratings for Targets and Fillers in Experiment 1

Type	Slide No.	Ratings
Positive Target	1460	8.54(0.88)
Neutral Target	7000	4.69(1.25)
Negative Target	9300	1.23(0.60)
Positive Filler 1	5000	7.54(1.13)
Positive Filler 2	5621	6.69(1.03)
Negative Filler 1	9471	2.69(2.50)
Negative Filler 2	9600	2.92(2.06)

Note. Digits in parentheses are standard deviations. Slide No. refers to ID numbers of pictures in Lang, Bradley, & Cuthbert (2005).

Relationships between indirect measures and the self-report measure. Table 4 shows participants' average pleasantness ratings for three target pictures and four filler pictures. As shown in Table 4, participants' pleasantness ratings were almost comparable with the mean valence scores found by Lang et al. (2005). These scores imply that participants rated two positive filler pictures as pleasant and two negative filler pictures as unpleasant.

Figure 2 shows scatter diagrams depicting indirect self-report measures from the present experiment. Two simple linear regression analyses were conducted to determine whether participants' ratings on the self-report measure (dependent variable) could be predicted using attitude scores obtained by the FUMIE test and the SECT. The results of the simple linear regression analysis with attitude scores from the FUMIE test as the independent variable revealed that the dependent variable was significantly predicted by FUMIE test attitude scores; however, an adjusted R squared was small ($F(1, 37)=5.70$, $p<.05$, $\eta^2=.13$; $R^2_{adjusted}=.11$). Results of a simple linear regression analysis with attitude scores from the SECT as the independent variable revealed that the dependent variable was significantly predicted by SECT attitude scores and that the independent variable was a better predictor ($F(1, 37)=23.14$, $p<.001$, $\eta^2=.38$; $R^2_{adjusted}=.37$). The present study did not investigate the correlation coefficients between attitude score and pleasantness rating for each target picture, because the

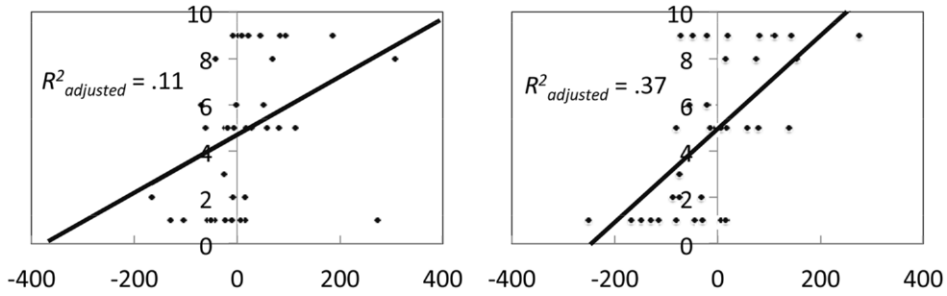

Figure 2. Scatter plots of participants' pleasantness ratings for target pictures (y-axis) and indirectly measured attitude scores of target pictures (x-axis) in Experiment 1. The independent variable (x-axis) of the left diagram is the attitude score obtained by the FUMIE test. The independent variable (x-axis) of the right diagram is the attitude score obtained by the SECT.

standard deviation of participants' ratings for each target picture was extremely small (see Table 4). It is therefore inferred that their ratings tended to reflect knowledge common to their culture,[1] rather than participants' individual variability. In situations in which a variable does not vary, calculating a correlation coefficient between variables is thought to be unproductive.

Discussion

Analysis indicated that the FUMIE test was not an effective attitude measure for pictures, whereas the SECT had better predictive power. Results of the ANOVA on the attitude scores from the FUMIE test indicated that the FUMIE test did not discriminate at all between three emotionally different target pictures. Conversely, three attitude scores from the SECT were significantly different with respect to two of three comparison pairs. Simple regression analysis clearly indicated that the SECT was the superior predictor for the self-report measure. Although the reliability coefficient for the SECT was lower than for the FUMIE test, the reliability of the SECT was almost comparable to the IAT, showing exceptionally high reliability scores for attitude measures using response latencies.

It has been reported that indirect attitude and self-report measures do not often correlate significantly (for a review, see Dijksterhuis, Albers, & Bongers, 2009). As an example of a lower correlation, in a meta-analysis conducted by Dasgupta, McGhee, Greenwald, and Banaji (2000), $r = .12$ was reported as the overall correlation between self-report and attitude scores obtained via the IAT. Although it is difficult to directly compare the R squared calculated in the present study with correlation coefficients reported in previous research, it is possible to conclude that attitude scores from the SECT were better predictors of the self-report measure, relative to the FUMIE test, and the SECT's predictive power was satisfactory.

In conclusion, Experiment 1 suggested that the SECT had better potential than the FUMIE test as an indirect attitude measure for pictures. Experiment 2 further investigated the efficiency of the SECT.

Experiment 2

One methodological feature of the SECT is the use of positive and negative filler pictures as attitudinal objects along with target pictures. As Experiment 1 fixed filler pictures for all participants, it is possible that the SECT attitude scores obtained in Experiment 1 may have been an artifact derived from the specific filler pictures used in the experiment. That is, if attitude scores change significantly according to the filler pictures, it could be concluded that the practical utility of the SECT is

[1] For example, the proposition "An unclean lavatory basin is unpleasant" would be common knowledge among people living in developed countries.

seriously limited. To examine this possibility, this experiment assigned different filler pictures for two groups of participants, while target pictures were fixed across the two groups. If the attitude scores for the two groups did not differ between groups, the robustness of the SECT would be positively demonstrated.

Method

Participants. As a part of an experimental psychology laboratory course, 52 Japanese university students (22 men, 30 women, average age＝20.01 years, age range: 19–22) participated in the experiment. Half of the participants were selected randomly and assigned to Group A, and the remainder assigned to Group B.

Materials. The three target pictures used were identical to those in Experiment 1. For participants in Group A, four filler pictures were used, as in Experiment 1. For participants in Group B, two emotionally positive and two emotionally negative pictures were selected as new filler pictures from the IAPS (Lang et al., 2005; Appendix).

Procedure. Five to seven students participated at the same time and in the same laboratory as participants in Experiment 1. Participants completed the SECT procedure and rated the pleasantness of seven pictures as in Experiment 1. The entire experimental procedure took approximately 20 minutes.

Results

Two participants demonstrated erroneous responses of more than 20% on all trials were eliminated from analysis. Erroneous responses were excluded from the analysis (7.43% of all observations). Additionally, responses that showed short latencies of below 300 ms and long latencies of over 1500 ms were excluded as outliers (2.53% of all observations). Table 5 shows the mean response latency and number of errors for each of the six main blocks. For each participant, three attitude scores pertaining to three target pictures were obtained by subtracting the mean response latency for the positive block from the mean response latency for the negative block, as in the previous experiment (Table 5). Magnitude relationships for the three attitude scores obtained for both groups were matched with the original valence of the three target pictures. To investigate attitude scores, a 2 (group: A, B) × 3 (original valence of target picture: positive, negative, neutral) mixed design ANOVA was conducted with attitude score as the dependent variable. The group variable was the between-subjects factor and the original valence of target pictures was the within-subjects factor. Results revealed that there was no significant main effect of group or first-order interaction effect ($F(1, 48)=0.75$, *n.s*, $\eta^2=.01$; $F(2, 96)=.01$, *n.s*, $\eta^2=.00$). The lack of significance of these effects indicates that alter-

Table 5

Average Response Latencies (ms), Number of Errors, and Attitude Scores for SECT in Experiment 2

Group	Block	Original valence of target	Converted valence of target	Response latency	Number of errors	Attitude score for target
A ($n=25$)	1	Positive	Positive	696 (92)	2.56(2.04)	65
	2		Negative	761(112)	2.60(1.78)	
	3	Neutral	Positive	719 (94)	3.76(2.68)	3
	4		Negative	722(112)	2.76(2.17)	
	5	Negative	Positive	783(109)	3.84(2.32)	−70
	6		Negative	713 (90)	2.32(2.38)	
B ($n=25$)	1	Positive	Positive	722(107)	3.88(2.11)	79
	2		Negative	801 (91)	3.64(2.98)	
	3	Neutral	Positive	723(113)	3.48(2.71)	20
	4		Negative	744(114)	3.28(1.84)	
	5	Negative	Positive	765(120)	3.64(2.23)	−55
	6		Negative	710(107)	3.04(1.79)	

Note. Attitude score represents the difference in average response latencies between two blocks.
Digits in parentheses are standard deviations.

ing filler pictures between groups had no effect on attitude scores. A significant main effect of original valence of target picture was found ($F(2, 96)=33.75$, $p<.001$, $\eta^2=.27$). Multiple comparison using Ryan's method revealed that there were significant differences between all comparable pairs of three attitude scores.

In order to investigate the split-half reliability of the SECT, 32 trials included in each main block were divided evenly into two parts, and an adjusted reliability coefficient was calculated as in the previous experiment. Results revealed that the SECT in Experiment 2 showed nearly identical reliability ($\rho=.65$) to the previous experiment.

Figure 3 shows a scatter diagram depicting attitude scores from the SECT and pleasantness ratings for participants in Experiment 2. A simple linear regression analysis with attitude scores from the SECT as the independent variable revealed that the dependent variable was significantly predicted by SECT attitude scores ($F(1, 148)=51.51$, $p<.001$, $\eta^2=.26$; $R^2_{adjusted}=.25$).

Finally, participants' pleasantness ratings were analyzed to investigate whether the emotional valence of the filler pictures used in the present experiment was almost equal between the two groups. Table 6 shows average pleasantness ratings for each target and filler picture used in the experiment. For each participant, the mean rating score for the two positive filler pictures and the mean rating score for the two negative filler pictures were calculated. A2 (group: A, B) × 2 (valence of filler pictures: Positive, Negative) mixed-design ANOVA was conducted with the mean rating score for the filler pictures as the dependent variable. Results revealed that the main effect of the valence of the filler pictures was significant ($F(1, 48)=164,20$, $p<.001$, $\eta^2=.70$). However, there was no significant main effect of group or interaction effect ($F(1, 48)=.01$, *n.s*, $\eta^2=.00$; $F(1, 48)=.76$, *n.s*, $\eta^2=.00$). These results show that the emotional valence of filler pictures did not differ between the two blocks, despite those pictures differing between blocks.

Table 6

Average of Participants' Ratings for Targets and Fillers in Experiment 2

Group	Type	Slide No.	Ratings
A	Positive Target	1460	8.64(0.70)
	Neutral Target	7000	4.56(1.33)
	Negative Target	9300	1.32(0.63)
	Positive Filler 1	5000	7.80(1.00)
	Positive Filler 2	5621	7.08(1.35)
	Negative Filler 1	9471	2.96(2.39)
	Negative Filler 2	9600	3.16(1.99)
B	Positive Target	1460	8.12(1.17)
	Neutral Target	7000	4.76(0.97)
	Negative Target	9300	1.24(0.52)
	Positive Filler 1	5982	8.04(1.37)
	Positive Filler 2	2360	7.44(1.92)
	Negative Filler 1	9901	2.40(1.47)
	Negative Filler 2	9440	3.04(2.42)

Note. Digits in parentheses are standard deviations.

Discussion

Participants in Groups A and B completed the SECT with different filler pictures between groups, whereas the target pictures were fixed between

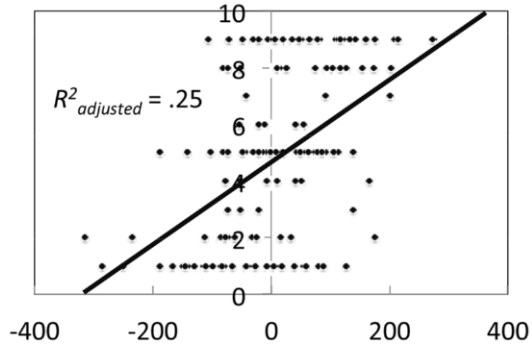

Figure 3. Scatter plots of participants' pleasantness ratings for target pictures (y-axis) and attitude scores of target pictures from the SECT (x-axis) in Experiment 2

groups. Nevertheless, attitude scores obtained were almost comparable with each other, and there was no significant effect of group. These results indicate that the SECT does not depend on specific filler pictures. That is, emotionally positive and negative filler pictures different from those used in the present study could serve as appropriate filler pictures in the SECT. Thus, results indicate the practical utility of the SECT. Next, Experiment 3 examines the possibility of artifacts in the SECT.

Experiment 3

Attitude scores obtained in the SECT in the previous two experiments could significantly predict pleasantness ratings. However, it is possible that attitude scores obtained in the two previous experiments were caused by an artifact dependent upon the three target pictures being specific because the target pictures used in the previous two experiments were identical. For this reason, the present experiment assigns different sets of three target pictures to two groups of participants with the four fixed filler pictures. The purpose of the present study is to examine whether the SECT appropriately measures attitudes toward target pictures that differ from the previous two experiments.

Method

Participants. As a part of an experimental psychology laboratory course, 39 Japanese university students (17 men, 22 women, average age＝20.00 years, age range: 19–22) participated in the experiment. Half of the participants were selected randomly and assigned to Group C and the remainder assigned to Group D.

Materials. As target pictures, two emotionally positive pictures, two emotionally neutral pictures, and two emotionally negative pictures were selected from the IAPS (Lang et. al, 2005). These six pictures did not relate to socially delicate matters and differed from the three target pictures used in the previous two experiments (Appendix). From the six pictures, one each of emotionally positive, neutral, and negative pictures were selected and used as the target pictures for Group C. The remaining three pictures were used as target pictures for Group D (Appendix). For both groups, four filler pictures were used, identical to those in Group B of Experiment 2.

Procedure. Five to seven students participated at the same time in the same laboratory as in the previous experiments. Participants completed the SECT procedure and rated the pleasantness of seven pictures as in Experiment 2. The entire experimental procedure took approximately 20 minutes.

Results

No participants showed erroneous responses of more than 20% in all trials. Erroneous responses were excluded from the analysis (9.56% of all observations). Additionally, responses that showed short latencies of below 300 ms and long latencies of over 1500 ms were excluded as outliers (1.99% of all observations). Table 7 shows the mean response latency and number of errors for each of the six main blocks. For each participant, three attitude scores for three target pictures were obtained by subtracting the mean response latency for the positive block from the mean response latency for the negative block as in the previous experiments (Table 7). Magnitude relationships for three obtained attitude scores in both groups were matched with the original valence of the three target pictures. To investigate these attitude scores, a 2 (group: C, D) × 3 (original valence of target picture: positive, negative, neutral) mixed-design ANOVA was conducted with attitude score as the dependent variable. Group was the between-subjects factor and the original valence of target pictures was the within-subjects factor. Results revealed a significant main effect of group ($F(1, 37)=4.46$, $p<.05$, $\eta^2=.03$). The main effect of the original valence of target pictures was also significant ($F(2, 74)=32.80$, $p<.001$, $\eta^2=.31$). Multiple comparison using Ryan's method revealed significant differences between all comparable pairs of three attitude scores. Finally, a one-way interaction effect was significant ($F(2, 74)=5.90$, $p<.01$, $\eta^2=.06$). Tests for simple main effects revealed a significant simple main effect of group on neutral targets ($F(1, 111)=12.14$, $p<.001$, $\eta^2=.10$). This effect indicates that participants in Group C showed significantly lower attitude scores

Table 7
Average Response Latencies (ms), Number of Errors, and Attitude Scores in Experiment 3

Group	Block	Original valence of target	Converted valence of target	Response latency	Number of errors	Attitude score for target (ms)
C (n=20)	1	Positive	Positive	681 (99)	2.40(1.93)	126
	2		Negative	807(130)	3.35(2.64)	
	3	Neutral	Positive	780(121)	2.75(2.12)	−58
	4		Negative	722(147)	3.10(2.53)	
	5	Negative	Positive	781(133)	4.00(3.31)	−80
	6		Negative	701(173)	2.40(2.89)	
D (n=19)	1	Positive	Positive	637(114)	3.11(2.23)	95
	2		Negative	732(159)	4.21(2.39)	
	3	Neutral	Positive	629(117)	3.84(2.59)	53
	4		Negative	682(140)	3.53(2.12)	
	5	Negative	Positive	685(109)	5.63(3.13)	−27
	6		Negative	658(118)	3.11(1.79)	

Note. Attitude score (ms) represents the difference in average response latencies between two blocks. Digits in parentheses are standard deviations.

on neutral targets (M=−58) relative to participants in Group D (M=53). However, the simple main effect of the group variable on positive and negative targets was not significant (F(1, 111)=0.97, *n.s*, η^2=.06; F(1, 111)=2.74, *n.s*, η^2=.02). Furthermore, the simple main effect of original valence of target picture on Groups C and D was significant (F(2, 74)=29.74, p<.001, η^2=.39; F(2, 74)=8.96, p<.001, η^2=.24). Multiple comparisons using Ryan's method revealed significant differences between attitude scores for positive target–negative target and positive target–neutral target in Group C (p<.05). In Group D, there were significant differences between attitude scores for positive target–negative target and neutral target–negative target (p<.05).

To investigate the split-half reliability of the present experiment, for each of the two groups, the 32 trials included in each main block were divided evenly in two parts, and an adjusted reliability coefficient was calculated as in the previous experiments. This revealed that both groups showed slightly higher reliability coefficients relative to the previous experiments (Group C, ρ=.70; Group D, ρ=.75).

Table 8 shows participants' average pleasantness ratings for the experiment. Figure 4 shows a scatter diagram depicting attitude scores from the SECT and pleasantness ratings for each group of participants in Experiment 3. Using the data from Group C, a simple linear regression analysis was conducted with attitude scores from the SECT as the independent variable. This revealed that the dependent variable was significantly predicted by SECT attitude scores (F(1, 58)=32.54, p<.001, η^2=.36; $R^2_{adjusted}$=.35). Similarly, using data from Group D, the results of a simple linear regression analysis with attitude scores from the SECT as the independent variable revealed that the dependent variable was significantly predicted by SECT attitude scores (F(1, 55)=20.72, p<.001, η^2=.27; $R^2_{adjusted}$=.26).

Table 8
Average of Group A's Ratings for Targets and Fillers in Experiment 3

Group	*Type*	*Slide No.*	*Ratings*
C	Positive Target	5760	8.00(1.49)
	Neutral Target	7056	4.75(0.64)
	Negative Target	9570	1.25(0.55)
	Positive Filler 1	5982	7.90(1.37)
	Positive Filler 2	2360	8.35(0.88)
	Negative Filler 1	9901	2.00(1.26)
	Negative Filler 2	9440	1.70(1.03)
D	Positive Target	2540	7.26(1.10)
	Neutral Target	6150	4.84(0.90)
	Negative Target	1205	2.26(1.97)
	Positive Filler 1	5982	7.68(1.38)
	Positive Filler 2	2360	8.53(0.70)
	Negative Filler 1	9901	2.32(1.34)
	Negative Filler 2	9440	2.32(1.42)

Note. Digits in parentheses are standard deviations. Slide No. refers to ID numbers of pictures in Lang, Bradley, & Cuthbert (2005).

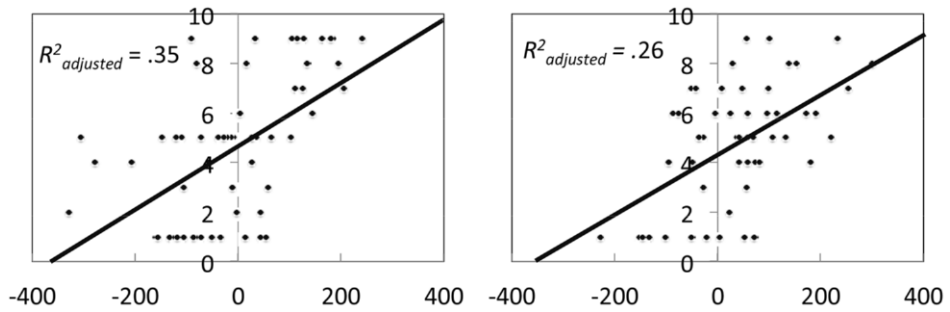

Figure 4. Scatter plots of participants' pleasantness ratings for target pictures (y-axis) and attitude scores of target pictures from the SECT (x-axis) in Experiment 3. The left diagram is the scatter plot of Group C participants. The right diagram is the scatter plot of Group D participants.

Discussion

The present experiment measured attitudes toward emotionally positive, neutral, and negative target pictures; however, the target pictures differed between groups. Nevertheless, both groups of participants displayed magnitude relationships for three attitude scores similar to the previous experiments and two-way ANOVA found significant effects of the targets' original valences. These results indicate that SECT attitude scores from previous experiments were not an artifact caused by specific target pictures.

However, attitude scores obtained in the present experiment were partly inconsistent with the prediction. On attitude scores from the SECT, Group C showed significantly more negative attitude scores on the neutral pictures compared to Group D. Although the present research does not provide sufficient evidence to interpret this result, it is possible to make inferences from the contents of the neutral pictures assigned to the two groups. The neutral picture assigned to Group D, an electrical outlet, is thought to be a less enjoyable common object despite being useful in daily life, and participants are thought to have a somewhat positive implicit attitude toward the picture. In contrast, the neutral picture assigned to Group C, a large pair of cutting pliers, is thought to be an unfamiliar object that many people do not use frequently; thus, participants are thought to have a more negative implicit attitude toward it relative to the electrical outlet.

Finally, a general analysis was conducted to examine the difference between scores for target and filler trials. As noted, the analyses in the present study included participants' response latencies for filler trials, which have no target picture included in their presentation pairs. This is because in cases when the original and converted valence of a target picture are inconsistent in a block, participants are expected to be cautious in all of the trials in the block and respond slowly on both target and filler trials. To test this hypothesis, for all 102 participants in Experiments 1, 2, and 3, attitude scores were calculated using only the response latencies for target trials. Similarly, other attitude scores were calculated using only response latencies for filler trials (Table 9). To investigate differences between the two sets of attitude scores, a 2 (source of the attitude scores: target trials, filler trials)×3 (original valence of the target: positive, neutral, negative) within-participants ANOVA was conduct-

Table 9
Average of Two Types of Attitude Scores for SECT in Three Experiments in the Present Study

Target's valence	Source of attitude scores	
	Target trials	Filler trials
Positive	85(135)	82(105)
Neutral	10(109)	-1(106)
Negative	-58(134)	-68 (96)

Note. Digits in parentheses are standard deviations.

ed with attitude scores from 102 participants as the dependent variable (Table 9). As expected, results revealed that the main effect of source of the attitude scores and the one-way interaction effect were not significant ($F(1, 101)=1.16$, *n.s*, $\eta^2=.00$; $F(2, 202)=.12$, *n.s*, $\eta^2=.00$). There was a significant main effect of original valence of the target ($F(2, 202)=70.29$, $p<.001$, $\eta^2=.20$). This indicated that the two sets of average attitude scores were almost identical to each other. The split-half reliability of the SECT, calculated using these two sets of attitude scores, was slightly lower than that of the other three experiments ($\rho=.57$). These results indicate that including filler trials when calculating attitude scores is beneficial; however, further research should be conducted for a more thorough investigation.

General Discussion

The purpose of the present study was to demonstrate a new method for indirect measurement of attitudes toward pictures, and determine the validity and reliability of this method. The method proposed in the present study, the SECT, was similar to the FUMIE test proposed by Mori et al. (2008), in that it forces participants to convert the original valence of target pictures; however, it was supposed that the SECT possessed prominent features to magnify the difference in average response latencies for two main blocks when compared with the FUMIE test. Experiment 1 compared attitude scores obtained using the FUMIE test and the SECT to examine whether the SECT would measure attitudes toward pictures more appropriately than the FUMIE test. Results showed that the FUMIE test could not discriminate at all between the three target pictures with different emotional valences, whereas SECT attitude scores differed significantly in two of the three pairs compared. These results supported the hypothesis that the SECT was a more effective method with which to measure attitudes toward pictures. Whereas the three target pictures were fixed, Experiment 2 altered emotionally positive and negative filler pictures between groups and confirmed that attitude scores were not altered significantly according to the filler pictures. The results indicated that the SECT attitude measurement was not influenced by the peculiarity of the content of the filler pictures. Experiment 3 altered the three target pictures between groups, and filler pictures were fixed between groups. The attitude scores obtained for positive, neutral, and negative target pictures showed the same magnitude relationships between groups, and attitude scores for the three target pictures differed from each other significantly. The overall results indicated that the attitude scores in Experiments 1 and 2 were not the result of an artifact caused by the peculiarity of target pictures used. However, an unpredicted difference was found between groups on attitude scores toward neutral target pictures. Although it was impossible to fully explain this difference using the evidence available from the present study, it could have been caused by differences in the participants' familiarity with the neutral target pictures between the two groups.

Throughout the three experiments in the present study, SECT attitude scores significantly predicted pleasantness ratings for target pictures with adjusted R squared ranging from .25 to .37. In contrast, several previous studies using the IAT as an indirect measure of attitudes have reported correlations between IAT scores and attitude scores on self-report measures. For example, Nosek (2005) reported that the average correlation coefficient was .34 on various measurements. Similarly, Hofmann et al. (2005) reported an average correlation coefficient of .24. Furthermore, many studies examining self-esteem have reported that correlation coefficients between self-esteem scores on the IAT and self-report measures tend to fall below .20, and are not always significant (e.g., Dijlsterhuis et al., 2009; Greenwald & Farnham, 2000). Although the calculated R squared in this study was not smaller than correlation coefficients between IAT and self-report measures, it would be difficult to compare them directly. As noted, the present study did not investigate correlation coefficients between the SECT attitude scores and the pleasantness rating for each target picture because pleasantness ratings

showed extremely small standard deviations; therefore, it was inferred that ratings did not reflect participants' individual differences. Hence, it would be difficult to compare the criterion-related validity of the SECT with the IAT using the results of the single regression analyses in the present study. The present study was at least able to conclude that the SECT showed minimum validity, because it was able to discriminate between emotionally positive, neutral, and negative target pictures to some extent; however, further investigation into the validity of the SECT is needed in future research. In particular, future research should investigate correlations between SECT attitude scores and self-report measures on pictorial attitudinal objects with higher individual differences.

Although the validity of the SECT was not fully investigated in the present study, the experiments demonstrated that the SECT has a remarkably high split-half reliability ranging from .64 to .75. These reliability coefficients are close to the IAT, which is known to show exceptionally high reliability with respect to indirect measures (Bosson et al., 2000). As noted, an emotional priming paradigm has been used to measure attitudes toward pictorial objects, but it was reported that this paradigm demonstrated an extremely low split-half reliability (Olson, & Fazio, 2003). Another indirect attitude measure, the Extrinsic Affective Simon Task, has also been reported to display unstable split-half reliability ranging from −.20 to .63 (De Houwer & De Bruycker, 2007). The relatively higher reliabilities of the SECT indicate that it could potentially be an attitude measure to replace the emotional priming paradigm and other indirect measures in examining attitudes toward pictorial objects.

In conclusion, the present study clarified that the SECT was a superior indirect attitude measure for pictorial objects compared with the FUMIE test, and showed remarkably high reliability for indirect measures. It was demonstrated that the SECT could differentiate between emotionally positive, neutral, and negative pictures; however, detailed investigation of validity was not conducted in the present study. Future research should concentrate on testing the criterion-related validity of the SECT.

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Appendix

Pictures Used in the Present Experiments, their Slide Numbers, and Contents by Lang et al (2007)

	Type	Slide No.	Mean valence	Contents
Experiment 1				
	Positive Target	1460	8.21	Kitten
	Neutral Target	7000	5.00	Rolling pin
	Negative Target	9300	2.26	Dirty toilet
	Positive Filler 1	5000	7.08	Flower
	Positive Filler 2	5621	7.57	Sky divers
	Negative Filler 1	9471	3.16	Burned building
	Negative Filler 2	9600	2.48	Sinking boat
Experiment 2				
Group A				
	Same as Experiment 1.			
Group B				
	Positive Target	1460	8.21	Kitten
	Neutral Target	7000	5.00	Rolling pin
	Negative Target	9300	2.26	Dirty toilet
	Positive Filler 1	5982	7.61	Sky
	Positive Filler 2	2360	7.70	Family
	Negative Filler 1	9901	2.27	Car accident
	Negative Filler 2	9440	3.67	Skulls
Experiment 3				
Group C				
	Positive Target	5760	8.05	Flowers
	Neutral Target	7056	5.07	Large pair of cutting pliers
	Negative Target	9570	1.68	Dead dog
	Positive Filler 1	5982	7.61	Sky
	Positive Filler 2	2360	7.70	Family
	Negative Filler 1	9901	2.27	Car accident
	Negative Filler 2	9440	3.67	Skulls
Group D				
	Positive Target	2540	7.63	Mother and child
	Neutral Target	6150	5.08	Electrical outlet
	Negative Target	1205	3.65	Spider
	Positive Filler 1	5982	7.61	Sky
	Positive Filler 2	2360	7.70	Family
	Negative Filler 1	9901	2.27	Car accident
	Negative Filler 2	9440	3.67	Skulls