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Investigating Facial Mimicry Responses to Emotional Stimuli in Spanish-English Bilinguals

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Abstract

This research analyzed facial mimicry responses in two groups of Spanish-English bilinguals: bilinguals for whom Spanish was the first language learned (L1) and bilinguals for whom English was the L1. Prior research suggested that Spanish-English bilinguals experience emotion differently, but no research to date had examined if exposed to language primes, Spanish-English bilingual participants would mimic facial expressions differently depending on when each language was learned. The results showed that Spanish L1 bilinguals were overall more emotionally expressive, and Spanish L1 bilinguals were more likely to mimic facial expressions when stimuli were primed with English. Additional findings from the study showed that Spanish L1 bilinguals were more likely to mimic happiness in English primed expressions, while English L1 bilinguals were more likely to mimic surprise. Spanish L1 bilinguals were more likely to mimic anger in the English prime, and English L1 bilinguals were more likely to mimic anger in the Spanish prime. The results are analyzed in the context of how culture shapes appropriateness of displaying emotional expressions, and future directions are discussed.

Keywords: Bilinguals; Language; Facial Mimicry; Spanish; English; Emotion
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Introduction

Language and culture are two closely related concepts that are highly influential to many aspects of cognitive processes, such as emotion. As a result, bilingual individuals have become an important group studied by psychologists in order to determine how linguistically determined cultures differentially affect different psychological processes, such as emotion and personality. Most of these cross-cultural studies examining how a language-bound culture can affect cognition focus primarily on differences between western, individualistic cultures, and eastern, collectivistic cultures (Hong et al, 2000). However, recent research has expanded to look at cultural differences between Spanish and English speakers, and whether or not differences between these two language environments exist in bilingual individuals when they are linguistically primed (Guttfreund, 1990; Pizarro, 1994; Ramírez-Esparza et al, 2006; Díaz-Peralta Horenstein, 2010).

Perlovsky (2009) has analyzed the effects of language on emotional thought in bilinguals. This research examined the emotional content of language and cognition, with the thought that emotion has developed evolutionarily as a separate adaptation from other forms of concrete cognition. Perlovsky developed a mathematical model to analyze the evolutionary development of emotion in the context of language, suggesting that emotion serves as an evolutionary method in the development of culture, and language is a method to convey these ideas. Perlovsky suggests that the emotional contents of language are equally as important, if not more so, than the conceptual contents of a language. The
importance of this study is the concept that language and emotion are interconnected evolutionarily. Several studies have analyzed how language and emotion are connected, suggesting that bilinguals will interpret emotion differently depending on the language-bound cultural concepts with which they are being primed (Matsumoto & Assar, 1992; Marian & Kaushanskaya, 2004; Pavlenko, 2008).

A study by Marian & Kaushanskaya (2004) analyzed autobiographical memories and personal narratives in bicultural Russian-English bilinguals to determine if there were differences in emotional content of the narratives based on language-based cultural primes. The study analyzed narratives and personal accounts with regard to emotional content and on levels of cross-cultural differences such as individualism versus collectivism. The results suggested that individuals gave more individualistic accounts when asked in English, which is a more individualistic culture, and more collectivist accounts in Russian, a more collectivist culture. They measured this by analyzing the use of individualistic and collectivist terms in the narratives (i.e. “us” versus “I” and “myself”). In addition, it was found that participants showed more emotional affect when speaking the same language at the time of retrieval as the language used at the time of encoding for each memory or narrative. The results from this study suggest that language affects cognition, particularly in highly emotional content, such as autobiographical memories and personal narratives. However, a limitation to this study was that it only analyzed autobiographical memories, and due to the nature of data collection through personal accounts, these differences could be attributed to other factors (i.e. emotionally charged memories associated with either culture) that could not be controlled within the experimental design.

**Emotional Expression in Spanish and English**
An important question to consider when analyzing emotional expression in Spanish-English bilinguals is whether or not there is any difference in the way Spanish-English bilinguals respond to emotion-laden language. Since English is a Germanic language and Spanish is a Romance language, there are important grammatical and lexical differences between the two, and it could be assumed that this would lead to differential methods of referring to emotion between the two language-based cultures. A meta-analysis of several language studies by Pavlenko (2008) interpreted studies that investigated differences in emotionality and responses to emotional lexicon in bilinguals. The results from this analysis suggest that emotion concepts vary across language-specific cultures, and differential emotionality affects language choice in bilinguals. In particular, for Spanish-English bilinguals, Spanish emotion words were more readily contextualized than corresponding English emotion words for English monolinguals. In addition, Spanish-English bilinguals better recalled emotion words in their first language learned, whether it was English or Spanish. However, part of the discussion around the causes for these differences is that they are potentially a result of the age of language acquisition. Thus, differences in responses to emotional words in Spanish-English bilinguals could be due to the age at which a language was learned, and thus associations resulting from the context, both emotional and cultural, in which it was learned.

Several studies have specifically looked at whether or not Spanish-English bilinguals experience emotions or express themselves differently in Spanish as compared to English, and these studies have all suggested that for the most part bilinguals seem to express more emotion in their first language (L1) as compared to their second language (L2) (Guttfreund, 1990; Pizarro, 1994; Díaz-Peralta Horenstein, 2010).
A study by Guttfreund (1990) focused on the difference in emotional experience based on language environment in Spanish-English bilinguals. The study analyzed emotional affect in different groups of bilinguals, which were compound bilinguals versus coordinate bilinguals. Compound bilinguals are those that learned two languages simultaneously within the same context, and thus generally learned them both at a young age around the same time. Coordinate bilinguals develop two different contexts for learning and utilizing their two languages, such as when one is spoken primarily at home and one is spoken primarily at school. Thus, in these individuals, they sequentially learned one language first and then learned the second language later in life. Within this model, since both languages were learned at different times, pertain to different contexts and are associated with different emotions based on associations made when they were learned, coordinate bilinguals tend to differentially express themselves emotionally in the two language contexts. Participants were asked to self-report emotional expression in response to emotional stimuli.

The results from the aforementioned study found that Spanish-English coordinate bilinguals showed greater affect in their L1 (Spanish) than in their L2 (English). In addition, subjects overall showed greater affect, measured through self-report measures of emotions, in the Spanish language condition (when given surveys in this language) than the English language condition, suggesting that they associated Spanish with higher levels of emotional expressivity. However, a limitation to this study was that it only addressed emotion in context of depression and anxiety and should be expanded to other psychological measures of emotion. The study also used self-reported data and could be further expanded to more objective measures. In addition, the study only looked at
bilinguals and did not expand the study to measure differences between these individuals and Spanish or English monolinguals. However, the study leaves room for more research into emotional expression in Spanish-English bilinguals as a function of when a language was learned (Guttfreund, 1990).

Pizarro (1994) also studied the second language effect proposed by the research of Guttfreund (1990). Specifically, the research was investigating the theory that in bilingual individuals, emotional intensity diminishes when the individual is switching to or speaking in their L2 and increases when switching to or speaking in their L1. Emotional intensity was measured by interviewing bilinguals on equivalent emotional topics when speaking in both languages, with a week between the two language-based conditions. This emotional arousal was elicited by asking participants to discuss an emotional topic, and was measured using the State-Trait Anxiety Inventory.

However, the results from the study suggested that there was no effect of language being used on discomfort or self-disclosure when discussing emotional topics. An important conclusion from the research is that with higher level of proficiency in the L2 in bilinguals, the L2 should produce a relatively equal level of emotionality as L1. Limitations to this study suggest further study on this topic is necessary. Primarily, the study was done in a clinical setting, and thus to protect patients from embarrassment, lower degrees of emotional topics were picked as part of the self-report process. However, the study did not measure the individuals rating of level of emotion on the topics. In addition, the assessment of the self-disclosures by outside judges was shown to be low in inter-rater reliability (Pizarro, 1994).
One study by Harris and colleagues (2005) expanded upon the work of Guttfreund by comparing autonomic arousal in coordinate and compound Spanish-English bilinguals due to exposure to emotionally charged words. Specifically, the study examined bilingual individuals who had become fully acculturated to their second language, and thus considered it to be their stronger and more frequently utilized language environment. The participants were divided into two groups: the first group consisted of Spanish L1 early English learners who considered English to be their dominant language-bound culture, and the second group consisted of Spanish L1 late English learners who considered Spanish to be their dominant language-bound culture. The results from the study suggested that both groups had stronger reactions to emotional words than to neutral stimuli.

More importantly, results from the aforementioned study showed that childhood reprimands created stronger emotional responses in Spanish L1 late English learners when presented in the L1. For the early English learners, there was no difference in emotional reactivity to either language condition, suggesting that Spanish-English bilinguals’ arousal due to emotional stimuli may be similar when age of acquisition is similar for both languages, and when the L1 is the less frequently utilized language. The importance of this study is that it supports previous studies’ findings that the L1 can be more emotionally evocative than the L2 for coordinate bilinguals. When the L1 is learned much earlier than the L2, the L1 is more likely to cause arousal to emotional stimuli. In addition, it is important because it supports the idea that in compound bilinguals, where both languages are learned from a young age, emotional arousal in response to emotional stimuli was very similar.
Another study by Díaz-Peralta Horenstein (2010) looked at emotional expression in Spanish-English bilinguals by studying verbal expression of emotional expressions in coordinate and compound bilinguals. The study specifically looked at sad and happy mood states that were induced by presenting participants with film clips and two recall-of-events procedures. The research attempted to replicate the findings from Guttfreund (1990) and Harris et al. (2005) that coordinate bilinguals would show more emotional reactivity to emotional stimuli in L1 than in the L2. The study was unique in that not only was age of language acquisition considered, but also measurements included level of acculturation and levels of bilingualism (i.e. frequency of speaking of each language, comfort using each language, identification with a linguistically-defined culture) in the participants. The study was also unique from prior studies because it asked participants to write about either a very sad or a very happy experience. The participants then viewed a video clip and finally were asked to describe how the film clips had made them feel.

The results from this study revealed findings contrary to those discussed in Guttfreund (1990) and Harris et al. (2005), in that coordinate bilinguals showed stronger emotional reactivity, measured by self-reports of emotions, in response to stimuli in their L2 instead of their L1. In addition, the study utilized Spanish and English monolingual groups for comparison, and found that Spanish monolinguals displayed more positive and negative affect than coordinate bilinguals. This was an unexpected finding because the study hypothesized that coordinate bilinguals would have similar affect to Spanish monolinguals. The author of the study suggested that a reason for these findings could be that both types of bilinguals, living in the United States, were more similar in their expression of emotional affect to Anglo-Americans than to Latin Americans living outside
the U.S. due to exposure to U.S. culture. One explanation proposed by the author is that immersion in the new culture could result in subtractive bilingualism, by which L2 proficiency comes at a cost to the L1. Part of this could result from perceived discrimination from the host culture and a desire to acculturate to the host culture. Another explanation for the findings in this study could be a complex interplay between several factors: language proficiency in bilinguals, education, levels of acculturation, and time spent speaking each language (Díaz-Peralta Horenstein, 2010).

The study by Díaz-Peralta Horenstein (2010) had several limitations to consider when studying emotional expression in Spanish-English bilinguals. Primarily, as the author mentioned, the research only studied bilinguals in which Spanish was the L1 and English was the L2. The study did not include a group of bilinguals for whom English was the L1 and Spanish was the L2, which the current research aims to do. In addition, the study utilized video clips to elicit emotional expression, yet there was no analysis of this content to examine whether emotional content of the videos was similar in both language-primed conditions. Further studies could concentrate more on levels of acculturation and the effects of acculturation, class, race and gender on emotional expression in the L1 and L2, and how language-bound cultural differences affect emotion in Spanish-English bilinguals (Díaz-Peralta Horenstein, 2010).

The concept that bilinguals may experience emotions differently in their two languages has become an important consideration in therapeutic settings in the U.S. This is particularly important with the growing Spanish-speaking population in the U.S., while most therapeutic settings are limited to using English and thus fail to serve this underrepresented population in a clinical setting. Several studies have suggested that since
language, culture and emotion are closely connected, utilizing both languages in therapy is important because clients may be more comfortable discussing emotional content in one language context over another. These studies suggest that utilizing language-based, culturally specific techniques such as language-switching, *cuento* therapy, *dichos* and performing assessments in two languages help to better serve a Hispanic population seeking clinical help for mental disorders. Thus, it is important to determine whether differences exist in how Spanish-English bilinguals not only express themselves emotionally, but also display emotion, in order to better serve this growing population in the U.S. (Santiago-Rivera & Altarriba, 2002; Rozensky & Gomez, 1983; Costantino, Malgady & Rogler, 1986).

**Spanish-English Language Context Cultural Studies**

A study by Ramírez-Esparza and colleagues (2006) looked at measures of personality in Spanish-English bilinguals. The justification for this research was based on previous studies that suggest differences in personality between individuals living in American culture and Mexican culture. The researchers hypothesized that based on prior research; Mexicans would score higher on extraversion due to their high sociability.

The results from the research of Ramírez-Esparza and colleagues (2006) found contrary evidence that suggested bilinguals were more extraverted, agreeable and conscientious when speaking English than they were when speaking Spanish, which reflected differences in personality across these two cultures. This finding was attributed to the fact that extraversion was associated more with assertiveness, which is an important concept in individualistic English-speaking cultures, and not emotional expressivity, which is associated with more collectivistic Spanish-speaking cultures. While it is not suggesting
that bilingual individuals have two distinct personalities, the research demonstrates that an individual may become more extraverted when speaking English than when speaking Spanish. The research reflects the tendency of bilingual individuals to change their interpretations based on internalized cultures, due to external cues. The limitations to this study leave room for further research in differences among Spanish-English bilinguals, primarily how acculturation to either culture affects the idea of cultural frame switching. In addition, while this task examined personality, it leaves room for further research on emotional expression since this is closely related to personality and varies across cultures. However, the study shows the importance of cultural frame switching and how cultural priming can affect cognition.

An important aspect to studying bicultural individuals is the concept discussed in the research done by Ramírez-Esparza and colleagues (2006), which is an idea that bicultural individuals have two internalized cultures, which can be contradictory, that they rely on to make judgments and interpret the world. Research on Chinese-Americans and westernized Chinese students in Hong Kong utilized cultural icons to prime these individuals into either their Chinese or American construct networks, and then asked them to make attributions of social behavior in presented stimuli. The findings showed that after being primed with American cultural icons, the students were less likely to attribute the social behaviors to external forces than they were when primed with Chinese cultural icons. The importance of this research is that it suggests that cultural priming can be effective to prime bicultural individuals to rely one of their two cultural cognitive constructs (Hong et al, 2000).
The study by Hong et al (2000) was important in that it suggested the effectiveness of cultural priming as a method to elicit cultural frame switching in bicultural individuals. Furthermore, the research suggested that language (as a culture-bound phenomena) could be an effective method to prime bicultural individuals not only on personality and cognitive style, but also on emotions. The researchers suggested that the close connection of language and culture could allow a language environment to prime a cultural mindset and cognitive style. In addition, the study suggests that many bicultural individuals, when acculturating to a new society, utilize cultural frame switching, not only to achieve a cognitive state similar to those in the host culture, but also to maintain aspects of one’s original culture. The study showed that cultural priming is effective to elicit a culturally specific way of thinking, and that language context can serve as a cultural prime, particularly when looking at different emotive styles in different cultures (Hong et al, 2000).

Another study analyzing the effects of linguistically defined cultural differences on emotion looked at judgments of universal facial expressions of emotions (Keltner, Ekman, Gonzaga & Beer, 2003). The study looked at judgments of emotion in bilingual (English and Hindi) students in India. The students made judgments not only of the universal expressions of emotion, but also intensity ratings of emotions, during two different sessions, one conducted entirely in English and the other entirely in Hindi. The results from the study found that individuals more accurately identified anger, fear and sadness in the English setting than in the Hindi session. In addition, the participants rated a greater intensity of anger of female photos in Hindi, but a greater intensity of sadness of female photos in English. The findings from this study suggest that cultural influences may affect
judgments of emotion, and since language and culture share a close connection, the differences of judgment of emotion may differ as a function of a linguistically defined culture. However, limitations of the study, such as a lack of a highly concrete measure of bilingualism and culture within the research design, leave room for more research with regard to emotion judgments in bilinguals (Matsumoto & Assar, 1992).

**Role of Facial Expressions**

Something to consider when analyzing emotional facial expressions in bilingual individuals is sensitivity to interracial facial expressions. A body of research suggests that there is a race bias, which indicates individuals more easily recognize faces of individuals within their own race (Brigham and Barkowitz, 1978). A study by Wolfgang & Cohen (1988) utilized this body of research to examine if there is sensitivity to race when analyzing interracial facial expressions of emotion. The study looked for potential differences within the universalist and cultural-racial specific hypotheses of this phenomena in groups of white Canadians, and Latin American, Ethiopian and Israeli immigrants. Of particular interest with regard to the current research was the research regarding Latin American immigrants and sensitivity to judgments of interracial emotional expressions.

In the Latin American condition of the Wolfgang & Cohen (1988) study, they found support for the racial and minority position, which is the idea that judgments of facial expressions will be more accurate in similar individuals. Latin Americans from Chile, Argentina, Uruguay and several Central American countries performed better on judging emotional expression in individuals who more closely resembled them; in this instance white faces as compared to black West Indian faces. Another finding from this study was
that bilingual Latin Americans were more accurate judging emotional expressions in both conditions than monolingual Latin Americans. It was suggested that this could be due to the process of learning a second language, and the increased reliance on non-verbal communication (i.e. decoding facial expressions) when speaking in a second language. While this study was very limited in discussing the difference between monolinguals and bilinguals in the judgment of emotional expressions, it leaves room for more research with regard to investigating the difference in judgments of emotional expression in Spanish-English bilinguals.

**Facial Mimicry**

An important aspect to judgments of emotional expression is how people interpret emotions in other individuals. A manner in which interpretation of others’ emotions manifests itself is through mimicry of facial expressions when interacting with other individuals. By doing this, the observer of the emotion will experience the corresponding affective state through a feedback process, referred to as the facial-feedback hypothesis. A theory developed to explain this mimicry response is that shared affect allows individuals to better understand one another’s emotions, and thus allows for more nuanced social interactions. This concept was tested in a study conducted by Blairy, Herrera & Hess (1999).

The research included several designs to analyze the different aspects of the theory of facial mimicry in response to emotional expressions. The first part of the study measured spontaneous mimicry of facial expressions when subjects were decoding images of the universal facial expressions (happiness, anger, sadness, fear and disgust) in others, and utilized EMG to detect potential mimicry that could not be seen through simple
observation. The other part of the study examined accuracy of decoding facial expressions when the participants were asked to either mimic faces or were not instructed to mimic facial expressions. The results from the study supported the theory that individuals will spontaneously mimic facial expressions when exposed to facial expressions, and that emotional contagion occurs as a result. The study also found that these responses were strongest in anger, sadness and disgust. However, the study does not provide support that either voluntary or spontaneous facial mimicry enhances understanding of emotion in others. The results from the second part of the study showed no significant difference when individuals were asked to purposefully mimic expressions. There were several limitations to this study, among them that the study utilized pictures of facial expressions, as opposed to in vivo facial expressions. This could have resulted in a weakened response, since the interactions were not true social interactions. Another weakness was that the study aimed to examine effectiveness of facial mimicry to increase empathy in a therapeutic setting. However, the study failed to establish a concrete method to measure empathy (Blairy, Herrera, & Hess, 1999).

Another study conducted by Lee, Dolan & Critchley (2008) aimed to map neural networks involved in the process of facial mimicry. Specifically, they aimed to investigate how making an incongruent facial expression to facial expression stimuli would differentially activate brain regions compared to a congruent facial expression. The subjects viewed video clips of emotional expressions while being asked to either create a congruent or incongruent facial response, and an fMRI was utilized to analyze brain regions activated by the task. The results of the study showed a greater activation of brain regions associated with facial expressions and facial recognition (i.e. the interior frontal gyrus and
supplementary motor areas) when creating an incongruent facial expression in order to override an evolutionary imitative response system. The importance of this finding is that it suggests an evolutionary system in which imitation of facial expressions is important for adaptive social behavior and is part of a mirror neuron system.

As was mentioned in the Blairy, Herrera, & Hess (1999) study, a popular explanation for the evolutionary development of the facial mimicry response is empathy. One study analyzed this theory in an attempt to show the importance of empathy resulting from emotional contagion via facial mimicry. The study utilized fMRI to observe brain activation when individuals were either viewing or mimicking facial expressions. The brain areas were more strongly activated by imitating facial expressions and included the inferior frontal cortex, the superior temporal cortex, the insula and the amygdala. These brain regions are important in emotions and play a role in empathy, primarily the insula and the amygdala. Thus, this research is important because it suggests the neural mechanisms underlying facial mimicry are closely connected to the neural mechanisms involved in modulating affect and emotions in response to other individuals’ emotional expressions (Carr et al, 2003).

Another study that has contributed to the concept that facial mimicry may play a role in eliciting emotions in the observer of a facial expression looked at the role of emotion in rapid facial reactions (RFRs). The research looked at RFRs in response to emotional stimuli, assuming that if there was no emotional aspect to this mimicry response, then the facial expressions would simply be mimicry. However, if there was an emotional aspect to the responses, then they should see facial responses that reflect an appropriate emotional response. Specifically, the research induced a fear response by presenting subjects with a
fear inducing stimuli, and then presenting subjects with angry, fearful or neutral expressions. The facial expressions were measured using electromyography (EMG), and the results showed that when fear was induced, facial responses were not exact mimicry but context appropriate expressions. Thus, participants would show fearful RFRs in response to angry stimuli, as opposed to merely mimicking the anger response. The results from this study support the concept that facial mimicry is not simply a non-affective motor response but facial mimicry includes an emotional aspect (Moody, McIntosh, Mann & Weisser, 2007).

**Display Rules for Emotional Expressions**

The concept of facial mimicry as an evolutionary response to allow individuals to experience empathy for other individuals is an important concept when analyzing cross-cultural differences in emotional expression. Research has proposed that facial expressions are universal, and all humans experience the same emotions, a theory that is in line with evolutionary explanations behind the phenomenon of facial mimicry. However, research has also found that cross-cultural differences exist in display rules for facial expressions of emotions. Display rules dictate when it is appropriate to display facial expressions when interacting with in-group versus out-group individuals, and these cultural rules for appropriateness of expression are passed down through a language-bound cultural environment (Matsumoto, 1994).

Research on Japanese and English-speaking individuals asked individuals to view facial expressions and rate the appropriateness of displaying these expressions in public. The findings were that Japanese participants rated displays of anger, disgust and sadness as more appropriate with the out-group (group of individuals not belonging to an intimate social group) and displays of happiness more appropriate with the in-group (group of
socially connected individuals), while Americans rated these displays inversely appropriate (Matsumoto, 1994). Matsumoto (1994) proposes that since prior studies have found cultural differences in how we display facial expressions towards others, further studies should if these differences persist in spontaneous expressions of emotion. Since facial mimicry is theorized to serve an evolutionary role of producing emotion contagion to allow empathy between interacting individuals, and evidence suggests culturally based differences in appropriateness of displaying these expressions, there is potential to study culturally based differences in facial mimicry responses based on language cues. Language, particularly when comparing monolinguals to bilinguals, could determine an individual’s perception of their status as either being in-group or out-group when compared to others.

Purpose

The purpose of the current research is to further test the hypothesis that Spanish-English bilinguals express emotion differently, based on which language was learned first, since prior research suggests that individuals may experience emotions differently depending on the language-defined cultural environment in which they are being primed (Guttfreund, 1990; Harris et al, 2005; Díaz-Peralta Horenstein, 2010). This is being measured by analyzing facial mimicry responses to emotional stimuli presented in videos of emotional expressions primed within the context of a linguistically defined culture as an objective measurement of emotional expression. Prior research has suggested that brain activation during facial mimicry is correlated to emotion regulation areas of the brain, and that individuals’ affects change to reflect the emotion being mimicked (Blairy, Herrera, & Hess, 1999; Carr et al, 2003; Lee, Dolan, & Critchley, 2008). This study aims to examine whether there are language-bound cross-cultural differences in facial mimicry due to past
evidence that cultural display rules determine the way emotions are expressed and Spanish-English bilinguals experience emotions differently (Matsumoto, 1994; Guttfreund, 1990).

The current study also attempts to address gaps in the research on emotion in Spanish-English bilinguals (Harris et al, 2005; Guttfreund, 1990; Pizarro, 1994; Díaz-Peralta Horenstein, 2010) by utilizing groups of bilinguals for whom Spanish was the L1 and English was the L2, a group for whom English was the L1 and Spanish was the L2, and a group in which both languages were learned simultaneously from a young age (until age 5). It expands on previous methodology to include a more distinct measure of acculturation that had been validated in prior research (Marin & Gamba, 1996). The study also utilizes videos of individuals making facial expressions, as opposed to still images, in order to evoke stronger facial mimicry responses (Blairy, Herrera & Hess, 1999). The study measures facial mimicry responses against levels of Spanish-English acculturation and bilingualism, and thus examines rates of mimicry responses on a scale of language proficiency in both language contexts.

It was hypothesized that the different groups would exhibit differences in facial mimicry responses based on when age of acquisition for both languages and which language-context they were being primed with when viewing videos of facial expressions. Thus, it was expected that for participants for whom L1 was English and L2 was Spanish, there would be more facial mimicry responses in the English priming condition. For participants for whom L1 was Spanish and L2 was English, it was expected to find more facial mimicry responses in the Spanish priming condition. These hypotheses were based on findings from prior studies suggesting that there is indeed a difference based on age of
acquisition for both languages and emotional expression, where the L1 is generally more expressive than the L2 in bilingual individuals (Guttfreund, 1990; Harris, 2005; Rozensky and Gomez, 1987).

In addition, the study examined whether bilingual individuals would show more facial expression after being primed using a cultural prime (a short story in each language and utilizing typical names for each language environment condition). It was hypothesized that Spanish L1 and English L2 bilinguals would be more expressive overall when exposed to an emotional prime, since previous studies have suggested the finding that native Spanish-speakers tend to be more emotionally expressive as a result of cultural expectations surrounding appropriateness of emotional expression and based on research suggesting different cultures maintain specific display rules when demonstrating different facial expressions (Ramírez-Esparza et al, 2006; Matsumoto, 1994). The aforementioned research on empathy and facial mimicry (Blairy, Herrera, & Hess, 1999; Carr et al, 2003; Lee, Dolan, & Critchley, 2008) suggests it might be possible to determine if there is a difference in how individuals empathize with others, based on a measure of facial mimicry, if they are perceived as belonging to the same or different linguistically-determined cultural group (Matsumoto, 1994).

Methods

Participants

Sixty male and female (16 male, 44 female) participants between the ages of 18 and 29 were originally recruited for this study, from the College of William and Mary community. Spanish-English bilinguals were recruited from the Hispanic Studies department on a volunteer basis, and from Psychology introductory courses. Individuals
recruited from introductory courses received one course credit for participating in the study. English monolinguals were randomly selected from psychology introductory courses and also received one credit for participating in the study.

The bilingual participants consisted of individuals from diverse ethnic backgrounds, and could be divided into three groups. The groups consisted of Spanish-English bilinguals where L1 was Spanish and L2 was English (n=6), L1 was English and L2 was Spanish (n=16), and where both Spanish and English were learned during the primary language acquisition period (from birth until age 5, n=28). The group of English monolinguals (n=10) had limited (only introductory lessons in Spanish) to no experience with Spanish. Age of acquisition criteria to determine type of bilinguals was self-reported by participants. A language was considered L1 if it was learned from an age of 5 or younger, while a language was considered L2 if learned from age 6 or older. To determine L1 and L2, participants were also asked to report which language they were more comfortable speaking and which language they self-reported as being their native language.

The Spanish-English bilingual groups consisted of participants of Hispanic or Spanish-speaking background born in the U.S. (29) with various Spanish-speaking countries of descent. Self-reported descriptions for ethnicity and countries of descent included: Mexico (6), El Salvador (2), Guatemala (2), Peru (2), Puerto Rico (2), Bolivia (2), Mixed-race (2), Spain (1), Colombia (1), Ecuador (1), Cuba (1), Cuba and Argentina (1), Puerto Rico and Bolivia (1), Mexico and El Salvador (1), and unspecified (4). The bilingual group also consisted of 9 individuals not born in the U.S., whose self-reported countries of origin included: Argentina (1), Colombia (1), Puerto Rico (1), Dominican Republic (1), Bolivia (1), El Salvador (1), Aruba/Colombia (1), Bolivia/Puerto Rico (1), and Mexico/Cuba
(1). The remainder of the Spanish-English bilingual group consisted of individuals born in the U.S that did not self-report as having a Hispanic background or different country of descent.

**Design**

The study was a within-subjects design, where each participant was presented with both a Spanish condition and an English condition. Each participant was presented with a short story in one language, then shown approximately 4 second long videos of the 6 universal emotions: Anger, Disgust, Fear, Happiness, Sadness and Surprise (Keltner, Ekman, Gonzaga & Beer, 2003) (See Appendix I). The videos were taken from the Cohn–Kanade database of emotional expressions, which were coded using FACS and validated in previous studies (Lucey et al., 2010). The videos were primed with a neutral expression of the individual and a name considered typical in the language context of each condition. In the English condition the names presented with the videos were Julie, Sarah, Mary, Tyler, John, and Robert. In the Spanish condition the names presented with the videos were Juan, Pedro, Antonio, Marta, Isabella and Rocío. After viewing each video, participants were asked to label the emotion they had seen in each video.

Prior to viewing the videos of emotional stimuli, participants read the short stories out loud. The stories read by participants were *The Princess and the Pea* by Hans Christian Andersen in the English condition, and *Lágrimas de Chocolate* by Pedro Pablo Sacristán in the Spanish condition (See Appendices II and III). Each story was rated using a survey that asked about the emotional contents of each story, given to an English-speaking population in the U.S. (n=6) and a Spanish-speaking population in Guatemala (n=7) that were not participants in the main study. This was done to determine if there was a difference in
emotional content of the stories that could have potentially caused changes in participants’
affect as a result of being primed with the short story. Thus, if there was any difference, this
could be analyzed with regard to any differences in results seen in facial mimicry responses
between conditions.

The stories and videos were presented to participants using the computer program
OpenSesame version 2.8.1 developed by Mathôt, Schreij & Theeuwes (2012). Participants
were seated behind a box that projected the stories and videos onto a screen, behind which
was a hidden recording camera that captured the facial expressions of participants in
response to the emotional stimuli. Both prior to and after seeing the videos of each
emotional expression, participants heard a loud beep that indicated the start and end of the
video, respectively. The participants were made aware of recording prior to participating
and they agreed to be filmed during the experiment. All directions were given in English
prior to the experiments, and participants were alerted that they could end the experiment
if they felt uncomfortable at any point during the experiment.

Participants were randomly assigned to one of four possible counter-balanced
conditions for the experiment. In two of the conditions the participants were presented
with the English condition first and the Spanish condition second, while the order of the
videos was reversed for one of the conditions. The other two conditions presented the
participants with the Spanish condition first and the English condition second, and again
the order of the videos was reversed for one of the conditions. Thus one of the English first
conditions and one of the Spanish first conditions had the same order of videos, while the
other two conditions had reversed order for the videos.

Each participant saw twelve videos, and saw each expression twice, once in English
and once in Spanish. In the two English first conditions, the participants were presented with the following stimuli: a male expressing anger, a female expressing disgust, a male expressing fear, a female expressing happiness, a male expressing sadness and a female expressing surprise, or a female expressing anger, a male expressing disgust, a female expressing fear, a male expressing happiness, a female expressing sadness and a male expressing surprise. These conditions were the same in the Spanish first conditions, so that each video was presented in both Spanish and English. After labeling expressions and narrating the short stories, participants then filled out a survey that recorded information regarding levels of bilingualism, acculturation to either language, and demographic information. The study took participants approximately 15 to 20 minutes to complete.

**Measures**

Facial mimicry responses were recorded using a video camera to capture facial expressions of participants while viewing the emotional expression stimuli presented in the videos. To examine mimicry, we determined whether or not a particular facial muscle movement known to be strongly associated with each emotion was displayed as, or immediately after, participants viewed the videos of each facial expression. The videos of the participants were coded using the Facial Action Coding System, focusing on actions that are common in the universal emotional expressions (Ekman, Friesen & Hager, 1978).

The Facial Action Coding System (FACS) is an objective and validated measurement of facial muscle movements. These muscle movements on the face have been codified utilizing a number system that identifies each muscle movement as distinct, referred to as an action unit (AU). While FACS describes many possible combinations of facial muscle movements, it has been specifically adapted to look at the universal emotional expressions, referred to
as emotion FACS (EMFACS). EMFACS identifies distinct action units and combinations of action units that are unique to each emotional expression. For the purpose of this research, these distinct action units were the only facial movements being coded as important for mimicry of emotional expressions (Ekman, Friesen & Hager, 1978). (Refer to Table 1)

Participants were given a short survey after reading the short stories and labeling the emotional expressions in the video clips. Included in this survey was the Bilingual Acculturation Scale for Hispanics (BAS). The BAS was adapted from a survey developed by Marin & Gamba (1996) that analyzes bilingual acculturation in Spanish-English bilinguals. The survey measures levels of acculturation to English and Spanish language-bound cultures through a series of questions asking about use of both languages and exposure to the language-specific cultures. The scale includes 24 items (12 for each language) that are rated from 1 to 4, with 1 being no acculturation and 4 being complete acculturation. The items are averaged out, and the scale was validated such that receiving above a 2.5 is indicative of biculturalism in the linguistically defined culture (see Appendix IV).

Since the scale did not account for the growth of social media use in the past decade, it was adapted to include a new question that measured extent of using social media (i.e. Facebook, Twitter) in either language on the following scale: (1) almost never, (2) sometimes, (3) often, (4) almost always. Thus, the scores were averaged amongst 13 items instead of 12 items. The scale was used to measure extent of acculturation, primarily with regard to the Spanish-speaking culture, since all participants had high scores (above 3) on English acculturation. This was mostly likely explained by the demographic of using participants attending college in the U.S. Thus, individuals that learned Spanish first, or Spanish and English concurrently, with a score above a 2.5 were considered to be in a
higher level of Spanish-speaking capability (proficient or close to proficiency) than individuals who scored below a 2.5.

The BAS was also used as a cutoff range for creating a control group of English monolinguals. With the growing prevalence of Spanish-speakers in the U.S., it could be assumed that exposure to the language is common for English monolinguals and thus they might score above a 1 on the BAS. Thus, scores below 1.5 on the BAS were considered to be a cutoff for participants in the control group to account for everyday exposure to Spanish, and 3 participants had to be excluded due to this criterion.

The survey also included Guttfreund’s Bilingual questionnaire (1990), which is a comprehensive questionnaire that measures language proficiency in individuals. The study utilized the scale to verify language proficiency in the Spanish-English bilinguals, and to verify that English monolinguals in the control group were not proficient in any other language. The study also included measures important for the study with regard to rating the language participants felt they were more likely to use when very angry, happy or sad. This questionnaire was also important for identifying the age at which participants learned both languages, thus determining which group to place each participant in with regard to analyzing results (see Appendix V). Basic information about the participants was gained from a brief demographic questionnaire included in the survey that asked participants to report information about age, ethnic identity, and gender (See Appendix VII).

**Emotional Content of the Short Stories**

The emotional content of the short stories was measured by utilizing groups of participants who were not involved in the main study. A group of native Spanish-speakers rated the emotional content of the Spanish short story, while a group of native English-
speakers rated the emotional content of the English short story. The participants were asked questions about how they felt after reading the story, and what emotions they felt were conveyed by the stories with regard to the six universal emotions. They were asked how the story had made them feel and how strongly they felt that the emotions were portrayed in the story on a 5-point Likert scale (where 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5= Strongly Agree) (see Appendix VI).

**Data Analysis**

**Facial Mimicry Responses**

Once the videos of participants and surveys measuring acculturation, bilingualism and emotional content of the short stories were collected, the videos were coded using FACS for the specific action units measuring emotions (refer to Table 1). The videos of participants were coded only at times when the emotional stimuli were being presented, in order to measure facial mimicry responses as a direct result of the videos of emotional expressions. Thus, the beeps that were presented with each stimulus were used to mark the start point and end point of each potential episode of facial mimicry. Utilizing normal FACS protocol, the action units were coded by a certified FACS coder and were measured for intensity on a scale from A to E, where A is the lowest intensity and E is the highest intensity. However, this data was later simplified, so that instances of corresponding facial mimicry responses to stimuli were simply measured as either being present or not present. Mimicry was then measured by calculating the averages of percentage of trials where the expected action unit was observed (see Table 2). In addition, due to technical difficulties while recording the videos of participants, only 34 videos of the participants could be coded for facial mimicry with the following new distribution: individuals for whom the L1
was English and L2 was Spanish (n=21) and individuals for whom the L1 was Spanish and L2 was English (n=13).

**Bilingualism and Acculturation**

Results from the surveys of bilingualism and the Bicultural Acculturation Scale (BAS) were combined to determine language proficiency, level of acculturation and age of language acquisition. The scores from the BAS were calculated by taking the averages of individual scores on each of the 13 items included on the scale for both language conditions. Thus, receiving an average of 1 on the scale meant absolutely no acculturation to the language-specific culture, while a score of 4 meant absolute acculturation to the language-specific culture. Using validated measurements from previous studies, a score of 2.5 was used as the cutoff to determine acculturation to either language-bound culture (Marin & Gamba, 1996).

Participants were placed in the English L1 and Spanish L2 group if they learned English before the age of five, considered their L1 to be English, and received a score below a 2.5 on the BAS for Spanish. Since all participants attended a university in the U.S., where it is presumed that they are exposed to English on a regular basis, scores on the BAS for English were not significantly considered since every participant received a score above a 3 on the English version. Participants were placed in the Spanish L1 and English L2 group if they considered their L1 to be Spanish and scored above a 2.5 on the BAS for Spanish. However, a few participants had learned both Spanish and English before the age of 5, but still considered Spanish to be their L1, and thus were placed in this grouping due to the decreased sample size. These criterion were utilized to determine the new distribution of the two groups being compared: individuals for whom the L1 was English and L2 was
Spanish (n=21) and individuals for whom the L1 was Spanish and L2 was English (n=13).

Due to the small sample size analyzed, the demographic information was mostly unused for the purposes of this study. Thus, effects of gender or ethnicity were not considered in this study, but could be considered in future studies analyzing emotional expression in Spanish-English bilinguals.

**Emotional content of the short stories**

The emotional content of the short stories was measured using short surveys asking how the stories had made participants feel, and the perceived emotional content of each story. The questions asked about all six of the universal emotions: sadness, happiness, anger, disgust, surprise and fear (refer to Appendix VI). The survey for the English short story was distributed to a group of native English speakers (n=6). The survey for the Spanish short story was distributed to a group of native Spanish speakers in Guatemala (n=7). Results from these two surveys were analyzed using an independent samples Mann Whitney U test in SPSS in order to determine if there was any statistically significant difference in how the stories made participants feel or how they were related with regard to emotional content.

The results from the Mann Whitney U test showed that there was no statistically significant difference between the stories with regard to how participants rated their feelings upon reading the story, as measured on each of the six universal emotions (happiness, p=.095; sadness, p=.69; anger, p=.413; disgust, p=.22; surprise, p=.42; and fear, p=.69). However, the results showed that there was statistical significance with how participants rated the emotional content of the stories on happiness (p=.032), such that they rated the Spanish short story as containing more happy emotional content than the
English short story. There was no statistical significance on how participants rated the emotional content of the short stories with the remaining five emotions tested (sadness, p=.55; anger, p=1.0; disgust, p=.31; surprise, p=.31; and fear, p=.69). While the statistical significance suggests that the Spanish story contained more happy emotional content, participants did not show significant differences in how they felt upon reading the stories. Thus, this will be considered when analyzing data, but due to the small sample size and the lack of statistical significance in how participants rated their own feelings, it is not assumed that it should prevent analyzing the facial mimicry data.

**Results**

First, we analyzed overall emotional expressivity in the Spanish L1 group compared to the English L1 group using a repeated measures ANOVA looking at only the bilingual status (Spanish as the L1 and English as the L2 versus English as the L1 and Spanish as the L2) of the participants. There was a trend moving towards a statistically significant difference in expressivity between English L1 bilinguals and Spanish L1 bilinguals, with Spanish L1 bilinguals (n=13) showing at least one action unit in response to emotional stimuli (M=.054, SD=.03) more often than native English speakers (n=21; M=.03, SD=.03), (F(1,31)=3.13, p=.086). This measured the average percentage of trials in which an emotional action unit (see Table 1) was observed when presented with emotional stimuli. As seen in Figure 1, this result indicates a promising trend toward significance of the predicted effect of bilingual group status on emotional expressivity as a measure of observed facial responses to emotional stimuli.

*Figure 1* Overall emotional expressivity as a function of AU presence.
Next, overall mimicry was analyzed in the Spanish L1 group compared to the English L1 group using a repeated measures ANOVA test with the language priming condition (English versus Spanish primes) and the bilingual status of individuals (Spanish as the L1 and English as the L2 versus English as the L1 and Spanish as the L2). This measured overall mimicry as the average percentage of trials in which the expected action unit was observed as a facial mimicry response. The main effect of L1 was not significant when measured against the specific language primes $F(1,31)=3.13$, $p=.086$. Due to the small sample size, interactions of participant gender and target gender were not examined. However, independently of bilingual category, results suggested a trend moving towards significance that participants were more likely to mimic facial expressions after the Spanish short story and name primes ($M=.21, SD=.21$) than with the English short story and name primes ($M=.16, SD=.15$), $F(1,31)=3.45$, $p=.072$. The means are shown in Figure 2.

Figure 2 Overall mimicry responses compared to language-based cultural primes
While the Spanish language prime elicited more facial mimicry responses than the English language-based cultural prime, the interaction between the language-based cultural prime and the type of bilingual (Spanish L1 bilinguals versus English L1 bilinguals) suggested a promising trend towards significance, $F(1,31)=2.62, p=.115$. This suggests a larger sample size may result in more significant findings. However, the results from this interaction suggest, as seen in Figure 3, that the Spanish L1 bilinguals (n=13) elicited more facial mimicry responses to the English condition than to the Spanish condition (English condition: $M=0.26$, $SD=0.24$; Spanish condition: $M=0.15$, $SD=0.15$), and more average responses than the English L1 bilinguals (n=21; English condition: $M=0.17$, $SD=0.18$; Spanish condition: $M=0.16$, $SD=0.15$).

*Figure 3* Overall mimicry responses vs. language prime
Facial Mimicry Responses for Individual Emotions

After analyzing overall mimicry responses compared to language priming condition, bilingual group (Spanish L1 or English L1 bilinguals), and the interaction between the language priming condition and the bilingual group, interactions of these were analyzed for average number of mimicry responses observed in each trial as compared to what was expected for each individual emotion.

For happiness, there was a statistically significant main effect of bilingual group on instances of facial mimicry $F(1,31)=5.43, p=.0263$, yet there was no significant effect of language context nor a significant interaction between the two $F(1,31)=.40, p=.5322$. As shown in Figure 4, this result indicates that Spanish L1 bilinguals were more likely to mimic happy facial expressions (English condition: $M=0.42, SD=0.49$; Spanish condition: $M=0.31, SD=0.38$) as compared to English L1 bilinguals (English condition: $M=0.17, SD=0.29$; Spanish condition: $M=0.17, SD=0.29$), independent of the language priming condition. These results also show that the Spanish L1 bilinguals were more likely to mimic happy facial expressions in responses to the English-primed stimuli than they were in
response to the Spanish-primed stimuli. This finding is important with regards to the emotional rating of the short stories. Since individuals found the Spanish short story to contain happier emotional content, it would be expected that if this affected the results, then there would be more mimicry of happy facial expressions in the Spanish priming condition compared to the English priming condition. However, the opposite was seen and thus could be assumed that this confound did not affect the results.

*Figure 4* Means of facial mimicry responses to happiness stimuli

For anger stimuli, there was no significant effect of which type of bilingual the participant was and the mean percentage of facial mimicry responses $F(1,31)=1.00$, $p=.3249$, nor was there a significant effect of the language priming and the mean instances of facial mimicry per trial $F(1,31)=2.25$, $p=.1434$. However, there was a significant bilingual group (Spanish L1 bilingual vs. English L1 bilingual) X language prime interaction, $F(1,31)=4.20$, $p=.0487$. As seen in Figure 5, these results show that Spanish L1 bilinguals showed more facial mimicry responses to English-primed anger stimuli (English condition: $M=0.50$, $SD=0.46$; Spanish condition: $M=0.19$, $SD=0.38$), while English L1 bilinguals showed more
facial mimicry responses to Spanish-primed anger stimuli (English condition: M=0.21, SD=0.34; Spanish condition: M=0.26, SD=0.41). It can also be seen that this effect appears only for the Spanish L1 group.

*Figure 5* Mean of facial mimicry responses to anger stimuli

For surprise stimuli, there was a significant main effect of bilingual group on the mean number of facial mimicry responses, $F(1,31)=5.43, p=.0478$. However, there was no significant effect of which language prime was presented, nor was there a significant interaction between type of bilingual and the language prime. As seen in Figure 6, the results show that English L1 bilinguals (M=0.07, SD=0.25) were more likely to mimic facial expressions when presented with surprise stimuli than Spanish L1 bilinguals (M=0.058, SD=0.16).
For the other three universal emotions (disgust, fear, sadness) that participants were presented with, there were no significant effects of language prime or type of bilingual on facial mimicry responses to these stimuli. In addition, there was no significant interaction between language prime and bilingual group for disgust, fear or sadness stimuli. The data analysis for this paper was generated using SAS software. Copyright, SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

**Discussion**

After analyzing the results of overall emotional expressivity measured by instances of facial expressions (measured as all action units viewed, not instances of facial mimicry) when viewing emotional stimuli, a trend towards marginal significance was seen on the effect of age of acquisition for a language and emotional expressivity. This suggests that Spanish-English bilingual individuals who learned Spanish first and identified Spanish as
their native language (Spanish L1) were more expressive in response to emotional stimuli than Spanish-English bilingual individuals who learned English first (English L1). While these results failed to reject the hypothesis that individuals who learned Spanish first are more expressive than individuals who learned English first, the results showed a very small difference in this expressivity. This could be attributed to a very low sample size, and further studies may examine this phenomenon to examine these findings in a larger population. This finding was supported by prior research that found, due to cultural expectations on emotional expressivity, that native Spanish speakers were more emotionally expressive than native English speakers (Ramírez-Esparza et al, 2006; Díaz-Peralta Horenstein, 2010). The finding could also be explained by research done by Matsumoto (1994) that suggests the existence of culturally defined display rules that determine appropriateness of displaying emotional expressions in out-group versus in-group contexts. This might suggest that display rules in Spanish-speaking cultures are less strict when displaying emotional expressions than in the English-speaking U.S. culture, which would explain higher levels of emotional expressivity in native Spanish speakers. However, since the data was collected in a laboratory setting, it could not be assumed that this effect would be seen in natural social interactions.

When analyzing the results of overall mimicry responses to the emotional stimuli as a function of the language environment and the age at which a language was learned, the findings did not support the hypothesis that individuals who learned English first and Spanish second would show more facial mimicry responses to the English priming condition, while individuals who learned Spanish first and English second would show more facial mimicry responses to the Spanish priming condition. In order to analyze the
complex interaction of language-bound culture and facial mimicry, the conditions were first analyzed separately. It was found that independent of when participants learned a language, all participants showed more instances of facial mimicry during the Spanish language-based cultural priming condition than they did in the English condition. Thus, there was a significant effect of the linguistically based culture that individuals were primed with and the instances of facial mimicry. This finding could elaborate on the aforementioned finding that native Spanish-speakers are more emotionally expressive than native English speakers (Ramírez-Esparza et al, 2006). Thus, independent of when each language was learned in Spanish-English bilinguals, if cultural expectations dictate that Spanish-speakers are expected to be more emotionally expressive, then the bilinguals may have been primed to elicit more facial mimicry as a result of exposure to the Spanish condition when compared to the English condition. These results could suggest that since Spanish is perceived as a more emotionally expressive language-bound culture, both English L1 and Spanish L1 individuals showed more facial mimicry responses because they perceived the emotional stimuli as stronger in the Spanish priming condition (Pavlenko, 2008).

While the results were significant for facial mimicry as a factor of the linguistically defined cultural prime because all participants showed more facial mimicry in response to the Spanish priming condition, they were not significant as a factor of age of language acquisition. Thus, there was no significant difference between Spanish L1 individuals and English L1 individuals in overall mimicry responses. This supports prior research that suggests that facial mimicry responses are a universal phenomenon that are independent of language and culture, and occur similarly in individuals that belong to different
language-specific cultures, even when viewing others presented as belonging to a different language-bound culture (Blairy, Herrera, & Hess, 1999; Lee, Dolan & Critchely, 2007). This finding could support the concept that facial mimicry is used as a mechanism to understand emotions in other individuals and is independent of a linguistically defined culture (Blairy, Herrera, & Hess, 1999).

In order to determine that the results did not support the hypothesis that Spanish L1 and English L2 bilinguals would show more facial mimicry responses to Spanish stimuli, and that English L1 and Spanish L2 bilinguals would show more facial mimicry responses to English stimuli, the interaction of overall facial mimicry responses as a factor of both linguistic culture prime and when the language was learned was analyzed. These results approached statistical significance, which may have been obtained with a larger sample size, yet the results were contrary to what was expected. Participants whose L1 was Spanish showed more overall facial mimicry responses to the English prime than to the Spanish prime, which was opposite of what was hypothesized. The Spanish L1 group showed more facial mimicry responses than then English L1 group overall, but there was no significant difference seen between the two language-based cultural conditions and the facial mimicry responses in the English L1 group. These results are contrary to previous findings that bilingual individuals are more emotionally expressive in an L1 context than an L2 context, for the Spanish L1 group (Guttfreund, 1990; Harris et al, 2005). However, it supports prior research by Díaz-Peralta Horenstein (2010) who found similar results that Spanish-English bilinguals were more expressive in their L2, which was English for all the participants who had learned Spanish first. It also suggests that there is potential for acculturation, culture and language context to have an effect on facial mimicry responses.
These results could be explained by prior research that suggests the psychological basis for facial mimicry and nonverbal cues when individuals are communicating across linguistically unique cultures. Thus, the reason that the Spanish L1 group showed more instances of facial mimicry in response to the English prime compared to the Spanish prime could be a reliance on non-verbal cues (i.e. decoding facial expressions) when speaking a second language to compensate for lack of language comprehension in the L2 (Wolfgang & Cohen, 1988; Bavelas & Chovil, 1997). This suggests that in addition to utilizing facial expressions to understand emotions in other individuals, people may mimic faces more strongly when communicating in an L2 because it developed as a way to better understand individuals when speaking in a second language. However, this explanation is weak since the English L1 group did not have a similar response pattern to the Spanish priming condition, which was their L2. One explanation for this could return to the concept of display rules across cultures. If individuals who learned Spanish first from a Spanish-speaking culture, and then learned English at a later time, they might have culturally determined display rules that would allow for differences in facial mimicry responses to the English prime as compared to the Spanish prime that were not seen in the English L1 group (Matsumoto, 1994).

A more likely explanation for the finding that Spanish L1 individuals were more likely to mimic in response to the English language-bound cultural priming condition is that individuals are more likely to see a language-specific culture as more emotionally expressive if the culture-specific language is utilized more frequently. If Spanish L1 bilinguals are immersed in a primarily English-speaking environment and use English more frequently, then emotions are more easily activated in this language context, even if
the language environment is not the first one experienced and learned (Rozensky & Gomez, 1983; Díaz-Peralta Horenstein, 2010). Since all participants were recruited from the College of William and Mary, it could be assumed that even Spanish L1 bilinguals were exposed to English on a more regular basis than Spanish, and thus they were more likely to mimic facial expressions when primed in English than in Spanish. This concept would also explain why the English L1 group did not show more mimicry in either condition, since it could be assumed that they are exposed to English on a more regular basis than Spanish.

In addition to analyzing this data, analyses were performed on each individual language-based culture condition to determine if there were differences between when a language was acquired, the language priming condition and facial mimicry responses to individual emotional stimuli. When facial mimicry responses to happy emotional stimuli were analyzed separately, there was a significant effect of L1 and the instances of facial mimicry. These findings showed that Spanish L1 bilinguals were more likely to mimic happy expressions than English L1 bilinguals in both the English and Spanish primed conditions. This finding could again be explained by the concept of cultural display rules, suggesting that native Spanish-speakers have display rules that would elicit more facial mimicry responses to happy stimuli, and showing happy emotional expressions are more appropriate in this culture (Matsumoto, 1994). This result could be further studied by investigating cultural differences in displaying expressions of happiness across Spanish-speaking and English-speaking cultures.

Another interesting finding from analyzing the separate emotional stimuli was the significant interaction between which language was learned first and the language-based cultural prime for anger stimuli. These findings showed that Spanish L1 individuals were
Facial mimicry in Spanish-English bilinguals

more likely to mimic angry expressions in the English priming condition, while English L1 individuals showed less difference in facial mimicry, but a trend of more mimicry in the Spanish priming condition. This finding could be explained by facial mimicry responses and decoding facial expressions in in-group versus out-group environments based on a language-defined cultural identification.

Since anger is measured as an aggressive and potentially dangerous emotional expression, mimicry of anger can be indicative of feeling threatened and can be seen as an adaptive and protective response to displays of anger. If Spanish L1 bilinguals viewed the angry expression during the English priming condition as a threat from an out-group member, but the angry expression during the Spanish priming condition as a threat from an in-group member, this could explain the significantly higher rate of anger mimicry as a protective response against an out-group member. Since this finding was also seen in the English L1 bilingual group as a response to the Spanish priming condition, this concept of in-group versus out-group perception of a threat could be a likely explanation for the observed effects (Matsumoto, 1994; Moody, McIntosh, Mann & Weisser, 2007).

The only other emotional stimuli that showed a significant effect on facial mimicry responses was surprise. The findings from this analysis suggest that there is a significant effect of language group on facial mimicry to surprise stimuli, and that English L1 speakers were more likely to mimic surprise than Spanish L1 speakers, independent of language-specific cultural priming condition. This difference could also be explained by the aforementioned theory of cultural display rules, suggesting that in the English-speaking U.S. culture, showing expressions of surprise may be more socially acceptable and deemed appropriate compared to Spanish-speaking cultures (Matsumoto, 1994). As was previously
mentioned, there were no significant interactions or differences in facial mimicry responses to the other three emotion stimuli presented in the study: disgust, fear and sadness.

**Limitations**

A major limitation to this study was that the small sample size makes it difficult to draw overarching conclusions. In addition, the highly exclusive population makes it difficult to make conclusions with regard to the larger and more diverse Spanish-English bilingual population in the U.S. All participants in the study were either attending a university or had been college-educated in the U.S., and thus it could be assumed that they had significant exposure to English and were highly proficient at speaking English. If the study were to be repeated, it would be pertinent to look at a sample population with a wider range of educational background, and a wider range of language proficiency, especially with regard to proficiency in the English language. It would be suggested to examine not only a group of Spanish monolinguals for comparison, but also examine a group of Spanish L1 bilinguals with a larger range of English L2 proficiency.

The research did expand on prior research that had not looked at a group of English L1 and Spanish L2 bilinguals, but only Spanish L1 and English L2 bilinguals (Guttfreund, 1990; Harris et al, 2005; Díaz-Peralta Horenstein, 2010). This sample did have a much larger range of proficiency in the Spanish L2, but again the small sample size still makes it difficult to make conclusions about the larger Spanish-English bilingual population. Part of the limitation of sample size was due to technical difficulties that prevented the videos from being captured or made them unable to be coded properly for facial mimicry. Such difficulties included, but were not limited to, the program freezing in the middle of the
videos of emotional expressions, the window closing during the experiment when the videos were presented, or the camcorder failing to capture the videos. Thus, of the original sample size of 60 participants, data from only 34 participants could be analyzed properly. In order to observe if these results are seen in a larger population, it would be suggested to utilize more stable programming software and to recruit a significantly larger sample size.

Another limitation that resulted directly as a result of the small sample size, primarily due to technical difficulties, was that an original control group of English monolinguals was too small to make any significant comparisons between the two types of bilinguals and English monolinguals. In addition, the growing prevalence of the Spanish-based culture in U.S. society meant that many of the original controls had some form of exposure to Spanish, and thus it was difficult to find English monolinguals with no prior exposure to Spanish. Thus, in order to improve the study in the future, a larger group of English monolinguals should be recruited, as well as the groups of Spanish monolinguals. This would allow for better interpretation of the results where interactions were found between the types of bilinguals, to see if there were effects of speaking only one language and belonging to only one culture on the results.

Another thing to consider, particularly with regard to analyzing the current data, is that no effects of ethnicity or gender could be examined. This was again a result of such a small sample size. However, it would be an important consideration for future research of emotional expression in Spanish-English bilinguals. A consideration with prior research on Spanish-English bilinguals is that they focus primarily on one ethnic group of Spanish speaking persons, which limits potential variation due to cultural differences in Spanish speakers (Guttfreund, 1990; Harris et al, 2005; Díaz-Peralta Horenstein, 2010). However,
it is clear that Hispanics living in the U.S. are not a cohesive group with regard to cultural background and ethnicity, and if larger sample sizes could be collected, then these effects could be further studied. Since cultural display rules are hypothesized as potentially playing an important role in facial mimicry, an important consideration for future research is to gather enough participants from different ethnic backgrounds to examine if there are effects of ethnic identification on facial mimicry.

A final consideration in this study was that analyzing the emotional content of the two short stories used as primes for either language condition showed that there was a statistical significance between the two stories with regard to the amount of happy content in the stories. The Spanish short story was rated as containing more happy content than the English short story, when both were expected to have similar emotional content. However, the participants did not show a significant difference in how they rated their own emotions with regard to feeling happy after reading the story. For the purpose of the research, since individuals did not claim to feel happier upon reading the Spanish story, it was not considered when analyzing the data. In addition, the trends observed were opposite of what would have been expected if this difference had confounded the data, thus it was assumed it did not have an actual affect on facial mimicry. However, for future research purposes, if short stories are utilized as linguistically based cultural primes, it would be suggested that two stories are used that do not show any significant difference between their emotional content, since emotional expressions were being analyzed.

**Future Directions**

The results from this research and the limited prior research on emotional expression in Spanish-English bilinguals leave room for significant future research in this
area. Future studies should aim to continue investigating this phenomenon in order to establish a clearer idea and more definitive findings with regard to emotional expression in both types of Spanish-English bilinguals. In addition, there is limited research with regard to the connection between facial mimicry and emotional expression, so this interaction should be further studied prior to making conclusions about how facial mimicry reflects emotion (Blairy, Herrera, & Hess, 1999; Carr et al, 2003; Lee, Dolan, & Critchley, 2008).

Future research could focus on bilinguals to examine if language-bound culture does affect facial mimicry, since language and culture have been shown to affect emotion (Guttfreund, 1990; Harris et al, 2005; Matsumoto, 1994).

In this study, participants were asked to label emotions after viewing the videos of emotional expression. While this data was not analyzed for the purpose of this study, since the study focused on facial mimicry responses and not labeling emotional expression, it could be an interesting aspect to analyze with more time. Since some research suggests that facial mimicry and facial decoding serves as a non-verbal cue to understand others, particularly when learning a second language and subsequent usage of a second language, the responses to labeling emotions could be analyzed for accuracy (Wolfgang & Cohen, 1988; Bavelas & Chovil, 1997). By looking at these results and comparing them to instances of facial mimicry, one could examine if individuals were more likely to mimic the expressions when they could not consciously identify the emotion. If there were instances when emotions were incorrectly identified, and there was a facial mimicry response during this video, it could be determined if this was correlated to the language-specific cultural priming condition and the L1 of individuals.
Another measure collected during this study was level of acculturation to U.S. culture and level of acculturation to a Spanish-speaking culture. This data was utilized to determine language-speaking capability in the subjects; however it was not analyzed beyond this. Since studies have shown that acculturation relates to how readily individuals accept a host culture, and how much they continue to associate with their native culture, it could be interesting to study this data further to determine if differences existed based on levels of acculturation (Hong et al, 2000). Of particular interest, for the individuals belonging to the Spanish L1 group, there was a spectrum of levels of acculturation to Spanish-speaking culture. Thus, it would be interesting to determine if there were differences in the ways Spanish L1 bilinguals mimicked emotions as a function of language-specific cultural priming and their levels of acculturation to both their host culture and their native culture.

Finally, the facial mimicry responses were originally coded utilizing the FACS method by measuring the intensity of facial expressions (Ekman, Friesen & Hager, 1978). While the data that was collected was subsequently measured in such a way that only the presence of facial mimicry was analyzed across groups, intensity of these emotions could be examined to get a better understanding of the interaction between facial mimicry responses and type of bilingual. Again, since research suggests an evolutionary aspect of facial decoding as a non-verbal cue to help with comprehension in an L2 (Wolfgang & Cohen, 1988; Bavelas & Chovil, 1997), intensity of facial mimicry responses could be analyzed to determine if they were stronger in the context of the second language learned. There may not have been a significant difference between the two bilingual groups based
on language-bound cultural prime in some of the conditions, but if intensity was examined, a more nuanced difference between the groups could potentially be observed.

**Conclusion**

The current study aimed to fill gaps in research and investigate, in a novel way, prior findings that Spanish-English bilinguals express emotions differently in their two linguistically defined cultures as a function of age of acquisition for both languages (Guttfreund, 1990; Pizarro, 1994; Harris et al, 2005; Díaz-Peralta Horenstein, 2010). No prior study had analyzed if there was a difference in facial mimicry responses in Spanish-English bilinguals as a function of language-bound cultural prime and which linguistically based culture is considered the native culture (which language was learned first). Since facial mimicry is implicated in emotion, and has been theorized to relate to empathy (Blairy, Herrera, & Hess, 1999; Carr et al, 2003; Lee, Dolan, & Critchley, 2008), this would reveal if there is a difference in how bilinguals empathize with and relate to others depending on which language-based cultural frame they are utilizing.

The results suggest that Spanish L1 bilinguals were overall more expressive, in that they responded with more facial reactions to emotional stimuli than did English L1 bilinguals. In addition, the results were contradictory to what was expected, in that Spanish L1 bilinguals showed more facial mimicry responses to the English condition than the Spanish condition, and there was no significant difference in the English group. Spanish L1 bilinguals were more likely to mimic happiness than were English L1 bilinguals, Spanish L1 bilinguals were more likely to mimic anger in the English condition and English L1 bilinguals were more likely to mimic anger in the English condition. Finally, English L1 bilinguals were more likely to mimic surprise than were Spanish L1 bilinguals, while there
were no significant findings for disgust, sadness or fear. These findings could be explained by theories about the appropriateness of displaying emotional expressions, known as cultural display rules (Matsumoto, 1994). However, the small sample size suggests that further research needs to be done to examine if this phenomenon would be replicated in a population that is more representative of Spanish-English bilinguals in the overall U.S. population.
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**Table 1** Action Units examined for each emotion

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<th>Identifying characteristic</th>
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<td>Pulls lip corners back laterally to form smile</td>
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<tr>
<td>Sadness</td>
<td>AU1 (Inner brow raiser)</td>
<td>Raises inner corners of eyebrows in sadness expression</td>
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<td>Anger</td>
<td>AU4 (Brow lowerer)</td>
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<td>AU10 (Upper lip raiser)</td>
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<td>Surprise</td>
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<td>Fear</td>
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<td>Raises upper eyelids in fear expression</td>
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Table 2: Calculated Means for percentages of observed AUs in each trial

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Appendix I

Samples of emotional expressions seen by participants
Appendix I (continued)

*Samples of emotional expressions seen by participants*
Appendix II

*English Short Story*

**The Princess and the Pea**

*By Hans Christian Andersen*

Once upon a time there was a prince who wanted to marry a princess; but she would have to be a real princess. He travelled all over the world to find one, but nowhere could he get what he wanted. There were princesses enough, but it was difficult to find out whether they were real ones. There was always something about them that was not as it should be. So he came home again and was sad, for he would have liked very much to have a real princess.

One evening a terrible storm came on; there was thunder and lightning, and the rain poured down in torrents. Suddenly a knocking was heard at the city gate, and the old king went to open it. It was a princess standing out there in front of the gate. But, good gracious! What a sight the rain and the wind had made her look. The water ran down from her hair and clothes; it ran down into the toes of her shoes and out again at the heels. And yet she said that she was a real princess.

Well, we’ll soon find that out, thought the old queen. But she said nothing, went into the bedroom, took all the bedding off the bedstead, and laid a pea on the bottom; then she took twenty mattresses and laid them on the pea, and then twenty eider-down beds on top of the mattresses. On this the princess had to lie all night. In the morning she was asked how she had slept.

“Oh, very badly!” said she. “I have scarcely closed my eyes all night. Heaven only knows what was in the bed, but I was lying on something hard, so that I am black and blue all over my body. It’s horrible!”

Now they knew that she was a real princess because she had felt the pea right through the twenty mattresses and the twenty eider-down beds. Nobody but a real princess could be as sensitive as that.

So the prince took her for his wife, for now he knew that he had a real princess; and the pea was put in the museum, where it may still be seen, if no one has stolen it.
Appendix III

*Spanish Short Story*

**Lágrimas de Chocolate**
**Por Pedro Pablo Sacristán**

Hubo una vez una princesa increíblemente rica, bella y sabia. Cansada de pretendientes falsos que se acercaban a ella para conseguir sus riquezas, hizo publicar que se casaría con quien le llevase el regalo más valioso, tierno y sincero a la vez. El palacio se llenó de flores y regalos de todos los tipos y colores, de cartas de amor incomparables y de poetas enamorados. Y entre todos aquellos regalos magníficos, descubrió una piedra; una simple y sucia piedra. Intrigada, hizo llamar a quien se la había regalado. A pesar de su curiosidad, mostró estar muy ofendida cuando apareció el joven, y este se explicó diciendo:

- Esa piedra representa lo más valioso que os puedo regalar, princesa: es mi corazón. Y también es sincera, porque aún no es vuestro y es duro como una piedra. Sólo cuando se llene de amor se ablandará y será más tierno que ningún otro.

El joven se marchó tranquilamente, dejando a la princesa sorprendida y atrapada. Quedó tan enamorada que llevaba consigo la piedra a todas partes, y durante meses llenó al joven de regalos y atenciones, pero su corazón seguía siendo duro como la piedra en sus manos. Desanimada, terminó por arrojar la piedra al fuego; al momento vio cómo se deshacía la arena, y de aquella piedra tosca surgía una bella figura de oro. Entonces comprendió que ella misma tendría que ser como el fuego, y transformar cuanto tocaba separando lo inútil de lo importante.

Durante los meses siguientes, la princesa se propuso cambiar en el reino, y como con la piedra, dedicó su vida, su sabiduría y sus riquezas a separar lo inútil de lo importante. Acabó con el lujo, las joyas y los excesos, y las gentes del país tuvieron comida y libros. Cuantos trataban con la princesa salían encantados por su carácter y cercanía, y su sola presencia transmitía tal calor humano y pasión por cuanto hacía, que comenzaron a llamarla cariñosamente "La princesa de fuego".

Y como con la piedra, su fuego deshizo la dura corteza del corazón del joven, que tal y como había prometido, resultó ser tan tierno y justo que hizo feliz a la princesa hasta el fin de sus días.
Appendix IV

The Bidimensional Acculturation Scale for Hispanics (BAS)
Adapted from Marin & Gamba (1996)

Please answer the following questions on the following scale: almost always (4), often (3), sometimes (2), almost never (1).

Language Use Subscale
1. How often do you speak English?
2. How often do you speak in English with your friends?
3. How often do you think in English?
4. How often do you speak Spanish?
5. How often do you speak in Spanish with your friends?
6. How often do you think in Spanish?

Electronic Media Subscale
7. How often do you watch television programs in English?
8. How often do you listen to radio programs in English?
9. How often do you listen to music in English?
10. How often do you use social media (i.e. Facebook, Twitter) in English?
11. How often do you watch television programs in Spanish?
12. How often do you listen to radio programs in Spanish?
13. How often do you listen to music in Spanish?
14. How often do you use social media (i.e. Facebook, Twitter) in Spanish?

Please answer the following questions using the following scale: very well (4), well (3), poorly (2), very poorly (1).

Linguistic Proficiency Subscale
15. How well do you speak English?
16. How well do you read in English?
17. How well do you understand television programs in English?
18. How well do you understand radio programs in English?
19. How well do you write in English?
20. How well do you understand music in English?
21. How well do you speak in Spanish?
22. How well do you read in Spanish?
23. How well do you understand television programs in Spanish?
24. How well do you understand radio programs in Spanish?
25. How well do you write in Spanish?
26. How well do you understand music in Spanish?
Appendix V

*Guttfreund's Bilingual Questionnaire (English Version) (1990)*

a. Where did you first learn English?
   1. Home  
   2. School  
   3. Other (please, specify)

b. In what country did you first learn English?

c. How old were you when you first learned English?
   1. 0-5 years old  
   2. 6-17 years old  
   3. 18-22 years old  
   4. 23 years old and above

d. Where did you first learn Spanish?
   1. Home  
   2. School  
   3. Other (please, specify)

e. In what country did you first learn Spanish?
   1. United States  
   2. Other (please, specify)

f. How old were you when you first learned Spanish?
   1. 0-5 years old  
   2. 6-7 years old  
   3. 18-22 years old  
   4. 23 years old and above

g. The language I consider to be my native tongue is:
   1. English  
   2. Spanish  
   3. Other (please, specify)

h. I am most comfortable expressing my feelings in:
   1. English  
   2. Spanish  
   3. Other (please, specify)

i. I am most comfortable expressing my thoughts in:
   1. English  
   2. Spanish  
   3. Other (please, specify)

j. When I speak English, I do it mostly with (circle all that apply):
   1. Family  
   2. Friends  
   3. Job colleagues  
   4. School mates  
   5. Other (please, specify)
k. When I speak Spanish, I do it mostly with (circle all that apply):


1. I think I make a better impression when I speak:

1. English    2. Spanish    Other (please, specify)

m. The language that I have used most frequently in my life is:

1. English    2. Spanish    Other (please, specify)

n. When I am very angry the language I will first want to use is:

1. English    2. Spanish    Other (please, specify)

o. When I am very happy the language I first use is:

1. English    2. Spanish    Other (please, specify)

p. When I am very sad the language I first use is:

1. English    2. Spanish    Other (please, specify)

q. I would say that on average I speak English:

1. Once a day or more    2. Every other day    3. Once a week    4. Once a month    5. Less than once a month

r. I would say that on the average I speak Spanish:

1. Once a day or more    2. Every other day    3. Once a week    4. Once a month    5. Less than once a month
Appendix VI

Survey of the emotional content of the short stories

English

Please answer the following questions regarding the story you just read:

How would you rate your feelings while reading the story:

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<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>I felt happy while reading the story</td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td>I felt sad while reading the story</td>
<td></td>
<td></td>
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<tr>
<td>I felt angry while reading the story</td>
<td></td>
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</tr>
<tr>
<td>I felt disgusted while reading the story</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>I felt surprised while reading the story</td>
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<tr>
<td>I felt scared while reading the story</td>
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</table>

How accurately do these terms describe the emotional content of the story:

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<tr>
<th></th>
<th>Strongly Disagree</th>
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<th>Neutral</th>
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<td>Happiness</td>
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<td>Surprise</td>
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<td>Fear</td>
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Survey of the emotional content of the short stories

Spanish

Conteste las siguientes preguntas sobre el relato corto:

¿Cómo califica sus sentimientos cuando leyó el relato corto?

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<th>Neutral</th>
<th>De acuerdo</th>
<th>Completamente de acuerdo</th>
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</thead>
<tbody>
<tr>
<td>Me siento feliz</td>
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<td>Me siento triste</td>
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<tr>
<td>Me siento enojado/a</td>
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<tr>
<td>Me siento asqueado/a</td>
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<tr>
<td>Me siento sorprendido/a</td>
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<tr>
<td>Me siento asustado/a</td>
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¿Con qué exactitud está de acuerdo que las siguientes palabras describen los sentimientos del relato corto?

<table>
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</tbody>
</table>

Appendix VII

Demographic Questionnaire
1. Age

2. Sex: Male_______ Female_____

3. Marital Status
   a) Single
   b) married/living together
   c) separated
   d) divorced
   e) widowed

4. Please indicate your ethnicity
   a) Hispanic born/raised in the U.S._____(specify country of descent)
   b) Hispanic not born/raised in the U.S._____(specify country of origin)
   c) Non-Hispanic White
   d) African American
   e) Asian American
   f) Other (specify)

5. Were you born in the U.S.?

6. If no, how old were you when you moved to the U.S.?

7. Which is the highest level of education you have achieved?
   a) Elementary School
   b) High School
   c) College/University
   d) Graduate professional training
   e) Other (specify)