

Lateralized Mere Exposure:
An Analytic/Non-analytic Processing Approach

by


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B.A. (Hons), Simon Fraser University, 1999

A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE


In the Department of Psychology

We accept this thesis as conforming
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Abstract

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It is known that individuals have a preference for items they have seen before, even when those items are presented so quickly that they cannot be consciously recalled (the “mere exposure effect”). Whittlesea and Price (2001) concluded that the mere exposure effect was an artefact of the alternative strategies (analytic vs. non-analytic) that subjects were using to generate information about stimuli they were exposed to at test. Specifically, a non-analytic strategy promoted target selection above chance, whereas an analytic strategy prevented target selection above chance.

The current study elaborated on this analytic/non-analytic distinction. Many studies have demonstrated that the right-hemisphere uses a non-analytic strategy for processing stimuli, whereas the left hemisphere uses an analytic strategy. Given this dissociation, it was predicted that a mere exposure effect would be found when stimuli were initially presented to the LVF, but not when initially presented to the RVF. Results modestly supported these predictions.

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Acknowledgments

First, I would like to thank my supervisor, Dr. Kimberley Kerns, and my committee members, Dr. Roger Graves and Dr. Michael Masson for their comments and suggestions on this thesis. I would also like to thank Meredith Allison for her careful reading of earlier drafts of this thesis, and Ben Williams for his input on the statistical analyses. Finally, I would like to thank Shaun Chambers and all of my friends and family for their support.

Dedication

For my parents, Gary and Mary, and my brother James. Go Nucks.

The mere exposure effect is the finding that brief, unreinforced exposure to a stimulus is sufficient to bring about an increase in positive affect felt towards that stimulus on a later occasion (Zajonc, 1968). Research on the mere exposure effect has demonstrated that only one brief prior exposure is necessary to increase an individual's preference rating of a stimulus on a later encounter. The effect is robust and has been demonstrated using a diverse range of stimuli, including Chinese ideographs (Saegert and Jellison, 1970), irregular polygons, abstract paintings, and non-words (Zajonc, 1968), as well as a variety of other auditory and gustatory stimuli (Bornstein, 1989). The mere exposure effect has been a topic of interest in psychology for well over 100 years, due in large part to the fact that it suggests that it is possible to influence an individuals' feeling towards a stimulus without their awareness. Potential applications of mere exposure research findings in advertising, politics, law, entertainment, and many other areas, are extensive.

History of Exposure Effects: Early Work

Some of the first laboratory evidence suggesting the existence of "perception without awareness" was provided by Pierce and Jastrow in 1884 (Bornstein & Pittman, 1992). At the time, Pierce and Jastrow were examining what many early psychologists deemed to be of primary importance, namely psychophysics, and specifically, just noticeable differences. Pierce and Jastrow investigated what weight difference was required in order for subjects to consciously report a noticeable difference between two weights, one placed in each hand. They became interested in what would happen if subjects perceived no difference in the weights, but were then required to make a "forced-choice" decision, and indicate which hand contained the heavier weight. To examine this, Pierce and Jastrow adjusted the size of the weights in each hand until the subjects perceived no difference. There was still, in fact, a slight difference in weight, but it was so small that subjects could not consciously detect it. To the researchers' surprise, when forced to choose which hand contained the heavier weight, the subjects were correct in

their decisions 65% of the time. Thus, although subjects could perceive no difference in weight, they were "unconsciously" making the correct decision, identifying the heavier weight significantly more often than chance.

In 1917, Otto Poetzl conducted a series of studies using rapid visual stimulus presentations (as cited in Bornstein, 1989). Using a tachistoscope, Poetzl exposed complex visual images to subjects for very brief durations (1s). Following the presentations, he asked subjects to produce a reproduction of what they had seen in the form of a drawing. Due to the extremely brief exposure duration, subjects had a difficult time accurately reproducing what they had seen. After completing a meager sketch of what they could remember, subjects were asked to go home and return the next day. The following day, the subjects returned to the lab and reported on any of the dreams they had had the previous night. Poetzl discovered that details of the complex visual image that were originally omitted from the subject's drawings on the previous day emerged in the content of their dreams. Similar to Pierce and Jastrow, Poetzl had discovered that subjects had encoded information about a stimulus that they were not explicitly aware of, but that was recruitable under certain processing conditions.

The exposure effect was elicited in the auditory modality in the mid 1920's. Subjects in the study were exposed to a series of brief (10s) passages of unfamiliar piano music. Following this introductory training/exposure phase, subjects were asked to rate how much they "liked" pieces of music presented at test. Half of the music presented at test had been previously heard by the subjects during the training phase, the other half was new. Despite being unable to explicitly remember hearing any of the passages of music presented at test, subjects tended to prefer music that they had been exposed to in the training phase to music they had not heard before. The results of these auditory exposure experiments compliment those obtained in exposure studies conducted in nearly every other sensory modality; that is, despite limited exposure and an inability to

explicitly state why, subjects tend to prefer those stimuli they have been exposed to on a previous occasion to those that are new.

Although these early studies roused interest in the exposure-affect relationship, many of them were methodologically unsound; nearly all of them lacked proper control conditions, some even lacked control conditions altogether. It was not until 1968, when Zajonc published his seminal paper "Attitudinal Effects of Mere Exposure" that a controlled and standardized procedure was developed for eliciting the "mere exposure effect".

The Classic "Mere" Exposure Study

In 1968, Zajonc published "Attitudinal Effects of Mere Exposure", a paper that established the standardized procedure for eliciting a mere exposure effect (Zajonc, 1968). In his study, Zajonc first presented subjects with a series of visual stimuli (100+), each exposed for a short duration (1- 10s). Within this presentation, certain pictures were seen with different frequencies; some of the pictures were seen once, some 5 times, some 15 times, some 25 times, etc.

Following this training phase, subjects were asked to make a series of forced-choice preference judgments (e.g., "Which one do you like better?") based on two pictures presented at test; one of the pictures was seen in the training phase, the other was novel. Up to 30 of these forced-choice preference judgments were made.

Zajonc's 1968 paper consisted of four experiments, all of which used the procedure outlined above. In his first experiment, Zajonc presented subjects with non-word letter strings in the training phase. At test, subjects were then asked to make a series of forced-choice preference judgments in which they indicated which of two test stimuli (non-words) they "liked" better. As noted above, one of the non-words presented at test was the target, having been seen before in the training phase, the other non-word was the foil, having never been seen before. Zajonc found that there was a positive relationship between the number of times a stimulus was presented during the training

phase and the number of times it was "preferred" at test. In other words, those target stimuli that were seen more often during the training phase were more frequently "liked" at test.

In his second experiment, Zajonc substituted Chinese ideographs for the non-words he used as training stimuli in the first experiment. Using these entirely novel stimuli did not affect the strength or direction of the relationship between frequency of exposure and ratings of preference. Subjects continued to judge those stimuli seen more frequently during the training phase as being more pleasant at test.

To further support the robustness of the exposure-affect relationship, Zajonc again changed the training stimulus category for his third experiment. In this experiment Zajonc substituted human faces for the non-words and Chinese ideographs he had used in his previous two studies. Despite using socially relevant stimuli, Zajonc again found the same exposure-affect relationship; at test, subjects were more accurate in selecting the target using the preference judgment when they had seen that face more frequently during the training phase.

Finally, in his fourth experiment, Zajonc examined the relationship between galvanic skin response (GSR) and the number of times a stimulus was presented in the training phase. Zajonc discovered a negative relationship between GSR and frequency of exposure such that as the number of exposures during the training phase increased, the GSR at test decreased. Thus, the more often a word was presented in the training phase, the lower the autonomic response it generated at test, suggesting a habituation to repeated stimuli and perhaps an unconscious strategy through which correct target identification could be achieved.

With the publication of Zajonc's paper, a standardized procedure for eliciting the mere exposure effect was established and researchers could begin to examine those factors that exaggerated, or diminished the exposure-affect relationship.

Variables That Impact the Effect

Beginning in the early 1970's, researchers began to manipulate the conditions under which an exposure-affect relationship could be found. A number of factors were discovered to be critical in modulating the strength of the effect.

In 1974, Stang and O'Connell conducted an experiment in which they sought to determine whether using different stimuli would cause a change in the exposure-affect relationship (Stang & O'Connell, 1974). They used three different kinds of stimuli in their experiment: (1) non-words, (2) simple line drawings, and (3) complex line drawings. Using the same procedure outlined by Zajonc, Stang and O'Connell found that stimulus type had no effect on the strength of the exposure-affect relationship. Thus, regardless of the type of stimulus presented, the same relationship was found; the more often a stimulus was presented during the training phase, the more often it was preferred at test. This work, along with subsequent work by Berryman (1986), supported the premise that the exposure-affect relationship held for nearly all categories of stimuli.

The relationship between training item exposure duration and preference ratings was investigated by Hamid in 1973. Hamid used the same procedure developed by Zajonc, but varied the amount of time with which training items were exposed to subjects. Training items were exposed to subjects for 1s, 2s, 5s, 10s, or 15s. Changing the exposure duration during the training phase had a significant effect on the exposure-affect relationship. Specifically, Hamid found that as the exposure duration to a stimulus during training decreased, preference ratings of that stimulus at test increased. In other words, subjects tended to rate those stimuli that were seen for the shortest duration during training as being most pleasant at test. The strongest exposure-affect relationship was found for stimuli that were presented for 1s during the training phase.

In 1983, Seamon, Brody and Kauff examined the effect of a delay between training item exposure and preference rating (Seamon, Brody, & Kauff, 1983b). Again, using the paradigm instituted by Zajonc (1968), subjects were exposed to a series of

training items. However, rather than having subjects report their preference judgments directly after the training phase, they were asked to wait for a specified period of time. Subjects were required to wait anywhere from 2 minutes to a week before providing their preference judgments. The results of this study suggested that as the delay between training item exposure and preference judgments increased, the positive affect felt towards old stimuli increased. A meta-analysis of research in this area completed by Bornstein (1989) supported the findings of Seamon, Brody and Kauff and concluded that, in general, a longer delay between training item exposure and preference judgments resulted in significantly more accurate target selection at test.

Hundreds of experiments, beginning with Pierce and Jastrow in 1884, and culminating in Zajonc's classic paper in 1968, have confirmed the existence of a relationship between exposure and preference judgments. Studies following the publication of Zajonc's paper have elucidated some of the components of the exposure-affect relationship that govern the strength and direction of the effect. The basic finding, however, is that subjects consistently rate those stimuli they have seen before as being more pleasant than those they have not seen.

A New Piece to the Puzzle

In 1980, Kunst-Wilson and Zajonc discovered a fascinating dissociation with respect to the mere exposure effect (Kunst-Wilson & Zajonc, 1980). This dissociation has become pivotal to the understanding of the effect and has instigated much speculation and theorizing about its possible origin.

In their study, Kunst-Wilson and Zajonc (1980) employed the standard procedure for eliciting an exposure effect; subjects were exposed to a training phase in which a series of visual images were presented and then a test phase in which they were asked to make several forced-choice judgments.

Two changes were made in the study, however. First, in previous studies, visual images were presented supraliminally, with the shortest exposure duration being 1s. In

the present study, however, stimuli were presented subliminally, with exposure durations of only 1ms. Because of this brief exposure duration, subjects were unable to report seeing any of the stimuli presented during the training phase. Second, subjects were required to make two forced-choice judgments at test. In addition to making a standard preference judgment (e.g., "Which one do you like better?"), subjects were also required to make a forced-choice recognition judgments (e.g., "Which one did you see before?").

The results of the study revealed that subjects preferentially rated previously seen stimuli as being more pleasant (typical mere exposure effect findings), but were unable to recognize old stimuli presented at test. In other words, correct target selection was greater than chance when making the preference judgment (subjects liked old items better than ones they had not seen), whereas correct target selection was no better than chance when making the recognition judgment.

The results of the Kunst-Wilson and Zajonc (1980) study, along with later work by Seamon, Brody and Kauff (1983a) has demonstrated that there is a dissociation between preference and recognition judgments when stimuli are presented subliminally. It seems strange that subjects consistently choose previously seen items when asked the preference question, but have no recollection of having seen these items when asked the recognition question.

The dissociation between target selection when making recognition and preference judgments has been the starting point for a number of models attempting to explain the mere exposure effect: these include the nonspecific activation model (Mandler, Nakamura, & Van Zandt, 1987), the fluency attribution model (Seamon, Brody, & Kauff, 1983a; Bornstein & D'Agostino, 1994), the hedonic fluency model (Winkielman & Cacioppo, 2001) and the uncertainty reduction model (Lee, 2001). A brief description of these models of mere exposure will now be presented.

Models of Mere Exposure

The Nonspecific Activation Model

The nonspecific activation model (Mandler, Nakamura, & Van Zandt, 1987) posits that prior exposure to stimuli in a mere exposure experiment (i.e., during the training phase) generates and activates representations of those stimuli in memory. These activated stimulus representations then become more accessible; that is, they capture attention and “stand-out” from other stimuli. Thus, upon viewing a previously seen target in a mere exposure experiment, the activation associated with that target will be noticeably higher than the activation associated with the novel stimulus it is paired with. This increased activation “sensitizes” subjects to the target and biases them to select it more frequently. As the name suggests, the activation associated with a previously seen stimulus is “nonspecific”. As a result, it can be used to influence any of a number of judgments made about the stimulus including judgments of preference, brightness, familiarity, fame, or clarity, to name but a few.

A problem with the nonspecific activation model is that it has difficulty explaining why recognition in a mere exposure experiment does not occur above chance. If prior exposure activates stimulus representations in memory and this nonspecific activation can influence any of a number of judgments about a stimulus, why, then, does it not influence recognition judgments?

Fluency Attribution Model

The fluency attribution model (Seamon, Brody, & Kauff, 1983a; Bornstein & D’Agostino, 1994) asserts that repeated exposure to stimuli during the training phase increases one’s ability to process the perceptual features of those stimuli. Thus, in a mere exposure experiment, old stimuli will be processed more fluently than new stimuli at test. This experience of fluency is affectively neutral and can be attributed to a wide variety of stimulus characteristics made available by the context. For example, in the context of a liking judgment, the fluency generated upon exposure to a previously seen stimulus may

be attributed to “liking” of the old stimulus. By contrast, in the context of a disliking judgment, the fluency generated upon exposure to a previously seen stimulus may be attributed to “disliking” of the old stimulus.

Similar to the nonspecific activation model, the fluency attribution model has difficulty accounting for at chance recognition performance in mere exposure experiments. If prior exposure leads to increased perceptual fluency and perceptual fluency can be attributed to any available stimulus characteristic, why, then, can it not be used to differentiate new from old?

Hedonic Fluency Model

The hedonic fluency model (Winkielman & Cacioppo, 2001) maintains that facilitated processing (e.g., as a result of prior exposure) elicits a genuine affective reaction and that this affective reaction is always positive. Thus, this model stands in contrast to the nonspecific activation model and the fluency attribution model, which state that the affect accompanying the fluent processing of a previously seen stimulus can be positive or negative depending on the context. The hedonic fluency model predicts that fluent processing of an old stimulus (in the context of a mere exposure experiment) should always be accompanied by an increase in positive evaluations of that stimulus, but never an increase in negative evaluations. For example, according to the hedonic fluency model, the old stimulus in a mere exposure experiment should always be rated as being more positive (e.g., “liked”, “brighter”, “clearer”, etc.), but never more negative (e.g., “disliked”, “darker”, “hazy”, etc.).

A problem with this model is that a number of studies have reported an increase in negative evaluations of previously seen stimuli (Klinger & Greenwald, 1994; Brickman, Redfield, Harrison & Crandall, (1972); Mandler, Nakamura, & Van Zandt, 1987). Thus, it appears that not all evaluations of fluently processed stimuli are inherently positive. In addition, like the nonspecific activation model and the fluency attribution model, the

hedonic fluency model has difficulty accounting for at chance recognition performance in mere exposure experiments.

The Uncertainty Reduction Model

The uncertainty reduction model (Lee, 2001) suggests that two opposing processes, positive habituation and tedium, mediate the mere exposure effect. The theory asserts that there is a delicate balance between these two processes. Increased exposure leads to decreased uncertainty about a stimulus, which in turn leads to increased ratings of preference. However, after exceeding a critical number of exposures, continued presentation of training stimuli leads to tedium and decreased preference. Thus, the theory contends that there is an exposure threshold that, when exceeded, leads to boredom and decreased (i.e., at chance) preference ratings.

A problem with this theory is that it is dependent on subjects' explicit recognition of repeated stimuli. How can one become bored with a stimulus if one can not recall ever having seen it? The theory relies on the conscious recall of previously exposed stimuli, which, in many mere exposure experiments, is impossible given the extremely brief exposure durations.

Summary of Previous Mere Exposure Models

The models described above do not provide an adequate explanation of findings in the mere exposure literature. In general, they do an admirable job of proposing mechanisms by which preference judgments may be made above chance, but do not provide a satisfactory explanation as to why recognition judgments remain at chance. Thus, there remains a need for a comprehensive model of the mere exposure effect. A recent study by Whittlesea and Price (2001) attempted to provide such a model. The model was anchored in SCAPE, a theory of mind proposed by Whittlesea in 1997.

SCAPE

SCAPE (Selective Construction and Preservation of Experience) is a theory that conceives of the mind as a unitary entity that performs two fundamental functions: (1)

production, and (2) evaluation (Whittlesea, 1997; Whittlesea & Williams, 1998a; Whittlesea & Podrouzek, 1995).

The production function is initiated whenever one encounters a stimulus for any reason, in any context. Thus, with each stimulus encounter, there is a concurrent mental production. A mental production can be thought of as the generation of information about a stimulus; for example its name, its use, its colour, its meaning, etc. Each mental production is governed by the stimulus complex, which consists of: (1) the item, (2) the context in which the item occurs, and (3) the purpose for encountering the item. These three components of the stimulus complex interact with one another and collectively serve as a cue to recruit prior processing experience one has had with similar stimuli, in similar situations, in the past. Thus, every hour of every day (and night), we are constantly producing mental events mediated by the stimulus complex recruiting prior processing experience.

The second function performed by the mind is evaluation. The job of the evaluation function is to assess the fluency with which each mental production occurs, given the current processing conditions. Thus, the evaluation function evaluates the clarity, quality, and cohesiveness of the information one produces about a stimulus and determines if the information has been produced with the fluency one would expect for the current situation. Without the evaluation function, an individual would be continually producing information about stimuli with no way to assess the appropriateness of their productions.

In most situations, the evaluation function deems a mental production to be appropriate for the given processing conditions and so the production process continues unencumbered. Occasionally, however, the evaluation function discovers a discrepancy in the fluency with which a mental production is produced and the fluency with which it was expected to be produced. In this situation, the production process is terminated, and a source is sought to account for the greater than expected fluency.

There are a number of reasons why the production process on a particular stimulus might occur more fluently than expected. These include prior exposure, the use of predictive contexts, and reduced stimulus masking, to name a few. Studies that have covertly manipulated processing conditions to increase processing fluency have demonstrated that subjects will ascribe a diverse range of qualities to stimuli in an effort to account for greater than expected fluency. For example, fluently processed stimuli have been judged to be more pleasant (Zajonc, 1968), less pleasant (Brickman et al, 1972), brighter or darker (Mandler, Nakamura, & Van Zandt, 1987), more recently presented, repeated, and presented for longer durations (Whittlesea, 1993), more familiar (Bonnano & Stillings, 1986) and more famous (Jacoby, Woloshyn, & Kelly, 1989). Thus, subjects appear to reconcile discrepancies between expected and actual fluency by attributing excess fluency to a stimulus characteristic made available by the stimulus complex. Unconsciously, the reasoning process may proceed as follows: (1) I processed that stimulus with surprising fluency (2) Why did I process that stimulus so fluently? (3) It must be because it is brighter/clearer/more pleasant, etc.

In summary, SCAPE theory contends that the mind performs two fundamental functions, production and evaluation. The stimulus complex guides the production of information about a stimulus and then the evaluation function determines how fluently the production process occurred given the processing conditions at the time. If the production process occurs more fluently than expected, a source is sought to explain this increased fluency.

SCAPE and Analytic/Non-Analytic Processing

According to SCAPE, the fundamental functions of production and evaluation are constantly occurring as we encounter stimuli in our daily lives; we come upon a stimulus, the stimulus complex guides the production of information about that stimulus and the evaluation function assesses how fluently the production of information about that particular stimulus occurred.

With each encountered stimulus, an infinite amount of information can be produced (e.g., name, colour, likeability, use, height, value, etc.). This information can be based on processing either a part of the stimulus (e.g., a piece of the puzzle) or the entire stimulus (e.g., the entire puzzle). The former is an example of an analytic processing strategy, the latter is an example of a non-analytic processing strategy. These two processing strategies are important to the SCAPE model of the mere exposure effect and are further elaborated below.

The Analytic Processing Strategy

When processing an item analytically, something within the stimulus complex suggests that the item should be deconstructed into its component parts. Thus, rather than perceiving the stimulus as a coherent, integrated whole, one is encouraged to process the individual components that constitute the larger stimulus. For example, when processing the pseudo-homophone "PHRAWG" from an analytic perspective (e.g., "does this string of letters contain an 'M'?"), a separate mental production would be generated for each part of the stimulus (i.e., information would be produced about the P, then the H, and then the R, etc.) rather than generating one mental production for the entire "global" form of the stimulus. The letters in the stimulus "PHRAWG" would not be integrated with one another to allow the individual to perceive the stimulus as a word.

The Non-analytic Processing Strategy

If an item is processed non-analytically, something within the stimulus complex indicates that the item should be processed as an integrated, coherent whole. Rather than viewing the stimulus as a collection of parts, one is encouraged to process the stimulus as a synthesized whole and thus generate a mental production for the entire stimulus. For example, when processing the pseudo-homophone "PHRAWG" from a non-analytic perspective (e.g., "if pronounced phonetically, is this a word?"), one would perceive the stimulus as an actual word and thus gain access to the wealth of prior processing

experience related to the word/concept "PHRAWG" (e.g., their appearance, their colour, habitat, etc.).

SCAPE, Analytic/Nonanalytic Processing, and the Mere Exposure Effect

Whittlesea and Price (2001) conducted a series of experiments in which they sought to understand the mere exposure effect based on the principals of SCAPE. They concluded that the mere exposure effect was an artifact of the alternative strategies (analytic vs. non-analytic) that subjects were using to generate information about stimuli they were exposed to at test. When subjects were encouraged to adopt an analytic strategy at test, target selection was at chance. However, when they were encouraged to adopt a non-analytic strategy at test, target selection was significantly above chance.

The Analytic Approach to Test Stimuli in Mere Exposure

Making a recognition judgment in a mere exposure experiment is a very demanding task; in 10 seconds, subjects can see up to 100 training stimuli, making recognition incredibly difficult. Whittlesea and Price proposed that when subjects were faced with the recognition judgment, they adopted a recognition strategy in which they desperately searched for a distinctive feature on one of the two test items that would allow them to differentiate new from old; that is, subjects examined the parts of test items for a memorable detail. By adopting this strategy, subjects processed the test items analytically; each part of the test stimulus was analyzed separately in search of a distinctive element.

Unfortunately, in a mere exposure experiment, the training items are presented so briefly that subjects do not have time to process the "parts" of training items. Therefore, at test, if they attempt to make recognition judgments by examining the parts of test items, they will perform poorly because they have no prior processing experience with these parts. According to the SCAPE theory, with no prior processing experience available, the production process carried out on the parts of old test items cannot occur

fluently. Without this fluency to help guide their decision-making process, subjects are unable to distinguish old from new.

The Non-Analytic Approach to Test Stimuli in Mere Exposure

Whittlesea and Price (2001) proposed that the preference judgment is completed in a different manner. When making the preference judgment, rather than adopting a strategy in which the individual components of test items are examined for distinctiveness, subjects instead evaluate and appreciate the global form of the test stimuli. Most preference decisions are made by taking into account the entire stimulus, rather than focusing on a particular part. For example, when deciding whether a painting is pleasant or not, one does not typically base one's decision on a single corner, or brush stroke, but rather, one acknowledges the quality, coherence, and global form of the painting prior to arriving at a decision. This non-analytic strategy is crucial in mere exposure experiments because it grants subjects access to prior processing experience with training items.

Recall that the training items in a mere exposure experiment are only seen very briefly. Despite this brief exposure however, the overall, global form of each item is processed, albeit slightly, and this processing experience can become available to subjects when they approach test items non-analytically (i.e., make the preference judgment). According to SCAPE theory, this prior non-analytic processing experience can be recruited to help the production process on old test items occur more fluently than would be expected. At test, this extra fluency may be attributed to the old item being more "pleasant" and result in target selection greater than chance.

Whittlesea and Price (2001) conducted a series of experiments in which they covertly manipulated the strategy with which subjects approached test stimuli in mere exposure experiments. They found that when subjects were encouraged to adopt a non-analytic strategy at test, target selection was above chance. By contrast, when subjects were encouraged to adopt an analytic strategy at test, target selection fell to chance.

The current study is based, in part, on this dissociation in target selection when using analytic and non-analytic processing strategies.

Cerebral Lateralization

One of the fundamental aspects of human brain organization is a differentiation in anatomy and function between the cerebral hemispheres. Although at first glance the hemispheres appear to be mirror images of one another, this apparent symmetry is an illusion. Asymmetries between the two hemispheres can be found in neuroanatomy, neurotransmitter distribution and reception, and most importantly in terms of their involvement in cognitive and emotional processing.

Paul Broca (1861, 1865) made one of the first hemispheric specialization discoveries in the 1860's when he reported that damage to a region of the left temporal lobe disrupted the ability to produce fluent speech. The importance and specialization of the left hemisphere for language was later corroborated by Carl Wernicke (1874), who observed that damage to a different region of the left-hemisphere produced the opposite syndrome: disrupted language comprehension with intact production. The discoveries by Broca and Wernicke paved the way for the theory of cerebral dominance: the notion that one hemisphere dominates or leads the processing of information in a particular domain.

One-hundred years after the pioneering work done by Broca and Wernicke, more systematic work examining cerebral laterality was conducted using so-called "split-brain" patients. Split-brain patients were individuals who suffered from severe epilepsy. In the hopes of containing the epileptic foci to one hemisphere and preventing the spread of seizure activity to healthy brain tissue, neurosurgeons occasionally performed a procedure in which the corpus callosum (the commissure of nerve fibers connecting the two cerebral hemispheres) was severed, thus limiting both the spread of seizure activity and the flow of information between the two halves of the brain. This procedure allowed the competencies of each hemisphere to be assessed in isolation from one another. Work by Gazzaniga, Bogen, and Sperry (1965) using split-brain patients confirmed the superiority

of the left-hemisphere for language processing, especially in the domain of speech output and phonology (as cited in Van Kleeck, 1989). The right-hemisphere was found to be superior at visuospatial tasks, such as the arrangement of blocks, the transformation of spatial patterns, and the recognition of faces.

Subsequent studies using patients who have suffered unilateral brain damage have generally found that the left-hemisphere is dominant, or specialized, for comprehension and expression of language, arithmetic, and analytic functions, whereas the right-hemisphere is specialized for complex nonverbal perceptual tasks, for some aspects of visual and spatial perception, and non-analytic functions (Oken, Kishiyama, Kaye, & Jones, 1999; Fagot & Deruelle, 1997; Lamb, Robertson, & Knight, 1990; Blanca, Zalabardo, Garcia-Criado, & Siles, 1994; Weber, Schwarz, Kneifel, Treyer, & Buck, 2000).

Hemispheric specialization can also be demonstrated in neurologically intact individuals by directing sensory information so that initially it is only received by one hemisphere. In the visual modality, this can be accomplished using the divided field technique. The divided field technique makes use of tachistoscopic presentation to limit the initial presentation of visual information to one hemisphere of the brain. Neuroanatomically, stimuli in the right half of the visual field are registered by receptors on the left side of the retina on each eye, which then transduce impulses to the visual cortex of the left occipital lobe. Stimuli in the left half of the visual field are transmitted by both eyes to the visual cortex of the right occipital lobe. In other words, information presented in the left visual field (LVF) is initially transmitted to the right-hemisphere, whereas information presented in the right visual field (RVF) is initially transmitted to the left-hemisphere.

Researchers using the divided field technique restrict the access of visual information to one cerebral hemisphere by flashing stimuli very briefly (e.g., <200ms) to one of the visual fields, effectively negating an individual's opportunity to shift his or her

eyes to the presented stimulus and thus view the stimulus in both visual fields. The result is that information flashed to the LVF is initially processed by the right-hemisphere and information flashed to the RVF is initially processed by the left-hemisphere.

Hemispheric performance on a particular task is generally measured by either the speed or accuracy of responding. For example, if the recall of information is, on average, superior when presented to the RVF than when presented in the LVF, the left-hemisphere is assumed to be specialized for processing that type of information. In contrast, an advantage for information presented in the LVF is considered indicative of right-hemisphere specialization.

Research using the divided field paradigm has generated a number of important findings which tend to confirm the work done with split-brain patients and patients with unilateral brain damage; specifically, the left-hemisphere processes information in a piece-meal and analytic fashion with a special emphasis on temporal relationships, whereas the right-hemisphere processes information in a gestalt and holistic fashion with special emphasis on spatial relationships (Fink, Halligan, Marshall, Frith, Frackowiak, & Dolan, 1999; Van Kleeck, 1989; Banich & Noll, 1993; Hubner, 1997).

Potential Research Question

As detailed previously, recent research by Whittlesea and Price (2001) has suggested that the mere exposure effect may be an artifact of the different strategies (analytic versus non-analytic) used by subjects when making recognition and preference judgments. Further, as noted above, the two cerebral hemispheres appear to use different processing strategies. Specifically, the left-hemisphere has been implicated in "analytic"-type processes such as reading, writing and language and appears to be particularly efficient at processing smaller parts, higher spatial frequencies, and the details of stimuli. By contrast, the right-hemisphere has been implicated in "non-analytic" or "Gestalt"-type processes such as spatial processing and face recognition, and appears to be particularly efficient at processing the global form, lower spatial frequencies, and course patterns.

This sets up an interesting dissociation in which one half of the brain uses predominantly an "analytic" strategy and one half of the brain uses predominantly a "non-analytic" strategy. The question posed by the current study was, would a mere exposure effect be found when training item presentation was restricted to either the RVF, or the LVF?

The author predicts that when subjects are restricted to using their right-hemisphere to process the training items, typical mere exposure results should be found; that is, target selection should be above chance when making the preference judgment and at chance when making the recognition judgment. Hypothetically, when the right-hemisphere is used to process the training items, a limited, but useful amount of non-analytic processing can take place. This non-analytic processing may then become available to subjects when they adopt a non-analytic approach to stimuli at test (i.e., make the preference judgment). Having access to this prior processing should help the production process on old items occur more fluently and lead to an increase in target selection when making the preference judgment.

Conversely, since predominantly analytic processing is theorized to occur in the left-hemisphere, the author predicts that when subjects are restricted to using their left hemisphere to process training stimuli, no mere exposure effect should be found; that is, target selection should be at chance for both preference and recognition judgments. Hypothetically, when the left-hemisphere is used to process the training items, virtually no analytic processing can take place because the items are flashed too quickly. With no prior processing to help the production process on old items occur fluently, target selection by both recognition and preference judgments should be at chance.

With these hypotheses in mind, a brief review of previous lateralized mere exposure studies will now be conducted.

Previous Lateralized Mere Exposure Studies

A number of studies have examined the effect of lateralized training item presentation on the mere exposure effect. In general, the findings are inconclusive; some

studies report an increase in target selection following initial presentation of training items to the RVF, while others report an increase in target selection following initial presentation of training items to the LVF.

The first lateralized mere exposure study was conducted by Seamon and his colleagues at Wesleyan University (Seamon, Brody, & Kauff, 1983a). In the training phase, 50 stimuli (10 irregular polygons shown 5 times each) were displayed for 2ms each with a 2s interstimulus interval. Half of the stimuli were shown 1° to the left of fixation (LVF) and half were shown 1° to the right of fixation (RVF). Results revealed a RVF advantage for preference judgments.

As a follow up to this experiment, Seamon and his colleagues (1983a) conducted a second lateralized mere exposure study. The study used the same procedure outlined above with the following changes: (1) stimulus exposure during training was lengthened from 2ms to 5ms, and (2) a pattern or energy mask now followed each training item presentation. The results of this second experiment replicated those of the first; there was a RVF advantage for preference judgments. In addition, there also appeared a LVF advantage for recognition judgments.

The results of the Seamon et al. studies are in contrast to what would be predicted by the SCAPE theory. Target selection by affect (i.e., making the preference judgment) would not be expected to be above chance when stimuli are initially presented to the RVF. This is due to the hypothesized ineffectiveness of left-hemisphere analytic processing in mere exposure studies. Similarly, target selection by recognition would not be expected to be above chance in the right-hemisphere. This, again, is due to the hypothesized ineffectiveness of the analytic processing strategy induced by recognition questions.

Later in the same year (1983), Seamon et al. attempted to replicate the findings of their earlier lateralized mere exposure experiments (Seamon, Brody, & Kauff, 1983b).

They were unable to do so; no visual field differences were noted between preference and recognition judgments.

Landis, Christen and Graves (1992) conducted a series of lateralized mere exposure experiments in which they varied training item exposure duration and stimulus characteristics. Subjects were required to make preference and recognition judgments on pictures of faces or non-words following subliminal (1ms), liminal (2-5ms), or supraliminal (20ms) training exposure. There were 16 different targets: 8 were presented to the LVF and 8 were presented to the RVF. Each target was paired with a distractor and presented 5 times in a heterogeneous sequence for a total of 80 presentations.

Target selection by preference was significantly better than target selection by recognition for faces initially presented subliminally to the RVF. Under liminal conditions, neither preference nor recognition judgments were significantly different from chance for either faces or non-words. Finally, in the supraliminal condition, recognition of non-words presented to the RVF was significantly different from chance, whereas stimulations of the LVF did not dissociate the two types of judgments.

The predictions of the current study are not supported by Landis et al. Affective judgments were superior to recognition judgments for subliminal faces presented to the RVF, which would not be predicted by the current author. Further, the null results of the liminal condition are contrary to what would be expected according to the present hypotheses. The mixed results of the supraliminal condition are less noteworthy for the purposes of the current study given that the mere exposure effect was not possible because the stimulus was explicitly recognized (20ms exposure).

Zarate, Sanders, and Garza (2000) conducted an interesting mere exposure study in which training stimuli were shown centrally (presented to both visual fields), but test stimuli were presented laterally (presented to one visual field). In the training phase, 32 pictures of faces were presented for 3s each. In the test phase, two vertically arranged pictures were shown (1 target, 1 foil) in either the LVF or the RVF for 200ms. Subjects

were asked to identify which of the two pictures presented at test appeared to be “friendlier”. Results showed that the mere exposure effect was detected only for those test stimuli presented to the subjects’ LVF.

Though these results suggest a right-hemisphere advantage for target selection and thus appear to support the hypotheses of the current study, they may be confounded by the fact that faces were used as stimuli. The right-hemisphere has been shown to be specialized for the processing of faces (Banich, 1997; Sergent, Ohta, & MacDonald, 1992). Thus, the LVF advantage demonstrated in this experiment may be attributable to the right-hemisphere’s superiority in processing of faces and for no other reason. It would be interesting to carry out a similar study using neutral stimuli and observe if a LVF advantage remains, or alternatively, using words and observe if a RVF advantage appears.

In 1998, Elliott and Dolan presented functional neuroimaging data on the mere exposure effect (Elliot & Dolan, 1998). In the training phase, 20 black and white Japanese ideograms were randomly presented 10 times each. The stimuli were presented for 50ms each and were immediately followed by an energy mask lasting 450ms. During the test phase, subjects were asked to make a series of forced-choice recognition or preference judgments on two test stimuli. In support of the current hypotheses, preference judgments were associated with activation of the right lateral prefrontal cortex, whereas recognition judgments were associated with activation of the left frontopolar cortex. Thus, it may be that making recognition judgments engages the analytic left-hemisphere, whereas making preference judgments engages the non-analytic right-hemisphere.

The results of the lateralized mere exposure studies described above have observed variable results when training stimuli are initially presented to one visual field. Some studies report an increase in target selection following presentation to the RVF, while others report an increase in target selection following presentation to the LVF. In

general, the results of previous lateralized mere exposure experiments are inconclusive. Given the small size of the mere exposure effect, only consistent replication of one finding over another will provide insight into which hemisphere is superior at processing briefly presented stimuli.

Current Study

The current study was conducted to provide additional information on the effect of lateralized presentation of training items on the mere exposure effect. The author predicted that no mere exposure effect would be found when training items were presented to the RVF. This was based on the theory that the left-hemisphere is an analytic processor and that analytic processing (according to Whittlesea and Price) is ineffective in mere exposure experiments. Conversely, the author predicted that a mere exposure effect would be found when training items were presented to the LVF. This was based on the theory that the right-hemisphere is a non-analytic processor and that non-analytic processing (according to Whittlesea and Price) is effective in mere exposure experiments.

The current study differed from previous lateralized mere exposure studies in a number of ways. First, rather than having subjects make preference judgments, the current study required subjects to make brightness judgments (e.g., Which one is brighter?). A number of studies have reported on the discordant abilities of the right and left hemispheres to process emotional stimuli. Specifically, the right-hemisphere appears to be more involved in the processing of negative emotion, whereas the left-hemisphere appears to be more involved in the processing of positive emotion (Gainotti, 1972; Reuter-Lorenz & Davidson, 1981). This hemispheric asymmetry may bias subjects' preference decisions in lateralized mere exposure studies. For example, those stimuli presented to the RVF may be positively valenced due to the superior ability of the left-hemisphere to process positive emotions. As a result, subjects may be more inclined to rate stimuli initially presented to the RVF as more pleasant. Conversely, those stimuli

presented to the LVF may be negatively valenced due to the superior ability of the right-hemisphere to process negative emotions. As a result, subjects may be more inclined to rate stimuli initially presented to the LVF as less pleasant.

To avoid this potential confound and reduce the possibility that any observed difference between the hemispheres was merely due to differences in the ability to process emotional stimuli, a brightness judgment was substituted for the preference judgment. According to the SCAPE theory, accurate target selection when making brightness judgments should not differ from accurate target selection when making preference judgments (Whittlesea, Jacoby, & Girard, 1990). In each case, the fluency generated upon processing a previously seen stimulus is attributed to an available stimulus characteristic (brightness or preference). The only difference between the two judgments is the stimulus characteristic to which the fluency is attributed; in previous studies it was preference, in the current study it is brightness.

The second change made in the current study was to avoid using stimuli that would be preferentially processed by one or the other hemisphere. It is well known in psychology that the left-hemisphere is specialized for language operations and the right-hemisphere for face recognition. Thus, using faces as stimuli in a mere exposure experiment may favour right-hemisphere processing, whereas using words may favour left-hemisphere processing. In an effort to control for this potential confounding factor, neutral stimuli were used in the study (e.g., chairs and leaves). It was hoped that these stimuli would be processed equally well by both the right and left-hemispheres with the only difference being that the right-hemisphere would process the global form whereas the left-hemisphere would process the parts.

The third change made in the current study was to increase the number of stimuli presented during the training phase. Previous lateralized mere exposure studies have used a limited number of stimuli (10-16), each shown between 2-5 times. The current study elected to use a large number of stimuli (30), each shown 5 times.

Increasing the number of training item exposures was expected to decrease the likelihood that recognition would occur above chance. Above chance recognition has been shown to exterminate the mere exposure effect (Landis et al, 1992; Bornstein, 1992). One theory is that explicit recognition initiates a correction process whereby the fluency generated upon viewing a previously seen stimulus is correctly attributed to prior exposure and not to an available stimulus characteristic (Bornstein, 1992). To avoid this possibility, and to increase the likelihood that a mere exposure effect would be found, the number of stimuli exposed during the training phase was increased to 150.

The fourth change in the current study was to introduce a pattern mask immediately following each training item exposure. The vast majority of mere exposure studies do not use a mask following training item presentation (Bornstein, 1992). This allows the visual residue of each training item to remain active on the retina, thus permitting further processing. In an effort to reduce the possibility for extensive, detailed processing of the training items, each item was shown for 10ms and immediately followed by a 20ms pattern mask.

Method

Participants

Forty right-handed men registered in a first year undergraduate psychology class at the University of Victoria participated in the study. In exchange for participation, subjects were awarded points towards their grade in the class. In order to maximize the possibility of using subjects who demonstrated the typical left-hemisphere/analytic – right-hemisphere/non-analytic dissociation, certain subject restrictions were put into place.

First, the study was limited to right-handed subjects. Left-handed individuals show a right-hemisphere dominance for language at a much higher incidence rate than right-handed individuals (Rasmussen & Milner, 1977)). A right-hemisphere dominance for language may serve as an indicator that an individual does not exhibit the typical left-

hemisphere dominance for analytic processing. Allowing left-handed subjects to participate would thus increase the possibility of including subjects who manifest atypical hemispheric lateralization patterns, theoretically making it much more difficult to detect an effect. As a result, only right-handed individuals were recruited.

The second subject restriction was that the study was limited to men. Women have been shown to demonstrate less lateralization of function than men (Hiscock et al., 1995) meaning that cognitive processes in women are more evenly distributed between the two hemispheres. Conversely, men exhibit greater lateralization of function, thus cognitive processes are more likely to be localized in one hemisphere or the other. Given this finding, it is much more likely that analytic processing will be confined primarily to the left-hemisphere and non-analytic processing confined primarily to the right-hemisphere in men; women are more likely to have analytic and non-analytic processing evenly distributed between the two hemispheres.

By limiting the study to right-handed men, the current study maximized the possibility of including subjects who had analytic processing strategies localized in the left-hemisphere and non-analytic processing strategies localized in the right-hemisphere.

Materials

Sixty black and white pictures of chairs and sixty black and white pictures of leaves were assembled similar to those used in the Whittlesea and Price (2001) study (see Appendix A and B). The chairs were variously cloth-covered or wooden, had various leg and arm styles and were simple or highly decorated. The leaves were from various species of trees. The variation in this case was of shape, number and arrangement of veins, edge detail (e.g., serrations and indentations) and so on.

Thirty of the sixty chairs and thirty of the sixty leaves were used exclusively as training items for all subjects; that is, the same 30 chairs and 30 leaves were randomly presented within the training phase. The remaining 30 chairs and 30 leaves were used as

foils at test. The training stimuli were mounted along with distractors onto white index cards for use on a Gerbrands 300 series tachistoscope.

Two distractors (see Figure 1) and two pattern masks (see Figure 2) were constructed using the draw option from Adobe Photoshop. Distractors were presented during the training phase to dissuade subjects from dedicating their full attention to the "target" visual field. Masks were presented during the training phase to erase the retinal residue of training items, thereby preventing elaborate processing of training items.

The "chair" distractor and the "chair" mask were constructed for use with the chair training stimulus set. The chair distractor and mask had "chair-like" perceptual characteristics (e.g., shape, shading, size, etc.), but were not in fact actual members of the chair family. The "leaf" distractor and the "leaf" mask were constructed for use with the leaf training stimulus set. The leaf distractor and mask had "leaf-like" perceptual characteristics (e.g., shape, shading, size, etc.), but were not in fact actual members of the "leaf" family.

Procedure

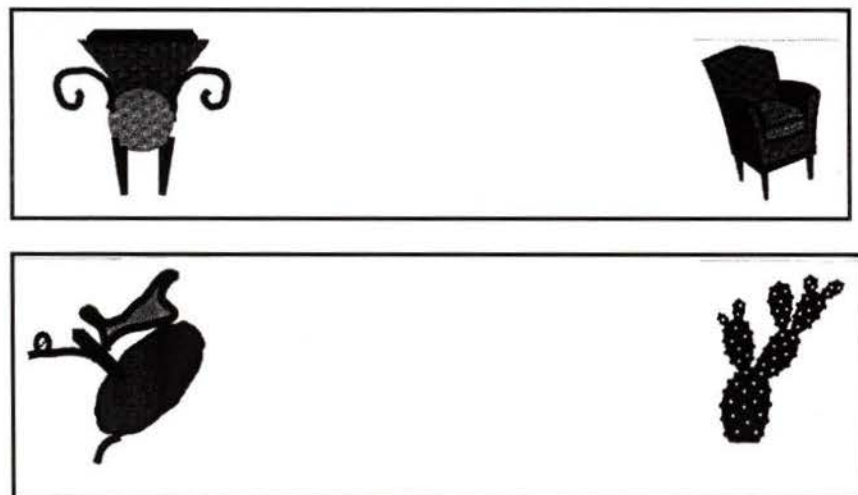
Two training and test phases were conducted with each subject. Type of stimulus (chair versus leaf) and type of judgment (recognition versus brightness) were alternated for all subjects. For example, if a subject viewed chairs in the first training and test phase, they viewed leaves in the second training and test phase. Likewise, if a subject made the recognition judgment in the first test phase, they made the brightness judgment in the second test phase.

Subjects were told that the purpose of the study was to investigate the processing of briefly presented stimuli. For each training phase, subjects were simply asked to remain focused on a central fixation point as a series of pictures were presented. Thirty stimuli (chairs or leaves) were used as training items in the first training phase. Each training item was randomly presented 5 times in the training phase for a total of 150 presentations. The random order of training phase stimuli in the LVF was different from

the random order of training phase stimuli in the RVF. Subjects were asked to focus on a central fixation point for 3 seconds after which two images (a target on one side, a distractor on the other) were flashed simultaneously for 10ms. The target stimulus was presented such that the closest edge of the stimulus was 2.2° to the right or left of midline, thereby limiting its initial presentation to the RVF or LVF, respectively. The distractor was concurrently flashed 2.2° from midline in the visual field opposite that of the target. For each subject, the target training item always appeared in the same visual field, thus, visual field was a between-subjects factor.

An exposure duration of 10ms was chosen to increase the likelihood that laterally presented stimuli were initially processed by one hemisphere and to prevent the details of training items from becoming available for extensive processing. Many subjects reported that they saw something that “looked like a chair of some kind”, or “looked kind of like a leaf”. Based on these responses, it was believed that subjects were able to process the general, holistic shape and form of training items, but were unable to process the specific details.

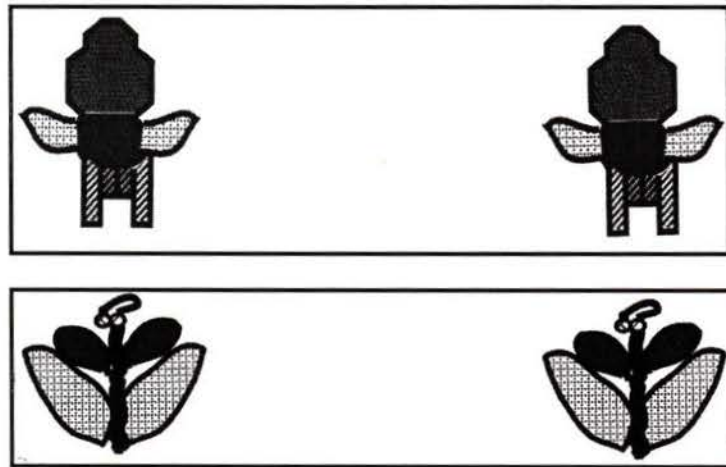
Figure 1 *Sample Training Item Presentation: Target on Right and Distractor on Left*



Immediately following each training item presentation (no interstimulus delay), a 20ms pattern mask appeared over the same spatial location previously occupied by the

target and distractor stimuli. All training stimuli were illuminated with the same intensity of light (100% Field Intensity on the Gerbrands Lamp Drive Circuit) therefore there were no physical differences in brightness between the stimuli.

Figure 2 Pattern Masks For Use With Chair and Leaf Training Stimuli



The training stimuli in the study were not presented “subliminally”; subjects were aware that they were being presented pictures in the LVF and RVF. Some even became aware that the picture in one field was constantly changing (the target), whereas the picture in the opposite field remained the same (the distractor). However, subjects were reminded throughout the study to remain focused on the central fixation point. They were informed that this would provide them with the best opportunity to get a sense of what was being presented.

Following the training phase (which lasted approximately 7.5 minutes), a test phase was conducted in which subjects were asked to make 30 forced-choice recognition or brightness judgments. Test stimuli were illuminated with the same intensity of light (100% Field Intensity on the Gerbrands Lamp Drive Circuit) therefore there were no physical differences in brightness between them. On each test trial, subjects were presented with two vertically arranged stimuli from the same category (chairs or leaves, depending on the initial training stimuli). Test stimuli were presented in the centre of the screen. One of the two stimuli presented at test was old (one of the 30 seen during

training) and one was novel (one of the 30 not seen in training). On half of the test trials, the target was the top picture, on half of the test trials the target was the bottom picture. All subjects viewed the test trials in the same order with the targets in the same position (i.e., top or bottom). Subjects made their recognition or brightness judgment by tapping keys on an electronic response box that corresponded with either the top or bottom picture. The left key on the response box corresponded to the top picture, the right key with the bottom picture. In order to ensure that subjects were pressing the response key that corresponded with the picture they were selecting, for the first 15 – 20 judgments, the experimenter verbally repeated the choice of the subject. For example, if the subject hit the left response key, the experimenter said “top”. The response box also recorded response time to make the judgment. Test stimuli remained visible until subjects made their response. Following this test phase, a second training and test phase were conducted using the second set of training items (chairs or leaves) and the alternate forced-choice decision (recognition or brightness).

Results

The data were first examined to determine whether subjects had responded differently to the two sets of stimuli (chairs and leaves). Recognition and brightness judgments of chairs and leaves were not significantly different from one another ($t(19) = .463, p = .645, t(19) = .986, p = .330$) for recognition and brightness, respectively. The data were next examined to determine whether there was an order effect for type of judgment (i.e. recognition and brightness). Recognition judgments made first were not significantly different from recognition judgments made second, ($t = -1.261, p = .215$) and brightness judgments made first were not significantly different from brightness judgments made second ($t = -1.122, p = .269$). Accordingly, subsequent analyses collapsed over the set type and order variables.

Accuracy Analyses

A mixed design 2-way ANOVA, with visual field of exposure (LVF or RVF) as the between-subjects variable and judgment task (recognition or brightness) as the within subjects variable was analyzed on average number of correct targets selected. The only significant effect was a main effect of judgment task, $F(1,38) = 5.33$, $p = .027$, Cohen's $d = .37$. Subjects selected target stimuli better for judgments of brightness than of recognition. The main effect of visual field was not significant, $F(1,38) = 4.044$, $p = .051$, and there was no visual field X judgment task interaction, $F(1,38) = .307$, $p = .583$. Table 1 shows the mean percentage of targets selected as a function of judgment type and visual field.

Table 1 Mean Percentage of Target Stimuli Selected

Judgment Task	Visual Field	
	RVF	LVF
Recognition	48.0	52.8
Brightness	53.0	56.3*

($p < .05$)

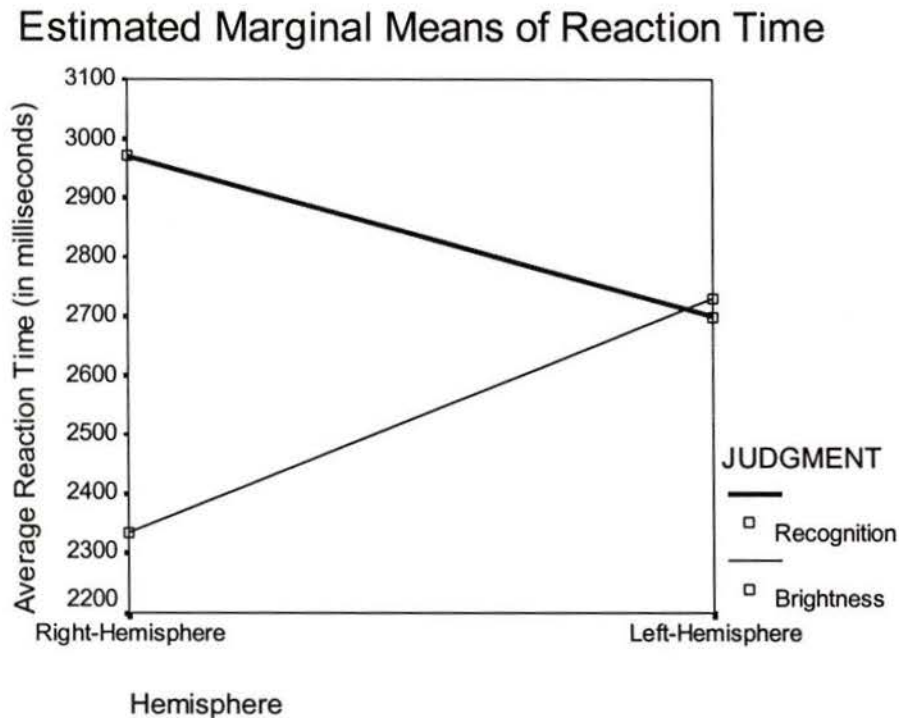
When analyzed by one sample t tests, target selection was significantly greater than chance only when making the brightness judgment on stimuli initially presented in the LVF, $t(19) = 3.421$, $p < .003$, Cohen's $d = .77$. None of the other means shown in Table 1 were statistically different from chance, though the power to detect an effect size of the magnitude found for the brightness judgment in the LVF was .93.

Reaction Time Analyses

Data were next examined in order to investigate the effect of type of judgment (recognition or brightness), visual field (LVF or RVF), and accuracy (hit or miss) on reaction time. Analyses were conducted on all reaction times, not just those correctly responded to.

A mixed design 3-way ANOVA with judgment task (recognition or brightness) and accuracy (hit or miss) as within-subjects variables, and visual field of exposure (LVF or RVF) as a between-subjects variable, was conducted with mean reaction time as the dependent variable. The only significant effects were a main effect of judgment task, $F(1,38) = 5.277, p = .027$, Cohen's $d = .34$, and a Judgment Task X Visual Field interaction, $F(1, 38) = 6.405, p = .016, \eta^2 = .134$. Subjects made their decisions faster for judgments of brightness than of recognition, and faster when those brightness judgments were made of stimuli initially presented in the left visual field (see Figure 3). Follow up tests showed that the visual field difference was not significant for either the recognition judgment, $t = .660, p = .513$, or the brightness judgment, $t = .951, p = .347$. However, the recognition versus brightness judgments differed significantly in the LVF, $t = 2.99, p = .008$.

Figure 3 *Estimated Reaction Time Means for Recognition and Brightness Judgments in the Left and Right-Hemisphere*



Discussion

The results are discussed in relation to four areas: (1) SCAPE and the mere exposure effect, (2) Implications for previous mere exposure studies (3) Limitations, and (4) Future research.

SCAPE and the Mere Exposure Effect

The mere exposure effect has been a topic of interest in psychology for well over 100 years. One finding that has puzzled psychologists about the effect, however, is the dissociation observed between target selection when making recognition judgments and target selection when making preference judgments. It seems strange that individuals consistently endorse previously seen items when making the preference judgment, but have no recollection of having seen those same items when making the recognition judgment.

Whittlesea and Price (2001) concluded that the dissociation between recognition and preference judgments was an artifact of the alternative strategies (analytic vs. non-analytic) subjects were using to make the two judgments. When making the preference judgment, they hypothesized that individuals were using an effective non-analytic strategy. This non-analytic strategy granted them access to prior processing experience from training, which they could then use to help differentiate new from old at test. By contrast, when subjects were making the recognition judgment, they were using an ineffective analytic strategy. This analytic strategy prevented subjects from gaining access to prior processing experience, and consequently limited their ability to differentiate new from old at test.

The current study elaborated on this analytic/non-analytic distinction. Many studies have demonstrated that the right-hemisphere employs a non-analytic strategy for processing stimuli, whereas the left-hemisphere employs an analytic strategy.

Given this hemispheric dissociation and the hypothesized advantage of using a non-analytic approach in mere exposure experiments, it was predicted that a mere

exposure effect (liking in the absence of recognition) would be found when stimuli were initially presented to the LVF (right-hemisphere, non-analytic), but not when they were initially presented to the RVF (left-hemisphere, analytic). Results from the current study support these hypotheses. Target selection accuracy was significantly greater than chance only when making the brightness judgment on stimuli initially presented in the LVF. For all other conditions (i.e., recognition and brightness judgments on stimuli initially presented to the RVF, and recognition judgments on stimuli initially presented to the LVF), target selection accuracy did not differ significantly from chance.

The current study was specifically constructed to control for the generation of fluency and a feeling of familiarity. Hypothetically, the only condition in which subjects were permitted access to prior processing experience, and thus the generation of fluency, was when making the brightness judgment on stimuli initially presented to the LVF. In this condition, non-analytic processing at test (i.e., making the brightness judgment) was matched to non-analytic processing from training (i.e., training item presentation to the LVF). This match permitted the recruitment of prior processing and consequently helped the production process on old items occur fluently. As noted above, this fluency could then be used to help the subject differentiate new from old. In all other conditions (i.e., recognition and brightness judgments based on stimuli presented to the RVF, and recognition judgments based on stimuli presented to the LVF), the generation of fluency was inhibited. In these cases, either processing at test did not match processing during training [e.g., making a recognition judgment (analytic) based on stimuli presented to the LVF (non-analytic)], or there was no prior processing available for recruitment (e.g., when stimuli were initially presented to the RVF). Without the recruitment of prior processing, the production process on old items could not occur fluently and, as a result, target selection by subjects in these other conditions fell to chance.

Analyses of the reaction time data from the study revealed an interesting

finding: subjects were faster at making the brightness judgment on stimuli presented to the LVF than in any other condition. One potential explanation for this finding is that subjects in the three conditions where reaction times were slower may have been waiting for fluency to materialize in order to help them make their judgments. When no fluency developed in these conditions, they were forced to change their decision-making strategy (e.g., guess, choose a chair that resembled one in their house, choose the leaf of their favourite tree, etc.), and this cost them time. By contrast, those subjects making the brightness judgment on stimuli presented to the LVF were granted immediate access to the fluency generated upon processing the old item non-analytically. This instantaneous sensation could then be used to allow subjects in this condition to make their judgments quickly and accurately.

In general, the data from this study support the SCAPE theory. SCAPE purports that the mind performs two fundamental functions: production of information and an evaluation of that production process. When the production process occurs more fluently than expected (due to the recruitment of prior processing), that fluency can then be attributed to a variety of stimulus characteristics (e.g., brightness, liking, more recently presented, etc.). By covertly manipulating processing conditions at training and test, the current experiment was able to control for the generation of fluency. As SCAPE would predict, when training and testing conditions were modified so that circumstances permitted the generation of fluency, target selection improved. Conversely, when training and testing conditions were modified so that circumstances prevented the generation of fluency, target selection fell to chance.

Implications for Previous Mere Exposure Studies

Given that the mere exposure effect could not be generated when stimuli were initially presented to the left-hemisphere, one might hypothesize that the effect in non-lateralized studies is a consequence of processing by the right-hemisphere. In other words, increased target selection by preference in standard, non-lateralized mere exposure

studies may be due to non-analytic processing carried out by the right-hemisphere. It is possible that, upon exposure to a stimulus, each hemisphere produces slightly different information. For example, upon brief, non-lateralized exposure to a picture of a tree, the left-hemisphere may be more likely to process specific features of the stimulus (e.g., leaves, trunk, etc.), whereas the right-hemisphere may be more likely to process the holistic form of the stimulus (e.g., overall shape, inter-relation of parts, etc.). When faced with the (analytic) recognition judgment, subjects may futilely attempt to recruit prior analytic processing experience from the left hemisphere, which, given the deprived processing conditions during training, is unsuccessful and results in target selection at chance. When faced with the (non-analytic) preference judgment, subjects may attempt to recruit prior non-analytic processing experience from the right-hemisphere. This small but significant amount of prior processing may be recruited from the right-hemisphere to aid in the fluent production of information about old stimuli, and lead to target selection above chance. Thus, in standard, non-lateralized mere exposure experiments, processing by the right-hemisphere may be responsible for target selection greater than chance.

The results of the current study are at odds with what has been found in previous lateralized mere exposure studies (e.g., Seamon, Brody, and Kauff, 1983a; Landis, Christen, and Graves, 1992). Previous studies have found target selection by preference to be greater than chance when stimuli were initially presented to the RVF. A number of factors may be responsible for this difference. Many of these have already been discussed, including the use of different judgments (i.e., brightness in the current study, preference in previous studies), the use of a different number of training item presentations (i.e., 150 presentations in the current study, a maximum of 80 in previous studies), the use of stimuli that do not favour the processing of one hemisphere (e.g., avoiding use of words and faces as stimuli), and the use of a pattern mask following each training item presentation. Any of these factors may be responsible for the difference between the results of the present study and the results of previous studies. Most

importantly, however, it should be noted that the current data on this phenomenon do not yet allow a decisive conclusion to be drawn as to which finding is most reliable. Only consistent replication of one finding over another will determine the true effect of lateralized presentation of training items on the mere exposure effect.

Limitations

The current study was unconventional in that it used visual field as the between-subjects factor rather than type of judgment. Given that all target stimuli were presented supraliminally in one visual field during training, subjects may have fixated their gaze on the “target” visual field rather than on the central fixation point. This may have allowed subjects to view the target stimulus with both visual fields, thus negating initial target presentation to one hemisphere. Supraliminal presentation may also have primed subjects to adopt different analysis strategies based on the known side of presentation (a hemispheric priming effect). Future research on the lateralized mere exposure effect could try presenting targets in both visual fields during the training phase (i.e., do not use a distractor). This might prevent subjects from dedicating their attention to one visual field and increase the likelihood that target stimuli are initially processed by only one hemisphere. Alternatively, shorter exposure durations could be used (e.g., 1ms) so that subjects are unaware that stimuli are even being presented during the training phase. This would further reduce the possibility that subjects could view the target stimuli with both visual fields during training.

A further limitation of this study was that it used only right-handed men as subjects. As a result, the generalizability of the findings is restricted. Future studies might try using women and left-handers and observe if similar results are found.

Future Research

An interesting question that cannot be addressed by the present experiment is: to what degree can information originally processed by the left-hemisphere be transferred

across the corpus callosum and secondarily processed non-analytically by the right-hemisphere? One way to investigate this might be to conduct a lateralized mere exposure study in which training items are presented only to the RVF. However, rather than separating the training and test phases by 7.5 minutes (as was done in the present study), a longer delay would be instituted (e.g., 1 hour, 1 day, 1 week). This delay might provide an opportunity for information to be consolidated between the hemispheres, presumably allowing information in the left-hemisphere to become available for processing by the right-hemisphere. Following the delay, a standard forced-choice test phase would be conducted.

One prediction might be that with a longer delay between training and test, more information originally presented to the left-hemisphere might be transferred across to the right-hemisphere and secondarily processed non-analytically. This secondary non-analytic processing might then be recruitable at test, allowing old items originally presented to the RVF to be processed fluently and selected above chance.

One might also wonder how an individual with left-hemisphere damage might perform in a mere exposure experiment. Based on the results of the current study, one might predict that individuals with left-hemisphere damage would continue to demonstrate a mere exposure effect. An individual with left-hemisphere damage would likely continue to score at chance when making the recognition judgment. Recall that analytic processing at test (making the recognition judgment) supposedly compels one to try and recruit prior analytic processing experience from training. With a left hemisphere, damaged or not, there is likely no prior analytic processing experience available given the brevity of the exposures during training. As a result, the generation of fluency should be inhibited and target selection should fall to chance. However, based on the current hypothesis, an individual with left-hemisphere damage might continue to score above chance when making the preference judgment. Recall that non-analytic processing at test supposedly compels one to try and recruit non-analytic processing from training. In this

case, a limited amount of prior non-analytic processing experience may be available based on processing done by the intact right-hemisphere. This small but significant amount of prior processing may be recruited from the right-hemisphere to aid in the fluent production of information about old stimuli, and lead to target selection above chance. As a result, when testing circumstances evoke a non-analytic strategy (thus promoting the recruitment of existent prior non-analytic processing from the intact right-hemisphere), an individual with left-hemisphere damage might gain access to the fluency of processing old stimuli and thus be more likely to select the target.

Conclusion

The idea that individual can have knowledge they are not aware of is a fascinating concept. The investigation of the mere exposure effect, and the conditions that regulate it, will continue to be an interesting and rewarding area of study because it permits a brief glance into some of the fundamental cognitive processes that govern the functioning of the mind.

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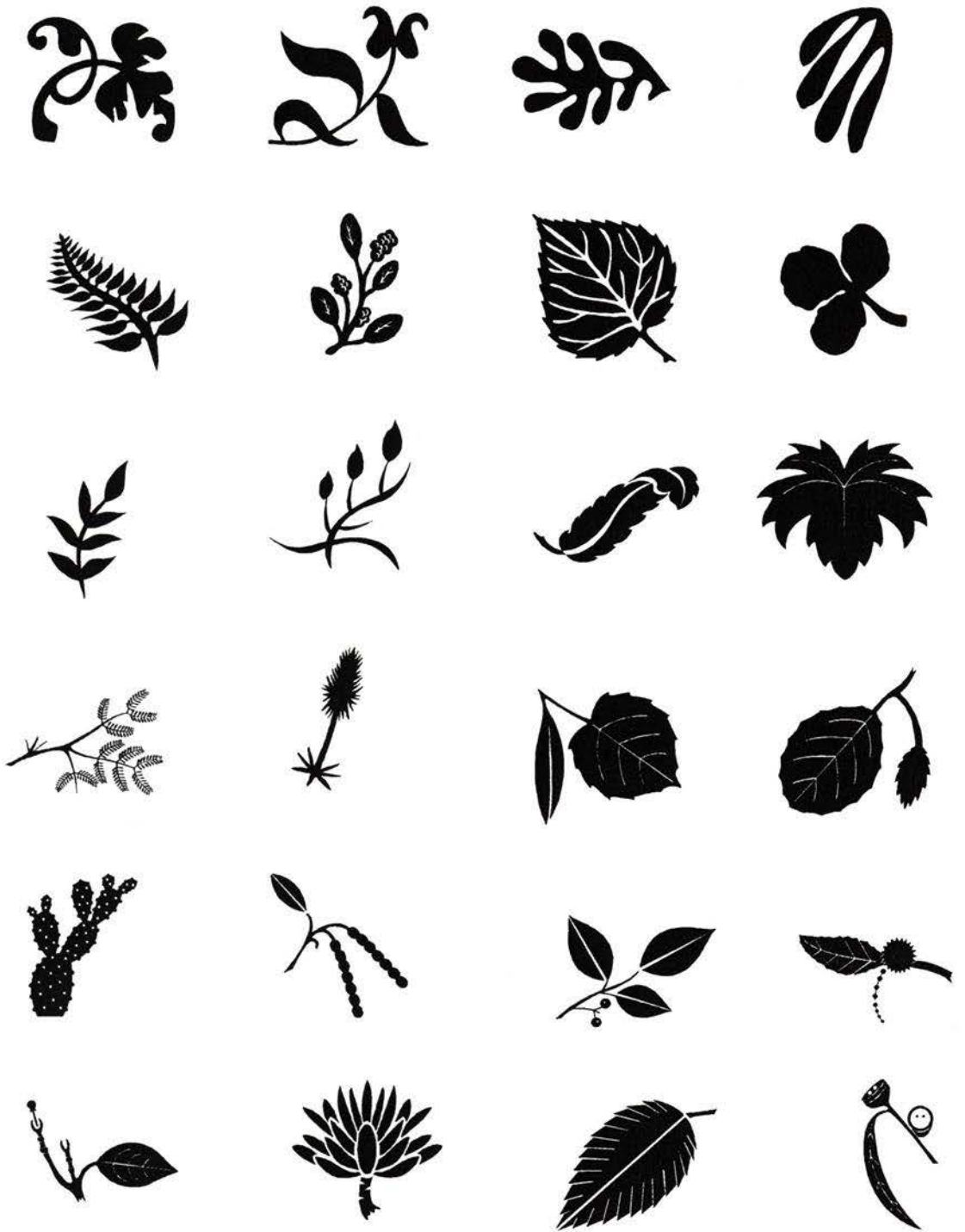
Appendix A
Chairs Used as Training and Test Stimuli







Appendix B
Leaves Used as Training and Test Stimuli







Vita

Surname: Price

Given Names: John Ryan

Place of Birth: Burnaby, British Columbia, Canada

Educational Institutions Attended:

Middlebury College	1994 to 1996
Simon Fraser University	1996 to 1999

Degrees Awarded:

B.A. (Honours)	Simon Fraser University	1999
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Honours Awarded:

Name of Award	Value	Type	Location	Period Held
Graduate Teaching and Research Fellowship	\$1000	Institutional	Victoria, BC	09/2001 – 04/2002
President's Research Scholarship	\$4000	Institutional	Victoria, BC	09/2001 – 04/2002
President's Research Scholarship	\$2000	Institutional	Victoria, BC	09/2000 – 04/2001
NSERC, PGS-A	\$34,600	National	Victoria, BC	05/2000 – 04/2002
Graduate Research Assistantship	\$1000	Institutional	Victoria, BC	05/2000-08-2000
Graduate Teaching and Research Fellowship	\$3000	Institutional	Victoria, BC	09/1999 – 04/2000
Norma M. Wilson Graduate Scholarship	\$700	Institutional	Victoria, BC	09/1999 – 04/2000
Queen's University Master's Fellowship	\$26,000	Institutional	Kington, ON	declined
Graduate With First Class Honours	N/a	Institutional	Simon Fraser University, Burnaby, BC	05/1999
First Class Honour Roll (GPA >4.0)	N/a	Institutional	Simon Fraser University, Burnaby, BC	Four times between 05/1996 – 05/1999

Publications:

Articles published or accepted in refereed journals

Whittlesea, B.W.A., & Price, J.R. (2001). Implicit/explicit memory versus analytic/nonanalytic processing: Rethinking the mere exposure effect. Memory and Cognition, 29(2), 234-246.

Other refereed contributions

Price, J.R., Kerns, K.A., & McInerney, R.J. (2002). Executive function in action: An analysis of the children's multiple activity test. Poster presented at the meeting of the International Neuropsychological Society, Toronto, ON, February 2002.

Price, J.R., & Whittlesea, B.W., (1999). Approaching an Understanding of the Mere Exposure Effect: An Examination of Analytic and Non-analytic Processing on Test Items. Paper presented at the Northwest Cognition and Memory conference, Victoria, BC.

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Title of Thesis:

Lateralized Mere Exposure: An Analytic/Non-analytic Processing Approach

Author



John R. Price
July 3, 2002