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20 Bilingualism and the impact of emotion: The role of experience, memory, and sociolinguistic factors

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There is an increasing interdependence and connectivity between the people and nations of the world which has led to a greater amount of communication across cultures and languages. Bilingualism, the use of two languages on a regular basis, has become increasingly common in today's world (see e.g., Altarriba & Santiago-Rivera, 1994; Santiago-Rivera & Altarriba, 2002). But what effect, if any, does bilingualism have on the memory and emotions of individuals? How does knowledge of multiple languages influence the perception of language? Is there an interaction between personality factors and language? Researchers have used numerous methodologies in order to study different aspects of emotional experience, perception, memory, and personality in bilinguals.

Bilinguals do not necessarily have equal abilities in both of their languages and can exhibit dominance and preference for one of their known languages. It has been proposed that balanced bilinguals are fluent in both languages and have no true dominant language, while unbalanced bilinguals are more fluent in one language and make more use of one language on a daily basis (Kroll & Stewart, 1994). It is important to note that the dominant language is not necessarily the bilinguals' first language (L1) and can be an individual's second language (L2) under some circumstances. Language dominance is dependent on the fluency and daily usage of both languages. The pattern of language usage over a lifetime is what determines language dominance in bilinguals. Some bilinguals segregate their languages and have language preferences depending on the environment they are in or the specific people they are talking to. This pattern of usage will most likely lead to a clear preference for one language and the development of a dominant language. Language dominance can have a large impact on studies using emotionally charged words, as bilinguals may activate the emotional associations of words in their dominant language more strongly than words in their non-dominant language.

In the literature, language dominance has been measured and operationally defined in several different ways, including age of acquisition, daily usage, self-reported preference, and self-reported ability and fluency.
These different measures all have varying assumptions of what constitutes language dominance. For example, age of acquisition measures define language dominance in chronological terms and assume that the first language learned is the dominant language, while daily usage measures assume that the most often utilized language is the dominant language. In contrast, using measures of self-rated abilities in language assumes that perception of ability is linked to language dominance. In the current chapter, research using all of these operational definitions of language dominance is explored.

The aims of the current chapter are to discuss existing data and present new data on the influence of the perception of emotion on the bilingual speaker. This chapter will outline the influence of emotion on automatic processing by discussing data from affective priming, the Emotional Stroop Task, and physiological measure paradigms. The influence of emotion on more complex cognitive tasks will be explored through a presentation of studies on recall, autobiographical memory, sociolinguistic variables, and frame switching. The interaction of language dominance and emotion will also be highlighted. Finally, this chapter will present data and findings of a study, conducted by the current authors, focusing on the repetition blindness effect (RB) and emotion across languages.

**INFLUENCE OF EMOTION ON AUTOMATIC PROCESSING**

The investigation of the relationship between the perception of emotion and cognitive processes begins with an examination of lower-level and automatic processes such as the early recognition of emotion words. This line of research has used methods previously established by cognitive psychologists including affective priming, the Emotional Stroop Task, and skin conductance response (SCR), a physiological measure. Researchers have studied the impact of the perception of emotion on bilinguals' cognitive processing in situations with brief stimulus presentation times and the recording of participants' reaction time (RT) in milliseconds (ms).

**Affective priming**

In the word-priming paradigm, word pairs are created and presented to participants individually in sequential order. Participants perform a lexical decision task (LDT) where they indicate whether the second word, or target, is a word or nonword. When the first word, or prime, is related to the target, participants generally exhibit a priming effect evidenced by faster reaction time (RT) in the LDT (e.g., responses to cheese would be faster after mouse than after cloud). This effect has also been established
when the prime and target are similarly emotionally charged (e.g., when both have negative or positive emotional connotations, such as hate–fear or kiss–happy; Fazio, Sanbonmatsu, Powell, & Kardes, 1986). Altarriba and Canary (2004) used the word-priming paradigm to investigate the effect of ‘word arousal’, an emotional component of words, on the priming effect in bilinguals. English monolinguals and fluent Spanish–English bilinguals were tested for RT differences in a LDT. Emotion words used were selected from the University of South Florida Word Norms database (Nelson, McEvoy, & Schreiber, 1998). The researchers created the following three prime–target categories: high arousal (e.g., prisoner–jail), moderate arousal (e.g., criminal–jail), and unrelated (e.g., guitar–jail). Participants viewed prime–target and prime–nonword pairs in English and used a key press mechanism to make a lexical decision for each target.

Evidence of affective priming was found in both groups, but monolinguals were faster to identify the target words than bilinguals. When compared to monolinguals, bilinguals had longer reaction times (bilingual overall RT mean = 640 ms, monolingual overall RT mean = 606 ms) and smaller priming effects in the high arousal (bilingual = 25 ms, monolingual = 63 ms) and moderate arousal conditions (bilingual = 29 ms, monolingual = 62 ms). The reduced affective priming in bilinguals provided evidence that word arousal had a different effect on bilinguals than monolinguals. The differences between affective priming in monolinguals and bilinguals may be explained by the different contexts in which the bilinguals had learned and used the English emotion terms. Bilinguals may have learned and used English in educational and work-oriented environments. Using English in only these limited settings reduced the emotional connotations for those words and reduced affective priming (Altarriba & Canary, 2004).

**Emotional Stroop Task**

Continuing the investigation of lower-level cognitive processes, Sutton, Altarriba, Gianico, and Basnight-Brown (2007) and Eilola, Havelka, and Sharma (2007) used the Emotional Stroop Task to investigate bilingual participants for differences in processing emotion words. The Emotional Stroop Task is similar to the traditional Stroop Task in which participants report the color of a word while ignoring the meaning of the word, which labels a color (e.g., the word red appears in blue ink, and the correct response is to say ‘blue’ aloud). A Stroop effect is exhibited when participants take longer to report the color of a word when there is a mismatch between the color the word appears in and the color the word labels, in comparison to when these two factors are matched (Stroop, 1935). While the task is the same, the words in the Emotional Stroop Task do not label colors, but instead have emotional definitions and associations. Again,
participants are to report the color of emotional and neutral words instead of the actual words (e.g., reporting that the words grief or seat appear in the color red). Emotional associations tend to have an interference effect and result in an increase in the time required for the color-naming task, similar to the interference found in a traditional Stroop Task (Sutton et al., 2007).

Sutton et al. (2007) sampled Spanish–English bilinguals. Participants were proficient in English and Spanish and used English more often in daily speaking. The Affective Norms for English Words (ANEW) database (Bradley & Lang, 1999) was used to select negative emotion words with low valence and high arousal ratings (e.g., nervous, fear, and angry). As defined by Bradley and Lang (1999), valence is a measure of the strength and direction of the emotional charge of words (low ratings indicate negative emotional associations, moderate ratings indicate few emotional associations, and high ratings indicate positive emotional associations). Arousal is a rating of the amount of excitement and energy associated with words (low ratings indicating lower levels of associated excitement and high ratings indicating higher associated excitement). Neutral words were selected from a list of boat parts (e.g., engine, boom, and propeller). Emotion and neutral words were matched on frequency and length. The participants viewed emotion and neutral words in both English and Spanish. The words were presented in either blue or green, and participants made a key press to indicate word color. The authors found evidence of interference for emotion words on the Emotional Stroop Task in bilinguals. In both languages, participants had shorter RTs with neutral words as compared to emotion words. Emotion words captured attention regardless of the language in which they appeared. Furthermore, participants were able to respond significantly faster when the words were presented in English. However, the size of the interference effect was similar in both languages (Spanish = 28 ms, English = 48 ms).

Eilola et al. (2007) followed an Emotional Stroop procedure similar to the procedure used by Sutton et al. (2007). The authors sampled Finnish–English participants who were proficient in Finnish and English, and were late learners of English. The study found a word type effect where participants had longer RTs on the Emotional Stroop Task when presented with taboo (e.g., bastard and slut) and negative words (e.g., rape and agony). When the results are considered along with those of Sutton et al. (2007), it appears that language proficiency had a larger influence on bilingual performance on the Emotional Stroop Task. In both studies, bilinguals had high levels of proficiency in their first language (L1), as well as their second language (L2), despite learning L2 later in life. Sutton et al. (2007) and Eilola et al. (2007) found that similar levels of proficiency resulted in no differences in Emotional Stroop Task interference when presenting words in participants’ L1 or L2. These findings suggest that emotional content in different languages does not result in processing
differences in bilinguals when they have equal levels of proficiency in both languages.

Physiological measures

Studies on the perception of emotion words have used psychophysiological measures, including skin conductance response, to measure autonomic nervous system reactions to emotion and neutral words (Gray, Hughes, & Schneider, 1982; McGinnies, 1949). More recent studies have measured the extent to which different types of emotion words presented in participants' L1 and L2 influence the response of the autonomic nervous system (Harris, 2004; Harris, Ayçiçeği, & Berko-Gleason, 2003). One component of the physical response to perceived danger is an increase of sweat on the fingertips and palms, which in turn increases skin conductance. Skin conductance response (SCR) measures the conductivity of the skin to determine if the autonomic nervous system has begun to activate in response to a perceived threat (Harris, Berko-Gleason, & Ayçiçeği, 2005).

Harris et al. (2003) recruited Turkish–English bilingual participants who were late learners of English and had greater fluency in Turkish. Neutral words (e.g., box and name), positive words (e.g., happy and love), aversive words (e.g., anger and poison), taboo words (e.g., breast and pee), and reprimands (e.g., Don’t do that! and Shame on you!) were selected from the Handbook of Semantic Word Norms (Toglia & Battig, 1978) and a previous study (Gonzalez-Regiosa, 1976). Reprimands were expressions commonly used with children, for example ‘Go to your room!’ Participants viewed half of the trials in English and half in Turkish. The Davicon C2A Custom Skin Conductance Monitor was used to measure participants' skin conductance response (SCR). Electrodes were attached to the index and middle fingers of each participant’s dominant hand, and SCRs were measured for a 10-second interval. A single word was presented during this entire 10-second interval, and participants rated the word on a pleasantness scale. The rating task ensured that participants attended and processed the target words during the entire SCR measurement interval (Harris et al., 2003).

The researchers found that language and word type had a significant impact on SCR scores. In general, Turkish words evoked higher SCR scores than English words. Taboo words and reprimands resulted in higher SCR scores than neutral words. However, only Turkish reprimands resulted in significantly higher SCR scores than their English translations. Emotional reactivity to childhood reprimands was limited to Turkish. During debriefing, several participants commented that the Turkish reprimands led to a memory of being reprimanded by a family member. Hearing reprimands in Turkish activated associated memories of the context in which those reprimands were originally heard. This was strong evidence for the existence of language-specific memories and of the notion
that context of use influences the formation of associations in memory (Harris et al., 2003).

Harris (2004) shifted focus onto language proficiency and the age of acquisition of bilingual participants. Spanish–English bilinguals were sampled and divided into early and late learners of English. Early learners were more proficient in English, while late learners were more proficient in Spanish. Several Spanish and English words were presented while participants underwent a SCR measurement procedure similar to Harris et al. (2003). In both languages, early and late learners had higher SCR scores for taboo words. In late learners, reprimands resulted in higher scores only when presented in Spanish, while early learners had higher SCR scores for reprimands in both languages. Early learners had similar SCR patterns in both languages, while late learners exhibited higher SCR in L1. Harris (2004) provided evidence that L1 is not inherently more emotional than L2 (but see Altarriba, 2003) and that language proficiency, age of acquisition, and context of usage all influence the experienced emotional intensity of a language.

INFLUENCE OF EMOTION ON MEMORY AND PERSONALITY

The study of more complex cognitive processes has included various procedures in addition to the methods more traditionally used in cognitive research. Some investigators have used more qualitative paradigms in order to determine the influence of the perception and production of emotional stimuli on bilingual participants. Processes, such as recall, have been investigated utilizing more traditional methodologies. Meanwhile, other constructs, including autobiographical memory, sociolinguistic variables, personality factors, and frame switching, have been analyzed using newly developed methods. These methods tend to focus on the creation of a natural situation or environment, as in the research on autobiographical memory, which allows participants to give detailed accounts of actual, personal memories.

Memory

Researchers have investigated the influence of emotion in bilingual participants using recall and recognition tasks. This line of research has provided evidence of language-specific advantages in a free recall task. Anooshian and Hertel (1994) measured bilinguals’ ability to recall neutral and emotional words in both their L1 and L2. Neutral words included box, part, and salt. Emotional words were both positive and negative terms, including laugh, kiss, death, and fight. The authors selected bilinguals who spoke Spanish and English and were late learners of their
second language. All participants were fluent in both languages, but half were native Spanish speakers and half native English speakers. The participants viewed neutral and emotional words in Spanish and English and performed one of three distracter rating tasks. After completing the rating task, participants were given an unexpected free recall test, where they were instructed to write down as many of the words as they could remember.

A memory advantage for emotion words, where emotion words were recalled more often than neutral words, was found in the participants’ native language but not in their second language. The advantage of L1 over L2 was the same regardless of specific language (Anooshian & Hertel, 1994). The recall advantage can be explained by the differences in the contexts in which participants learned and used their languages. The different contexts in which words are used influence the development of associations between words and concepts. Late learning of L2 reduced the use and associations in memory of L2 emotion words and hindered the effective use of recall strategies for words present in participants’ L2.

**Autobiographical memory**

The methods utilized by Anooshian and Hertel (1994) allowed for the controlled empirical study of memory and emotion, but created artificial situations that do not allow for the study of the natural formation of memories. Javier, Barroso, and Muñoz (1993) suggested that autobiographical memory allows for a more natural study of memory that does not attempt to control the meaning of memories as traditional experimental methods do. This line of research assumes that memory can be assessed through an analysis of verbalizations, and that language serves an encoding function to aid in the organization and retrieval of memories. The study of autobiographical memory has focused on cued memories that contain personal information about the self and events related to the self (e.g., having participants describe personal memories associated with the cuing word *store*).

Javier et al. (1993) investigated this theory of linguistic organization of memory by interviewing five Spanish–English bilinguals. Participants were asked to speak for 5 minutes about life experiences using the language in which the event took place. Participants also described the event again in their second language. The first monologue had more detail and elaboration than the second monologue, which was less imaginative and more abbreviated. Regardless of language, the first monologue was more vivid than the second monologue, as measured by the amount of detail, elaboration, and imagery. The study provided evidence that memory of personal events is organized using linguistic information from the event, and retrieving a memory may be hindered by using a language other than the original encoding language (see Marian & Neisser, 2000).

Schrauf and Rubin (1998, 2000, 2001) conducted several empirical
studies on autobiographical memory and the linguistic organization of memories and experiences in immigrants who moved from primarily Spanish-speaking nations to primarily English-speaking nations. Their studies shifted focus to the 'reminiscence bump'. The reminiscence bump refers to the time period between the ages of 10 and 30. There are typically a greater number of memories from the reminiscence bump than from other time periods of participants’ lives.

Schrauf and Rubin (1998) sampled Spanish–English bilinguals, who had emigrated from Spanish-speaking to English-speaking cultures. Participants were divided into the following three groups: early immigration (ages 20 to 24), middle immigration (26 to 30), and late immigration (34 to 35). The researchers utilized a word-cuing paradigm where participants were presented with a single word and associated the word with a specific personal memory (e.g., having participants describe personal memories related to the cue car). Participants were presented with 50 different words during separate, 2-hour, English and Spanish cuing sessions. Participants had to write their memories in the language of the session. After each session, participants were asked if they experienced any memories in their 'other' language. At the end of the second session, the participants dated each of the 100 memories.

The authors found that the reminiscence bump shifted with the immigration period in each of the immigration groups. The early immigration group had a relatively typical reminiscence bump, but the bump was shifted in both the middle and late immigration groups (Schrauf & Rubin, 1998). Rather than remaining in the typical time period, the reminiscence bump shifted with the emigration time period of the participants, and occurred later in participants who emigrated later in life. The reminiscence bump shift was also found by Schrauf and Rubin (2001), who had participants freely recount their life stories, rather than cuing memories. Again, the reminiscence bump shifted with the immigration period of the participants.

Schrauf and Rubin (1998) found additional evidence of language-specific memories as approximately 20% of participants’ memories did not occur in the cuing language. These memories occurred in participants’ other language (the cue was in English and the memory was in Spanish, or the cue was in Spanish and the memory was in English). Language-specific Spanish memories tended to be from pre-immigration periods (mean age = 29.69), while English memories tended to be from post-immigration periods (mean age = 46.52). The mean age of the memories with Spanish as a cuing language was 39.79 and with English as a cuing language was 40.55. The authors found evidence that language served an encoding function in autobiographical memory. Schrauf and Rubin (2000) found additional evidence for linguistic encoding. The authors had Spanish–English bilinguals label memories as non-linguistic, congruent (cue and retrieval language were the same), crossover (cue and retrieval language were
different), or dual language (cue and retrieval occurred in both languages) memories. Spanish congruent and crossover memories tended to be from pre-immigration periods (mean age = 27.74), while English congruent and crossover memories tended to originate from post-immigration periods (mean age = 50.55). Utilizing a similar cuing paradigm with Polish–Danish bilingual immigrants, Larsen, Schrauf, Fromholt, and Rubin (2002) also reported evidence of linguistic encoding. They found pre-immigration memories were more likely to be retrieved in participants’ L1, and post-immigration memories were more likely to be retrieved in L2.

Schrauf and Hoffman (2007) studied emotional intensity and valence in autobiographical memories. The authors studied the ‘fade effect bias’, which predicts that pre-immigration memories (formed during younger ages) will be less emotionally intense than post-immigration memories (formed during older ages). Furthermore, this fading effect should influence negative memories more than positive memories. The authors also studied the ‘positivity bias’, which predicts pre-immigration memories will be recalled as more pleasant than post-immigration memories. A cuing method similar to Schrauf and Rubin (1998, 2000) was used, and memories were coded for emotional intensity and valence. Memories from youth were recalled with less emotional intensity than memories from old age, and negatively valenced memories were rated as less intense than positively valenced memories. There was also evidence of a positivity bias, as earlier memories were recalled with more positive valence than more recent memories.

The evidence reported by this line of autobiographical memory research supports the notion that the cognitive associations formed with languages vary greatly depending on the context of use. In the studies reported above, the immigration event created separate contexts of usage for participants’ L1 and L2. These vastly different contexts, literally distinct geographic and social locations, led to the formation of different associations between bilinguals’ languages and their autobiographical memories.

Frame switching and biculturals

Luna, Ringberg, and Peracchio (2008) have begun a relatively new line of inquiry into personality, language use, and culture. This line of research is related to the previous investigations of autobiographical memory, as it also analyzes the influence of culture and language usage. While autobiographical research has focused on the reminiscence bump, ‘frame switching’ emphasizes changes in personality and judgments as a result of activating different mental frameworks containing different connotations and associations for the same concepts. The authors defined biculturals as bilingual individuals who have fully internalized two separate cultures. The full internalization of both cultures leads to the formation of separate
culture specific mental frameworks and identities, which are linked to the different languages biculturals have mastered. Biculturals are able to utilize language cues and frame switch, alternating between culturally defined identities which lead to different interpretations of specific concepts and stimuli. Monocultural biculturals have not fully identified with both cultures and have only internalized a single culture. For a more thorough discussion see Luna (Chapter 25, this volume).

**Sociolinguistic approaches**

Researchers have also focused on sociolinguistic factors that influence bilingual language use and speech production, including personality factors, demographic variables, and language history variables. Several authors have published articles highlighting the personality factor ‘extraversion’ as important in the perception and production of speech (Dewaele & Furnham, 1999, 2000; Dewaele & Pavlenko, 2002). Dewaele (2004, 2008) conducted studies on biculturals’ use of emotion and emotionally charged words in speech. Here, sociobiographical variables were used to study the perception of emotionally charged words and phrases, including the phrase *I love you* and taboo words.

In defense of extraversion as a sociolinguistic factor, Dewaele and Furnham (1999) emphasized that research has indicated that extraversion influences speech production through its impact on arousal, stress resistance, and immediate recall. Research has established that extraverts tend to be under-aroused by events, while introverts tend to be over-aroused (Eysenck, 1981). Extraverts, as compared to introverts, also show greater resistance to stress and have an increased ability in short term recall, which is influential in verbal task performance (Shapiro & Alexander, 1969). Taken together, this evidence suggests that extraverts have several advantages over introverts in speech production.

Dewaele and Furnham (2000) investigated the relationship between L2 production and extraversion by sampling 25 Flemish students with several years of classroom instruction in French. A sociobiographical questionnaire and the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1964) were used as extraversion measures. Each participant had a stressful conversation, focused on evaluating lingual proficiency, and a casual conversation. Introverts appeared unable to produce speech at the same level of automaticity as extraverts in stressful, formal situations. Introverted participants may have been more concerned with searching lexical memory stores and utilizing vocabulary in stressful, formal situations. Extraverts appeared more focused on fluency and used shorter high-frequency words to produce shorter and better-understood responses.

Dewaele and Pavlenko (2002) provided additional evidence of the influence of extraversion, language proficiency (as measured by linguistic
errors), and gender on the production of L2 speech and the use of emotion words in the second language. The researchers had relaxed, informal, one-on-one conversations with participants in their second language. Similar to Dewaele and Furnham (2000) the EPI was used to measure extraversion. All of the conversations were coded for the use of emotion words, as well as lexical and morphological errors. The authors found that extraversion, language proficiency, and gender all had significant effects on the use of emotional speech in a second language. Extraverts utilized a wider range of emotions in L2 conversation than introverts. Building on Dewaele and Furnham (2000), extraverts’ wider expression of emotion may be linked to their increased use of more simplistic and easily expressed vernacular vocabulary. Extraverts may be more comfortable expressing themselves and self-edit less often than introverts when speaking in their second language (Dewaele & Pavlenko, 2002).

Dewaele (2008) collected information on multilinguals’ perception of I love you in their different languages using a web questionnaire. Data on several sociobiographical variables, L2 learning history, recent use of L2, and lingual proficiency (self-report measures of competence in each language, including reading, writing, speaking, and comprehension) were also collected. Participants perceived the phrase I love you as more emotional in their L1 as compared to L2. Although no significant influence of sociobiographical variables on the perception of I love you was found, L2 learning history, recent use of L2, and self-perceived proficiency in L2 did have significant influences on the perception of I love you. The study found increased perception of emotional weight was related to increased fluency and use of a specific language. Dewaele (2004) utilized a similar web questionnaire paradigm when studying multilinguals’ perception of swearwords and taboo words (S-T words). Similar to Dewaele (2008), it was discovered that the perceived emotional force of S-T words was typically highest in participants’ L1. Furthermore, the perception of emotionality of S-T words decreased in L1 when L1 was no longer the dominant language (L2 had higher self-rated proficiency than L1) and increased in L2, as L2 proficiency increased. Both studies provided evidence that bilinguals, as well as multilinguals, experience greater emotional weight for emotionally charged words in their more fluent and dominant language. Presumably, the more dominant language was used in a greater range of contexts than the non-dominant language, and this increased use of the dominant language led to greater semantic and emotional meanings being associated with the dominant language.

Summary of bilingual emotion studies

Thus far, the articles reviewed on the cognitive research on bilingual participants provided several lines of convergent evidence. The research data have also supported the notion that bilinguals process emotionally charged
stimuli differently when the stimuli are presented in the dominant versus
the non-dominant language. Participants tested with an affective priming
paradigm (Altarriba & Canary, 2004), an Emotional Stroop Task (Ellola
et al., 2007; Sutton et al., 2007), physiological measures (Harris, 2004;
Harris et al., 2003), and a recall memory task (Anooshian & Hertel, 1994)
all provided empirical evidence of differences in processing emotional
stimuli in dominant and non-dominant languages. These studies also
provided evidence that language fluency and age of acquisition had a
significant influence on language dominance and the performance of L1
and L2 on the various cognitive tasks.

Furthermore, research on autobiographical memory encoding and
retrieval has shown that languages can cue memories from separate time
periods (Javier et al., 1993; Larsen et al., 2002; Schrauf & Rubin, 1998,
2000, 2001). Luna et al. (2008) provided evidence that language stimuli can
produce changes in personality and judgments, an effect they labeled ‘frame switching’. The differences in autobiographical memory and
personality frame are both related to the contextual use of language.
Sociolinguistic personality factors, such as extraversion, have also been
implicated in the perception and production of emotional speech
(Dewaele, 2004, 2008; Dewaele & Furnham, 1999, 2000; Dewaele &
Pavlenko, 2002).

In general, previous research has supported the view that bilinguals pro-
cess L1 and L2 emotional stimuli differently based on language domi-
nance. Participants tended to view emotional phrases and words as having
greater emotional weight when presented in their dominant language.
Inquiry into differences in the cognitive processing of emotional stimuli
has continued with the use of the rapid serial visual presentation (RSVP)
methodology. This topic forms the basis of the remainder of the present
chapter.

RECENT RESEARCH UTILIZING RAPID SERIAL
VISUAL PRESENTATION

Often when reading, words appear more than once within a single sen-
tence. For example, the sentence They arrived early for the play though
the play had been canceled contains a repetition of the word play. An
interesting question posed by several researchers has been whether these
repetitions of the same word are processed similarly or differently by
the reader. The RSVP (rapid serial visual presentation) procedure has
been used to present sentences, and other word stimuli, to participants
to determine if there are differences in the cognitive processing of a
repeated word as compared to unrepeated words.
Repetition blindness

Words in the RSVP paradigm are presented to participants for extremely brief periods of time, approximately 70 ms to 110 ms per word. As mentioned earlier, when investigating ‘repetition blindness’ (RB), target words can be repeated or unrepeated and are typically embedded within streams of distracter stimuli. These distracter stimuli can be symbols or other words. Targets are also embedded in strings of words that form entire sentences. Researchers have found that when words are presented in the RSVP paradigm, repeated words are actually recalled less accurately than unrepeated words. That is, participants are often ‘blind’ to the second repetition of a word. Kanwisher (1987) found that repetition blindness occurred even when the repeated target words were presented in different cases. This degraded recall suggested that RB is not a visual phenomenon but a cognitive processing phenomenon. Kanwisher and Potter (1990) found RB did not occur when targets were synonyms, and concluded RB must occur prior to semantic coding. The authors did find RB with orthographically similar words (e.g., cap/cape or barn/bar), words that were part of compound nouns (e.g., dog/hot-dog or heart-attack/attack) and orthographically identical words with semantic differences—for example, (the) rose/(she) rose or (to) watch/(the) watch. These results suggest that RB occurs at the orthographic level, rather than at the semantic level. Differences and similarities in orthographic information appeared to influence the RB effect, while semantic repetition did not result in a significant RB effect, and semantic differences did not hinder RB in orthographically identical words. Research focused on RB with bilingual participants may be able to provide insight into the connections between L1 and L2 words and their similar, conceptual representations.

Repetition blindness in bilinguals

Altarriba and Soltano (1996) investigated the level of processing at which repetition blindness (RB) occurs through the study of RB in bilingual participants. Fluent bilinguals are uniquely able to provide insight into whether or not RB occurs at the semantic level because they have L1 and L2 lexical representations of the same semantic concept. For example, Spanish–English bilinguals have the words sobrino and nephew linked to a semantic concept representing the son of one’s sibling. The researchers selected Spanish–English bilinguals from the Florida International University community, in Miami, Florida, to participate in two studies. Miami provided an environment where participants had a high likelihood of speaking and reading Spanish and English on a daily basis. The sample used in both studies included participants who were fluent in reading and writing both Spanish and English as measured by responses to a language history questionnaire (LHQ; Altarriba & Mathis, 1997).
The authors designed two studies to investigate RB at the semantic level. Participants in the first study were presented with sentences on a computer screen, one word at a time. Participants in the second study were presented with words embedded within symbol streams (e.g., door and nephew). The sentences and word–symbol strings were presented following the RSVP methodology and participants were asked to identify which words they had viewed after each trial. Both studies utilized two targets embedded within distracters. In the first study two of the words in the sentence were target words (e.g., I like steak but this steak tastes awful), while in the second study two of the words were targets and a third word was presented between the two targets as a distracter:

Altarriba and Soltano (1996) found that RB was eliminated when the sentences and word–symbol strings were presented in mixed languages. When the participants viewed sentences that were half English and half Spanish, recall was virtually identical in the repeated and unrepeated target sentences. The second study found significant RB within each language condition (recall was 30% poorer in repeated trials than unrepeated trials), where participants viewed word–symbol strings in only a single language. However, in the mixed language conditions, where one target was in Spanish and the other in English, recall was significantly facilitated (recall was 12.5% better in repeated trials than unrepeated trials). These findings were in line with the conclusion reached by Kanwisher and Potter (1990) that RB does not occur at a semantic or conceptual level. The recall facilitation in the Spanish–English repeated targets occurred despite the common conceptual representation that the repeated Spanish–English target activated. These findings provide further evidence that RB occurs at the lexical and orthographic levels of processing (see also MacKay, Hadley, & Schwartz, 2005, and MacKay, James, & Abrams, 2002 for similar results). Moreover, these data suggest that semantic information influences language processing, even in situations that are highly constrained in terms of presentation time (e.g., RSVP tasks).

THE PRESENT STUDY

The current study continues the investigation of repetition blindness (RB) in bilingual participants, while expanding the experimental design to include not only different language conditions, but also different types of emotion words. Silvert, Naveteur, Honoré, Sequeira, and Boucart (2004) used the rapid serial visual presentation (RSVP) methodology to investigate differences in the recall of repeated and unrepeated words with different levels of emotional valence. The authors found that recall of emotionally weighted words was higher than neutral words in the
unrepeated condition. However, emotionally weighted words exhibited lower recall than neutral words in the repeated condition resulting in a larger RB effect. Silvert et al. (2004) created a single emotion word category, which mixed together different types of emotion words possibly influencing their results. The current study expands the comparisons made by Silvert et al. (2004) by including separate emotion word (e.g., depression and angry) and emotion-laden word (e.g., blackmail and feeble) conditions. Different conditions were created for the emotion word categories to determine if various types of emotionally weighted words had differential influences on processing. The purpose of the current study was to determine whether emotion, emotion-laden, and neutral words exhibit similar RB effects when presented in Spanish and English following the RSVP paradigm. Do Spanish–English bilinguals process emotion, emotion-laden, and neutral words differently in Spanish and English?

Method

Participants

A total of 32 Spanish–English bilingual participants were selected from the University at Albany, State University of New York. Participants were awarded credit or payment for completing the study. The language background of the participants was measured with the Language History Questionnaire (LHQ: Altarriba & Mathis, 1997). Several LHQ measures are presented in Table 20.1. Anxiety levels could potentially influence

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
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</thead>
<tbody>
<tr>
<td>Mean years in US schools</td>
<td>12.66</td>
<td>5.36</td>
</tr>
<tr>
<td>Mean age began speaking English</td>
<td>6.16</td>
<td>4.76</td>
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<tr>
<td>Mean age began reading English</td>
<td>6.84</td>
<td>3.84</td>
</tr>
<tr>
<td>Mean age began speaking Spanish</td>
<td>1.26</td>
<td>1.44</td>
</tr>
<tr>
<td>Mean age began reading Spanish</td>
<td>6.58</td>
<td>3.59</td>
</tr>
<tr>
<td>Mean self-ratings* of ability on:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spoken English</td>
<td>9.31</td>
<td>0.90</td>
</tr>
<tr>
<td>Written English</td>
<td>9.22</td>
<td>0.94</td>
</tr>
<tr>
<td>Conversation skills English</td>
<td>9.22</td>
<td>1.01</td>
</tr>
<tr>
<td>Spoken Spanish</td>
<td>8.94</td>
<td>1.19</td>
</tr>
<tr>
<td>Written Spanish</td>
<td>8.31</td>
<td>1.51</td>
</tr>
<tr>
<td>Conversation skills Spanish</td>
<td>8.72</td>
<td>1.33</td>
</tr>
<tr>
<td>Daily use (%):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>78.63</td>
<td>13.72</td>
</tr>
<tr>
<td>Spanish</td>
<td>20.66</td>
<td>13.74</td>
</tr>
</tbody>
</table>

* Self-ratings were made on a 10-point scale, with 1 indicating low or poor language abilities and 10 indicating high or excellent language abilities.
participants' perception of stimuli, as previous studies have shown that high-anxiety individuals are more likely to perceive and respond to negative stimuli, as compared to neutral stimuli (Trippe, Hewig, Heydel, Hecht, & Miltner, 2007). Therefore, the Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996) and the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) were used as measures of trait and state anxiety. Participants who surpassed predetermined cut-off scores on either the BDI-II or STAI were eliminated from the study.

**Design**

The design included the following three within-participants factors: language (Spanish and English), repeatedness (repeated and unrepeated targets), and emotion word type (emotion, emotion-laden, and neutral).

**Materials**

The Affective Norms for English Words database (Bradley & Lang, 1999) was used to select 120 English words. Valance and arousal measures were used as indicators of the emotional weight of a word. Emotion words (which label a specific emotion or feeling, e.g., fear and hate) and emotion-laden words (which have emotional associations but do not actually refer to a specific emotional state, e.g., disaster and funeral) had low valence ratings, indicating strong negative emotional connotation, and high arousal ratings, indicating increased ability to capture attention. Neutral words (which have no emotional associations, e.g., cabinet and tool) had moderate valence ratings and moderate arousal ratings.

The selected emotion, emotion-laden, and neutral words were all normed on several measures, including length, frequency, orthographic neighborhood, mean naming reaction time (RT), and lexical decision task RT (Balota et al., 2002). The emotion and emotion-laden words had comparable valence and arousal ratings. The emotion and emotion-laden words had significantly lower valence and higher arousal ratings than the neutral words. The English words were translated into Spanish by a fluent Spanish–English bilingual, and the Spanish translations were normed on length and frequency.

Word–symbol string trials were created for the emotion, emotion-laden, and neutral words. The word–symbol strings contained target words and distracter symbols. Repeated and unrepeated target trials contained two target words, while filler trials contained only a single target word. The first target word appeared in the third position and the second target word appeared in the fifth position. The second target word could be either a new word or a repetition of the first target word. In the filler trials,
the fifth position was filled by distracter symbols. For an example of the word–symbol streams see Figure 20.1.

The study included 54 experimental trials, which were split into two blocks of 27 trials, one Spanish block and one English block. Each block contained nine repeated target trials, nine unrepeated target trials, and nine filler trials. Each block also contained nine emotion words (three emotion repeated, three emotion unrepeated, and three emotion filler), nine emotion-laden words (three emotion-laden repeated, three emotion-laden unrepeated, and three emotion-laden filler) and nine neutral word trials (three neutral repeated, three neutral unrepeated, and three neutral filler). The order of these trials was randomized within each of the two blocks. Eight unique and counterbalanced lists of stimuli were created, such that each block appeared in the first and second positions, each trial occurred in Spanish and English, and each non-filler trial appeared as repeated and unrepeated. Each participant viewed a single, unique list. Eighteen practice trials were split into two equally sized Spanish and English blocks, which were counterbalanced following a similar procedure.

```
+++++++(Trial Start)

* * * * *

% % % % % %

misery (Target 1 – 3rd String)

#####

PAIN (Target 2 – 5th String)

??????

& & & & & &

© © © © © © (Trial End)
```

**Figure 20.1** Sample trial for the current study (unrepeated trial). In repeated trials, the fifth string was a repetition of Target 1. In filler trials, the fifth string was filled with symbols.
Procedure

Participants were tested individually. The length of the study was approximately 30 minutes. Participants completed the BDI-II and STAI before the beginning of the experimental trials. The Language History Questionnaire (LHQ) was completed after the experimental trials. The BDI-II, STAI, and LHQ required a total of approximately 15 minutes to complete. The bilingual RSVP experiment also required approximately 15 minutes. The experiment was presented to participants on a Dell Optiplex GX240 PC running Superlab 4.0.

Participants viewed a practice block for one language, and an experimental block for that same language, followed by a practice block for the second language, and an experimental block for the second language. Each trial began with the presentation of a fixation row, + + + + + + + + + +, for 1000 ms. Targets and symbol rows were presented for 100 ms each. Every trial ended with a row of @@@@@@@@@, which signaled the end of the trial and that participants were to report the target words they recalled perceiving. Participant responses were recorded with a Memorex Personal Cassette Recorder, model MB1055.

Results and discussion

Language history measures are reported in Table 20.1. Participant self-ratings of written, spoken, and comprehension abilities in English and Spanish were analyzed as a 2 (Spanish or English) × 3 (spoken, written, and comprehension abilities) ANOVA. A significant main effect of language was found, F(1, 31) = 5.49, p < .05, indicating that participants rated themselves as significantly higher in English abilities (9.25) than Spanish abilities (8.66). Despite being native Spanish speakers, participants rated themselves as having higher abilities in English than Spanish. Pairwise comparisons revealed that participants rated English written abilities as higher than Spanish written abilities, t(31) = 3.00, p < .01. This is particularly important for the current study, as the RSVP task required the ability to read and understand the written word in English and in Spanish. Further, analyzing the self-reported ages of learning to speak and read Spanish and English revealed that participants did learn to speak Spanish earlier in life, t(31) = 5.76, p < .0005, but there were no significant age differences in learning to read English and Spanish, t(31) = .32, p > .05. Finally, participants reported using English significantly more in their daily lives than Spanish (79% vs 21%, respectively), t(31) = 11.99, p < .0005.

The results of the current study can be found in Figure 20.2. A repeated measures ANOVA was run, including a 2 × 2 × 3 design with the following three, within-participants variables: language (English and Spanish), repeatedness (repeated and un-repeated), and emotional word
Figure 20.2 Accuracy of recall of trials (percentages). A clear pattern of repetition blindness (RB) was observed in the English emotion, emotion-laden, and neutral trials. The RB effect was more robust in the emotion trials than either the emotion-laden and neutral trials. No consistent pattern of RB was observed in the Spanish trials.

type (emotion, emotion-laden, and neutral). In all of the following analyses, the dependent variable measured was the average percentage of correct trials under each condition of the three independent variables.

The main effect of language was significant, $F(1, 31) = 33.37, p < .001$. The significant main effect of language highlighted a generally lower recall of Spanish words compared to English words. In all conditions of repeatedness and emotion word type, English words had significantly higher recall than Spanish words. There was also a significant main effect of emotion word type, $F(2, 62) = 4.90, p < .01$. The significant main effect of emotion word type provided evidence of differences in the perception of the different emotion word types.

The interaction between language and repeatedness was significant, $F(1, 31) = 5.58, p < .05$. Spanish and English trials had different response patterns when repeated and unRepeated trials were compared. English trials evidenced a typical RB effect, with lower accuracy in reporting target words in repeated trials than unRepeated trials. However, in Spanish, the typical RB effect was not observed, and there were minimal differences between repeated and unRepeated trials. Each of these findings will be further explored below.

Pairwise comparisons between the average percentages of correct trials in the different conditions were conducted using a series of repeated measures $t$-tests. In line with the significant main effect of language, differences between the repeated English and Spanish word conditions were
significant, $t(31) = 4.46$, $p < .001$, and differences between unrepeated English and Spanish word conditions were also significant, $t(31) = 5.98$, $p < .001$. Comparisons between English and Spanish repeated emotion word conditions were significant, $t(31) = 3.48$, $p < .01$, as were comparisons between repeated emotion-laden word conditions, $t(31) = 4.63$, $p < .001$, and repeated neutral word conditions, $t(31) = 3.40$, $p < .01$. Similarly, differences between English and Spanish unrepeated emotion word conditions were significant, $t(31) = 5.75$, $p < .001$, as were differences between unrepeated emotion-laden word conditions, $t(31) = 5.11$, $p < .001$, and unrepeated neutral word conditions, $t(31) = 4.37$, $p < .001$. Each of these comparisons supported the finding that English words were recalled with greater accuracy than Spanish words. English words had significantly higher recall under both of the repeatedness conditions, as well as all of the emotion word type by repeatedness conditions.

Comparisons between English word conditions yielded several interesting outcomes. First, the repeated word condition was recalled with significantly lower accuracy than the unrepeated word condition, $t(31) = 2.35$, $p < .05$. Dividing the English words into emotion, emotion-laden, and neutral words, also allowed for several intriguing comparisons. The difference between the repeated emotion word and unrepeated emotion word conditions was significant, $t(31) = 2.79$, $p < .01$. Repeated English words, specifically repeated emotion English words, showed a typical RB effect. However, emotion-laden and neutral English words did not exhibit significant RB effects. The differences between repeated and unrepeated emotion-laden and neutral English word conditions reflected the typical RB effect. A larger RB effect in emotion words than neutral words does support the previous findings of Silvert et al. (2004). Emotion-laden and neutral English words exhibited small, non-significant differences between repeated and unrepeated conditions as compared to the emotion words. Emotion-laden words may have resulted in accuracy rates similar to the neutral words because they were perceived as less emotionally weighted when presented intermixed with emotion words. This interpretation of the findings is supported by Harris et al. (2003) and Harris (2004) where typical negative emotion words were intermixed with taboo words and reprimands. Similar to the current study, typical negative emotion words did not elicit significant SCR scores, while the taboo words and reprimands did elicit significantly raised SCR scores.

Overall, the Spanish word trials did exhibit slightly higher recall in the unrepeated condition when compared to the repeated condition, although this comparison was not significant ($p > .05$). Differences between the emotion, emotion-laden, and neutral repeated and unrepeated Spanish words were all non-significant. In the emotion word condition, unrepeated words were more accurately recalled than repeated emotion words, however the difference in means was not significant ($p > .05$).
GENERAL DISCUSSION

The results of the current study suggest that bilingual individuals process and experience emotional words differently in English and in Spanish. Under the repeated emotion word condition, English trials exhibited a significant repetition blindness (RB) effect while Spanish trials did not. This same pattern of results was found when word type was ignored; overall, English words evidenced a significant RB effect while Spanish words did not. These results can be explained by language dominance and participants' differing daily usage of English and Spanish.

Despite the fact that Spanish was the earliest-learned language, participants reported higher levels of English proficiency, learned to read English and Spanish at about the same age, and utilized English more heavily on a daily basis (no participant reported using Spanish more often on a daily basis, and only three participants reported a perfect 50–50 split in daily language usage). Spanish may have been the first language learned, but it appears that English was actually the dominant language of the participants. The higher accuracy of English trials overall, compared to Spanish trials, was further support for the argument that participants were more dominant in English than in Spanish. The dramatic increase in the daily use of English compared to Spanish suggested that the participants used English in most of their daily interactions. The participants generally reported utilizing Spanish at home with family and English in school and work settings. However, the participants were college students who were constantly in the school and work environment and were no longer in their home and family environments. It appears that Spanish was only used in specific situations and English was generally the language of choice. Thus, participants may have used English more often across all situations, including in more personal and emotional situations, as well as more social and professional situations. In contrast, Spanish was used only occasionally at home or with specific friends and family members. Due to the different patterns of daily usage, participants may have been more familiar with the general and emotional connotations and denotations of English words than Spanish words. This increased familiarity and comfort with English words would naturally result in English being experienced more emotionally than Spanish for the current set of bilinguals.

The results of this study support the views of several of the authors and studies presented in the automatic processing section of the current chapter. The prevailing theme of those studies was that emotion had a larger impact on automatic and lower-level processing when emotionally weighted words were presented and processed in the dominant language of the bilingual participants (Altarriba & Canary, 2004; Eilola et al., 2007; Sutton et al., 2007). Emotional words and phrases also had a larger impact on skin conductance response scores and autonomic nervous system response when they were presented in the dominant language of the
bilingual participants (Harris, 2004; Harris et al., 2003). Furthermore, the investigation into the perception of emotionally weighted phrases has found that specific phrases are perceived more emotionally when they are presented in the dominant language of bilinguals (Dewaele, 2004, 2008). Interpreting the findings of all of these studies together, the emotional weight of words has a larger impact on automatic, lower-level, and even some higher-level cognitive processes when those words are presented in the dominant language of bilinguals.

The current results mirrored the findings of experiments focused on memory and personality. The emotional weight of words was found to increase the recall of dominant language words (Anooshian & Hertel, 1994). Several authors were able to provide evidence that language served encoding and retrieval functions in the autobiographical memories of immigrants who moved from a Spanish-speaking culture to an English-speaking culture (Javier et al., 1993; Larsen et al., 2002; Schrauf & Hoffman, 2007; Schrauf & Rubin 1998, 2000, 2001). As a result of the very different contexts in which Spanish and English were used over the lifetime of this specific population of bilinguals, each language had become associated with memories from different time periods.

The current study is supported by research into the use of language as a personality cue conducted by Luna et al. (2008). When bilinguals have fully internalized both cultures, suggesting high fluency in both languages and the possibility of shared language dominance, language can have a cuing or priming effect and influence the personality and judgments of those individuals. Language can cue a specific cultural background and system of judgments which influences individuals’ interpretation of the content of the message. Furthermore, research has found evidence that extraverts are more likely to produce emotional speech in L2 than introverts (Dewaele & Furnham, 2000; Dewaele & Pavlenko, 2002). Due to limited experience with the nuance of non-dominant language emotional terms, introverts are less likely to use emotional speech in their subordinate language. Extraverts, with their increased confidence and comfort in expressing themselves have less trouble utilizing emotional speech in their non-dominant language. In general, all of the findings in memory, personality, and sociolinguistic research support a model where context of language usage and language dominance affect the perception and processing of language. If languages can be associated with different memories and personality trends, then they may also be associated with different emotional connotations.

In conclusion, the different experiences and daily routines that people experience can influence the perception and processing of emotional language in bilinguals. These different routines and patterns of language usage can lead to different memory structures and associations which will influence the processing of language in the immediate present, as well as in the future. These differences in the stored associations of words can lead to
language-processing differences that are observed in controlled cognitive studies and language production differences in more qualitative studies. Future research should focus on systematically examining language dominance and its influence on cognitive tasks involving emotion stimuli for bilingual speakers.

REFERENCES


