Miscommunication among Children through Text-Based Media and its Relation to Social Anxiety

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Dedicated to my grandmother, Mary (Betty) Elnore Doey, whose strength and dedication to her family will forever be an inspiration

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Abstract

This study examined how social anxiety, gender, and mode of presentation influenced miscommunication and perception of negativity in children's interpretation of computer-mediated messages. The initial phase of the research involved developing and validating the stimuli for emotion recognition via presentation of various emotionally toned messages. Following preparation of the stimuli, the 98 participants (aged 8-12 years) in the main study were randomly assigned to one of three conditions: audio-visual, audio-only, and text message. The same emotionally toned messages were presented in each of these three conditions. Participants were instructed to select from a list of six emotions (happy, sad, disgusted, angry, surprised, scared) which emotion each message conveyed. Participants then rated how positively or negatively they perceived each sentence, using a 5-point Likert scale that ranged from very negative to very positive. Following the emotion recognition and Likert rating task, participants completed questionnaires that gathered information about social anxiety and attribution bias. Findings revealed that additional nonverbal and paralinguistic, as in the audio-visual or audio-only condition, allowed participants to more accurately identify the emotion being conveyed in the message, compared to the text message condition. This advantage was found for all emotions with the exception of happiness. For happy messages, participants were able to identify the intended emotion at above-chance levels regardless of mode of presentation. When making interpretations about angry messages, a significant three-way interaction was observed between sex, condition and social anxiety. Likert rating analyses revealed that condition, sex, and social anxiety played important roles in the interpretation of both ambiguous and unambiguous emotions, such as surprise and happiness.

Table of Contents

List of Tables

List of Figures

Introduction

Language is constructed of many different components and multiple facets of language are used to communicate with one another. A great deal of communication occurs verbally; however, it is through nonverbal channels of language that much of the true, underlying essence of a message is relayed (DePaulo, 1992; Dijk, de Jong, & Peters, 2009; Dohen Schwartz, & Bailly, 2010; Frick, 1985; Gogot, 2009). In the verbal realm of language, nonverbal cues such as altering pitch or tone, as well as using delays can facilitate in communicating an entirely different message while using the same words (Ambady, Koo, Lee, & Rosenthal, 1996; Dohen et al., 2010; Hawk, van Kleef, Fischer, & van der Schalk, 2009). Similarly, in the nonverbal realm of language, individuals express meaning through nonverbal cues such as hand and body gestures, distance, eye contact, and facial expressions to name a few. These components of nonverbal language are referred to as "paralinguistic cues" (Kruger, Epley, Parker, & Ng, 2005; Whalen, Pexman, & Gill, 2009). In the absence of paralinguistic cues, crucial elements of a message may be lost. Researchers have shown that individuals continuously use paralinguistic cues to make judgments, both correct and incorrect, about the messages they are receiving from others (Berry, 1991; Bolino & Turnley, 2003; Costanzo, 1992; Dijk et al., 2009; Einav & Hood, 2006, 2008; Lieberman & Rosenthal, 2001; Riggio, Lippa, Salinas, 1990; Scherer, 1979). It has also been shown that even while maintaining neutral expressions, individuals invariably give away useful cues about their disposition or intended meaning (Berry, 1991; DePaulo, 1992; Malatesta, Izard, Culver, & Nicolich, 1987; Puccinelli, Motyka, & Grewal, 2010; Swerts & Krahmer, 2008;Vrij, Mann, Leal, & Fisher, 2010). Likewise, in the complete absence of verbal cues individuals are able to

convey emotional states accurately using only nonverbal cues (Cunningham, 1977; DePaulo, 1992; Jaeger, Borod, & Peselow, 1986; Montepare, Goldstein, & Clausen, 1987). Nonverbal cues are paramount when conveying a message accurately and effectively. They provide information that cannot be retrieved through verbal communication, as they are often disclosed unintentionally and without much forethought. It is not surprising then, that in the absence of nonverbal cues, miscommunication flourishes (Epley & Kruger, 2005; Kruger et al., 2005).

Research has shown that individuals use nonverbal cues continuously in everyday life for multiple reasons, some of which are to detect when people are lying or to infer likeability of individuals (Einav & Hood, 2006, 2008), to adjust behaviour to accommodate various situations (Elfenbein & Ambady, 2002), to convey emotion (Burns & Beier, 1973; Dusenbury & Knower, 1938; Frick, 1985; Sogon, 1975), to infer emotion (Hawk et al., 2009; Juslin & Laukka, 2001, 2003; Haidt & Keltner, 1999), or when establishing and inferring social status (Kowalski, 2000; Shapiro, Baumeister, & Kessler, 1991). It would be easy, then, to imagine scenarios of miscommunication in which an individual may incorrectly assume that another individual is lying because of his or her averted gaze, when in fact that person may just be shy (Einav & Hood, 2008). Similarly, teasing an individual may be intended as playful, but is often misperceived as hostile (Endo, 2007; Kruger, Gordon, & Kuban, 2006; Kowalski, 2000). These are scenarios that speak to both the intricacies as well as the importance of nonverbal communication. It seems that we rely heavily on nonverbal cues to interpret and process information from others in our daily lives far more often than we may be consciously aware.

Some researchers have shown that sex differences exist in the ability to process and decode nonverbal cues (Costanzo, 1992; Einav & Hood, 2008; Halberstadt, 1986; Riggio, 1986; Steckler & Rosenthal, 1985). In his study in 1992, Costanzo showed that while college women performed more accurately when asked to interpret nonverbal behaviour from others, college men actually rated themselves as more confident than did women in this task. Interestingly, Halberstadt (1986) found that, with respect to accuracy in sending and judging nonverbal cues, women displayed better accuracy than men when the information was reported as happy, whereas men displayed higher accuracy than women when the information was sad. In his 1986 study, Riggio found that women scored higher than men when sending accurate nonverbal cues as well as when decoding and processing nonverbal cues accurately. As might be expected, men were found to score higher than women in emotional control, which is referred to as the "general ability to control and regulate emotional and nonverbal displays" (p.651). In a study by Steckler and Rosenthal (1985) looking at nonverbal behaviour and competence, women were found to appear more competent when addressing their bosses and subordinates but less competent when addressing peers. In contrast, men appeared more competent when addressing peers and subordinates but less competent when addressing their bosses. Malatesta and colleagues (1987) found that when assessing the ability of women to decode and send emotional expressions accurately, women at all ages did best when paired with other women in a similar age group.

Other studies have also looked at age differences in ability to send and receive nonverbal cues. Einav and Hood (2006) found that at four years of age, children were able to use an individual's gaze duration and direction to infer preference of objects. In a

similar study, Lee, Eskritt, Symons, and Muir (1998) found that at three years of age, children were able to use nonverbal cues from people with whom they were interacting, such as pointing, to infer preference. Even when strictly using eye gaze, toddlers at two and three years of age could accurately infer preference at above-chance levels. Einav and Hood (2008) found that at the age of six, children use gaze behaviour of individuals as a socially informative cue. Much like adults, six-year-olds were found to infer that an individual was more likely to be lying when gaze aversion was displayed.

All of these studies provide evidence of the frequency and importance of nonverbal cues in communication. So what happens when some or all of these cues are removed? Halberstadt (1986) studied people's ability to communicate nonverbally in relation to the extent of their family socialization of emotional expression. This research used both audio and video streams of communication with participants in order to decode nonverbal expression and found that individuals decoding the video stream produced more accurate results than did those decoding from the audio stream. This finding provides evidence that when certain aspects of nonverbal cues are lost, such as being able to see a participant visually to decode nonverbal cues of a message, errors in interpreting that message become more prevalent.

In today's technological world of online communications where much of what we do on a daily basis requires a connection to the World Wide Web, we are left to wonder how effective our communication strategies really are in the absence of what have been found to be, in many cases, essential nonverbal cues. Did the e-mail to your boss or prospective employer come across as professionally as you had hoped? Did the text message you sent your friend come across as offensive rather than playful? Did the

Facebook message you just left for your romantic interest come across as desperate instead of aloof? After the "send" button is pressed, it is too late to go back and fix what could turn into a regrettable mistake. Unfortunately, while spell check can often produce a grammatically perfect message, it cannot guarantee an emotionally accurate one.

Universality of Emotions

Researchers have discovered seven different emotions that are recognized universally: anger, contempt, disgust, fear, happiness, sadness, and surprise (Anthony, Copper, & Mullen, 1992; Beier & Zautra, 1972; Boucher & Carlson, 1980; Buchman, 1973; Bullock & Russell, 1984; Ekman, 1972; Ekman & Friesen, 1971; Elfenbein & Ambady, 2002; Hess & Thibault, 2009; Izard, 1971; Izard, 1994; Russell, 1994; Waller, Cray, & Burrows, 2008). Contempt was the most recent of the universal emotions to be added in the 1990s, with the original six having been identified in 1972 (Ekman, 1972). In fact, research shows that among children, contempt is the most difficult emotion to recognize accurately (Izard, 1971; Widen & Russell, 2010). Not only is the word "contempt" rarely a part of a child's vocabulary at a young age, synonyms of contempt such as "despicable" or "derisive" are used equally rarely by youngsters. Additionally, there is scant research investigating children's ability to decode contempt. Those that have targeted this age group have generally studied children between the ages of 4-8 years (Izard, 1971; Widen & Russell, 2010; Wiggers & Van Lieshout, 1985). Recent studies in this area have eliminated contempt as a universal emotion and used the original six identified above (e.g., Juen, Huber, & Peham, 2012; Nelson & Russell, 2016).

To give credence to the extent of the universality of these emotions, it was discovered that children born blind also accurately display facial expressions that are

congruent with the six universal emotions (Eibl-Eibesfeldt, 1973). These universal emotions can be recognized through verbal, as well as nonverbal channels, with certain of them (e.g., anger) more easily recognized verbally rather than nonverbally, while others (e.g., happiness) are more easily recognized nonverbally (DePaulo, 1992; Elfenbein & Ambady, 2002). Moreover, certain emotions have been classified as more easily distinguishable from others overall, and are referred to as unambiguous. Emotions such as happiness and anger tend to be most accurately identified and less confused with other emotions, whether determining emotion recognition through vocal means, (e.g., Arunaite & Zardeckaite-Matulaitiene, 2015), whether participants are infants, preschool age, adolescents, or older adults with and without social-emotional difficulties or other mental health disorders (e.g., Amminger et al., 2012; Barrera & Maurer, 1981; In-Albon, Ruf, & Schmid, 2015; Chronaki et al., 2015; Shiroma, Thuras, Johns, & Lim, 2014), or whether participants are making judgments of emotion through music (e.g., Laukka, Eerola, Thingujam, Yamasaki, & Beller, 2012; Laukka & Juslin, 2007; Mohn, Argstatter, & Wilker, 2010), to name a few examples. Alternatively, other emotions are less easily recognizable and more often confused with other emotions, such as fear, disgust, and surprise (e.g., Barkl et al., 2014; Chronaki et al., 2015; Lydon & Nixon, 2014; Mohn, Argstatter, & Wilker, 2010).

The current literature also suggests that, especially among children, girls display a greater range of emotional expressivity than boys (DePaulo, 1992). While verbal and nonverbal communications have been shown to accurately portray universal emotions at above chance levels, a less studied area is the extent to which computer-mediated communication facilitates the accurate portrayal and recognition of universal emotions.

Computer-Mediated Communication versus Face-to-face and Voice-only Communication

A handful of studies have looked at the implications of computer-mediated communication for various reasons. Although there are numerous benefits to computer-mediated communication, it is evident that crucial nonverbal components of a message are lost (Boucher, Hancock, & Dunham, 2008; Buder, 2007; Endo, 2007; Epley & Kruger, 2005; Hine, Murphy, Weber, & Kersten, 2009; Igarashi, Motoyoshi, Takai, & Yoshida, 2008; Kruger et al., 2006; Kruger et al., 2005; Lee, 2007; Owen, O'Carroll-Bantum, & Golant, 2009; van der Meij, 2007; Watts, 2007; Whalen et al., 2009). Social presence theory (Short, Williams, & Christie, 1976) dictates that different modes of communication require different levels of interpersonal contact, such as being face-to-face, speaking over the phone, or texting through cell phones. Consequently, communication will be effective only when the appropriate amount of interpersonal contact, or social presence, exists (Short et al., 1976). Differences between face-to-face interactions and computer-mediated communication have been studied by researchers in several different contexts (Campbell et al., 2001; Owen et al., 2009; Zimmerman, 1987). One such context was the examination of online psychotherapeutic support groups versus face-to-face support groups. The utility of online support groups in these studies was unquestionable; participants reported having easier access to the groups and tended to talk about sensitive topics in more depth than was found in face-to-face support groups (Campbell et al., 2001). This latter finding is likely due to the anonymity that communicating through a computer allows an individual. Conversely, it was found that online support groups exhibited a marked lack of nonverbal emotional tone (Campbell et

al., 2001), which is understandable given that communication through text eliminates nonverbal emotional tone almost entirely.

As we know, an individual's words do not always match the emotional expression they are intended to convey. In one study by Owen et al. (2009), this was one of the difficulties identified with online support groups. Participants and facilitators alike found it difficult in the absence of paralinguistic cues to understand clearly what another individual was thinking or feeling during sensitive discussions. Another difficulty reported in this study was finding an equivalent to "appropriate silence" when providing support after a sensitive disclosure. Generally, silence in online interactions indicates a lack of presence rather than denoting support. This is a challenging obstacle that could create several problems for an individual who is self-disclosing sensitive information online and subsequently feeling ignored by the same individuals who are meant to be providing support.

Boucher and associates (2008) conducted a study comparing dominance roles using computer-mediated communication versus face-to-face interactions among university students. In the same-sex dyadic interactions, each student was assigned either a boss or subordinate role. "Bosses" and "subordinates" were then asked to rate the perceived level of dominance of both themselves and their partners. Among ratings from both bosses and subordinates, it was found that bosses were rated as more dominant and subordinates as less dominant in computer-mediated communication compared to the ratings in face-to-face interactions. These findings raise concerns when viewed in the context of computer-mediated communication among children who may be at higher risk of misinterpreting others' intentions. For example, social anxiety may be one factor that

can lead to a misinterpretation of intentions (Bell-Dolan, 1995; Miers, Blöte, Bögels, & Westenberg, 2008; Teglash & Spitz-Fagin, 1984). If the power differential between individuals is amplified in computer-mediated communication as seen in Boucher et al.'s study, it is possible that children with high levels of social anxiety may face a much bigger obstacle communicating in cyber space compared to the schoolyard.

On a related note, Watts (2007) conducted a study in which part-time graduate students received negative feedback from other part-time graduate students on final projects for their Information Systems course, using either e-mail or voicemail as the medium. Watts reported that participants in the e-mail group rated their feedback as more negative than did those in the voicemail group. Interestingly, individuals in the voicemail group were less comfortable providing the negative feedback than were those in the e-mail group. These findings have several implications: it is clear from this research that e-mail is one way to convey negative information or sentiment without the same censoring that is employed when a more direct form of communication is used, such as voicemail or direct face-to-face contact. It seems that due to the extra degree of separation that e-mail provides, individuals may be less concerned about the feelings of the receiver of negative information.

It has been posited that the reason for this phenomenon may be that when social presence cues are less salient (as is the case with computer-mediated communication), the feelings of receivers of information are more easily ignored (Rice, 1993 as cited in Watts, 2007). Therefore, when communicating through computer-mediated communication, it may be harder to think of the individual with whom you are communicating as someone with feelings in the same way one would if communicating face-to-face or via voicemail,

where this feature would be more obvious. This provides concern given the frequency of computer-mediated communication among both children and adults. Not only may senders of negative information be less cautious with their delivery, receivers may also be prone to misunderstanding sensitive information because of the lack of paralinguistic cues available in computer-mediated communication. Translated to computer-mediated communication use among children at higher risk of misinterpreting social cues, such as children with high levels of social anxiety, this combination could result in less than satisfying interactions with peers, potentially reaffirming their anxiety and cautiousness in social situations.

Furthermore, what happens in cyber space does not necessarily remain in cyber space. Hine and colleagues (2009) showed that while exchanging negatively toned e-mails, individuals adopted angry moods and negative perceptions of their counterparts after computer sessions had ceased. Therefore, even a relatively neutral digital message containing negative content could be perceived by the receiver as more negative than intended. This misperception could result in not only an angry mood and negative perception of the sender, but a potential cycle in which the receiver feels the need to defend him/herself by replying with a negative message back to the original sender. If these individuals also socialize in contexts outside of the digital world, this could lead to damaged peer relationships very quickly, especially for children and adolescents who still struggle with egocentrism and perspective taking (Elkind, 1967; Piaget & Inhelder, 1956).

In the cyber realm, two forms of communication exist: synchronous and asynchronous (Chan, 2011). Synchronous forms of computer-mediated communication

involve communication that occurs between individuals in real-time, such as instant messaging or chat rooms. Conversely, asynchronous forms of computer-mediated communication include communication methods that occur over time at the communicators' leisure, such as in e-mail or blogs. Researchers have found that with respect to e-negotiations, synchronous forms of computer-mediated communication tend to be less friendly than asynchronous forms of computer-mediated communication (Kruger et al., 2005). This difference could result from the quick-natured style of synchronous computer-mediated communication, where reactions to information (both positive and negative) are not as easily masked or edited as they are in asynchronous forms of computer-mediated communication (Kruger et al., 2005). These findings suggest that it may be useful to pay closer attention to synchronous as opposed to asynchronous forms of computer-mediated communication, such as text messaging (SMS) and online chats (MSN, Facebook, Twitter, etc.) rather than e-mail, when looking at the frequency and dynamics of computer-mediated communication among children.

Moreover, a study comparing e-mail with voice communication found that individuals communicating over e-mail used stereotypes and expectancies to judge their e-mail counterparts far more often than did individuals communicating vocally (Epley & Kruger, 2005), probably because of the greater ambiguity inherent in e-mail. As a result of the lack of cues available in computer-mediated communication, it is up to the receiver of information to "fill in the blanks" (Epley & Kruger, 2005) that would otherwise be more available in voice or face-to-face communication.

Kruger and colleagues (2005) conducted a series of three studies that assessed university students' confidence in effective communication via e-mail. It was

hypothesized that because people know how they are intending to convey a message through e-mail, they assume their audience will know as well (i.e., egocentrism). It was suitably stated that "what is obvious to us may be considerably less so to the person on the other end of the computer" (Kruger et al., 2005, p. 926). In the first study, students were asked to write an equal number of sarcastic and serious statements about given topics and to send these statements to other participants who would code which statement they thought was meant to be serious and which was meant to be sarcastic. Senders were also asked to rate the accuracy with which they thought receivers would correctly identify sarcastic versus serious statements. Results indicated that senders thought they were communicating significantly more accurately than they actually were.

In the second study, Kruger and colleagues (2005) looked at overconfidence in voice and e-mail situations in sending messages accurately, as well as in receiving and decoding them accurately. Results suggested that the students communicated more effectively when communicating vocally compared to when communicating via e-mail. Similarly, the overconfidence that was found in the first study in the e-mail condition was also found in the second study, but was absent in the voice condition. Furthermore, *recipients* of both voice and e-mail messages were overconfident in their ability to decode the messages accurately, but to a greater extent in the e-mail condition compared to the voice condition.

The third study separated students into an e-mail condition, voice condition, or face-to-face condition and included sadness and anger as emotions in addition to sarcasm and seriousness. Furthermore, students communicated with strangers as well as acquaintances to see if effective communication was more easily achieved when

communication occurred between individuals who are familiar with one another. Some researchers have suggested that the likelihood of messages in computer-mediated communication being misunderstood is less when users are familiar with one another rather than when they are strangers (Brown & Levinson, 1987; Pexman & Zvaigzne, 2004). This notion is not unfounded, given that individuals familiar with one another will also be more familiar with one another's communication styles, as well as the context within which one another tends to communicate (e.g., being aware that person X tends to joke often in person and therefore assuming that a particular statement from person X over computer-mediated communication is more likely to be playful rather than insulting). It was found that communication was more effective, once again, in the voice condition than the e-mail condition for both strangers and acquaintances. Levels of confidence for effective communication were less for students communicating with strangers than those communicating with familiar acquaintances. Additionally, students in the e-mail condition were more overconfident than those in the voice condition in their ability to communicate emotions accurately. Incidentally, accuracy in decoding messages did not differ between strangers and acquaintances. Although participants had greater confidence that they were communicating more accurately with acquaintances than with strangers, the results did not support this confidence. This finding is important because it highlights how prevalent miscommunication is, both among friends and strangers, regardless of whether individuals believe that they are communicating effectively.

Gender Differences

Due to the relative anonymity that computer-mediated communication provides, it is often necessary to use other available cues in order to discern the social context within

which you are communicating, as well as the audience(s) with whom you are communicating. Because visual cues are absent when using computer-mediated communication, individuals have been found to heighten their awareness of other available cues – including language cues, topic-based cues, and style cues – which, by their very nature, can result in increased instances of social stereotyping (Postmes, Spears, & Lea, 1998, 2002; Spears & Lea, 1992). By definition, stereotyping is categorizing people or things in an overly simplified way, based on accurate or inaccurate overgeneralizations that inform one's thoughts, feelings and behaviour (Cox, Abramson, Devine, & Hollon, 2012). By overgeneralizing the use of certain cues communicated through technology in order to better understand one's virtual environment or audience, an individual is engaging in social stereotyping. Men and women are theorized to employ markedly different patterns of communication using computer-mediated communication (Herring, 1993; Lee, 2007; Savicki, Kelley, & Oesterreich, 1998) and perceivers may make use of these differences. For example, Lee (2007) found that men and women using computer-mediated communication rely heavily on language cues based on characteristically masculine or feminine language use on the part of the sender in order to discern the gender identity of individuals with whom they are communicating. Other researchers have also found a similar gender-based language bias in receivers who do not know the gender identity of an individual with whom they are communicating.

Several case studies have found differences between men's and women's communication styles through computer-mediated communication. Men seem to focus more on activity- and task-based topics, whereas women have a more "person-oriented" communication style (e.g., van der Meij, 2007). Consistent with women's person-

oriented communication styles, it has been found that females, including elementary school children, generally send more elaborate messages through computer-mediated communication compared to males (Baron, 2004; Colley, Todd, Bland, Holmes, Khanom, & Pike, 2004; Mulac, Flanagin, Tiyaamornwong, & Palomares, 2001; van der Meij, 2007). For example, text-markers, such as the intentional misuse of capitals (e.g., Thank you SO much [emphasis]), multiple exclamation points (e.g., I love you!!!!!!!! [emphasis/exaggeration]), or other punctuation (e.g., Um…..I guess so [hesitation]) can be used in computer-mediated communication to replace nonverbal cues that are more easily portrayed during voice or face-to-face communication. Some studies have reported that females tend to use more of these text markers during computer-mediated communication than do males, which could be explained by the tendency of girls to be more emotionally expressive than boys (e.g., van der Meij, 2007). Another explanation for the tendency toward more elaborate messages by females using computer-mediated communication could be that they tend to possess a larger vocabulary than males of the same age, even as young as elementary school (Mullis, Martin, Gonzalez, & Kennedy, 2001; Prinsen, Volman, & Terwel, 2007; van der Meij, 2007). The above findings suggest that females might communicate more effectively through text-based media, with fewer errors than males.

The aforementioned literature suggests that not only do females communicate more often than males through computer-mediated communication, but they also communicate more effectively. However, effectiveness of communication does not necessarily indicate that interpretations from receivers of messages are always positively received. In a recent study, Kingsbury and Coplan (2015) analyzed sex of both the sender

and receiver of ambiguous text messages, along with social anxiety, and the propensity for interpretation bias. Although there was no significant interaction between the sex of senders and of receivers of text messages and social anxiety, results suggested that sex of the sender of text messages played an important role in the interpretation of those messages in the absence of social anxiety, especially for young men. Specifically, ambiguous text messages from women were interpreted as more negative than ambiguous texts from men for both male and female receivers, but even more so for men.

A large study on teens and text messaging use by Lenhart, Ling, Campbell, and Purcell (2010) found that female adolescents sent approximately 40% more text messages on a daily basis compared to their male adolescent counterparts. In contrast, a longitudinal study conducted by Underwood, Ehrenreich, More, Solis and Brinkley (2013) found no differences in the number of text messages that adolescent females and males sent to their peers. However, the data collection process used by Underwood et al. may have impacted these findings, given that only two, 2-day transcripts of text messages were collected from participants on phones provided to them for research purposes. Notably, there was a significant difference in one content area: female adolescents said "no" to sex significantly more often than did male adolescents. Furthermore, girls who engaged in *sexting* (text messaging about sexual content) had more somatic complaints than girls who did not engage in sexting, and boys who engaged in sexting reported fewer symptoms of withdrawn depression than boys who did not sext. Therefore, perhaps it is not the frequency with which adolescents text that is the concern; rather, the content of their messages may relate more closely to their overall psychological well-being.

Age Differences

Research has shown that misinterpretation through computer-mediated communication abounds in comparison to face-to-face interactions. Several factors may be responsible, the most prominent being the lack of social, nonverbal, and behavioural cues available to users of computer-mediated communication (Endo, 2007; Epley & Kruger, 2004; Hine et al., 2009; Igarashi et al., 2008; Kruger et al., 2005; Kruger et al., 2006; Watts, 2007; Whalen et al., 2009). Not all studies, however, have found this effect (e.g., Boucher et al., 2008; Currie et al., 2006; Hancock et al., 2007; Jacobson et al., 2006). Jacobson and colleagues (2006) reported that individuals were as capable at discerning emotional states in computer-mediated communication dyads as in face-to-face dyads. Similarly, Boucher and colleagues (2008) found in their study with undergraduate students that when removing a social bias prior to introducing dyads in a boss/subordinate interaction, the dyads interacted as equals using computer-mediated communication. The power differential that they found to be augmented in a previous study when social roles were known prior to computer-mediated communication was completely eliminated.

All the above studies showing an improved capacity for individuals to convey and discern emotional states of partners using computer-mediated communication used adult participants in their research. In a world where technology has taken over as a means of interaction for adults and children alike, the question remains whether children can communicate as effectively through text-based media as do adults.

Igarashi and colleagues (2008) examined Japanese high school students' use of cell phones and found that students preferred using text messages and e-mails to voice

communications. Among the reasons for this preference were "indirectness and asynchronicity of communication" (p. 2312). These researchers also found that students said to have "internet dependency" (p. 2312) preferred online communication to face-to-face interactions. The same study suggested that "text message dependency," which is described as the compulsion to send and receive text messages obsessively, may result from students' striving to avoid feeling ostracized and rejected. According to Igarashi and colleagues, by sending and receiving text messages alone, individuals may feel more closely connected to their social group. Such a possibility is worrisome, as it provides further evidence of the multifaceted ways in which children can feel rejected and victimized within their social groups.

Today, an entire generation has been born in the digital age, encompassing the growth and accessibility of the Internet and use of computer-mediated communication. Adolescents in particular have come to use text messaging as their primary means of communication compared to face-to-face and voice conversations (e.g., DeJong & Gorrindo, 2014; Lenhart, 2012). Underwood and colleagues (2013) found that while the majority of content sent between adolescents (age 14) and their peers was positive, those messages that included negative content predicted internalizing problems in the receivers of these messages. According to Lenhart et al. (2010), older teens (ages 14-17) text most frequently compared to younger adolescents, especially compared to young female youth.

Whalen and colleagues (2009) looked at the frequency of nonliteral language (e.g., sarcasm, exaggeration, jocularity) in e-mails among young adults. The average e-mail in this study included approximately three nonliteral statements. These researchers further contended that authors of e-mails are aware of the "risky" nature of nonliteral

language in computer-mediated communication, given that the probability of misunderstanding nonliteral statements is substantially higher than when used in face-to-face communication. This awareness of the differing contexts of communicative environment and the subsequent adjustment of conversation to accommodate the given environment is akin to Walther's (1992) social-information-processing theory (Whalen et al., 2009). This theory dictates that, due to the lack of cues available to users during computer-mediated communication, individuals will modify their communication style by capitalizing on whatever tools are available in the computer-mediated communicative environment in order to convey a nonliteral statement more effectively.

Unlike computer-mediated communication, face-to-face communicators can use the receiver's nonverbal cues to judge whether or not the sender's message was received as it was intended. For instance, an individual intending to be playful or witty may inadvertently insult the receiver. By the receiver's facial expressions, the sender may realize that the message was misunderstood and react accordingly by providing comfort, apology, or clarification. In computer-mediated communication, a sender using jocularity has no insight into whether or not the receiver has appropriately interpreted the message. If the receiver has been unintentionally insulted, there is much less opportunity for clarification unless the receiver asks for it.

Researchers have found that when individuals successfully communicate nonliteral statements through asynchronous and synchronous forms of computer-mediated communication, they capitalize on the tools available to them in computer-mediated communication, such as high usage of discourse markers (i.e., "so," "OK," "anyway"), punctuation, emoticons (picture icons of faces with various expressions or

items to enhance a message such as a heart, thumbs up/down, etc.), intentional misspelling, clarification (i.e., "jk" or "lol"), intentional misuse of grammar or spelling (e.g., using all uppercase letters, misspelling to convey exaggeration or intensity, i.e., sorrryyyyy), and the like (Gill, Oberlander, & Austin, 2006; Gill, Gergle, French & Oberlander, 2008; Hancock et al., 2007; Oberlander & Gill, 2006). These forms of text-based communication tools are encouraged in attempts to assure successful interpretation of nonliteral statements in computer-mediated communication. Whalen and colleagues (2009) argue that, especially in asynchronous forms of communication such as e-mail, users should take extra time to compose their message and maximize their usage of the aforementioned tools in order to reduce instances of misinterpretation.

It seems natural that individuals would use emoticons frequently in computer-mediated communication, since emoticons can convey facial expressions that are absent in the computer-mediated communication environment. Emoticons can also be easily accessed in e-mails, text messages, Facebook messages, and so on. Nevertheless, research has found that people use emoticons the least out of the available tools in computer-mediated communication to convey meaning (Walther & D'Addario, 2001; Whalen et al., 2009). Whether or not an individual chooses to use various tools to help convey meaning in computer-mediated communication, it goes without saying that each individual brings a personal style to his or her computer-mediated communicative environment.

Individual Differences

Kruger and colleagues (2006) studied teasing through e-mail among university students and found that the targets of the tease perceived the event more negatively than did the perpetrator of the tease. It was hypothesized that because of the lack of

paralinguistic cues available in computer-mediated communication, a friendly gesture such as smiling accompanied by a tease is lost when communicating through text-based media. Therefore, while the teaser may regard his or her intentions as neutral or even playful, the target of a tease may actually perceive negative intentions. Because the target cannot witness accompanying gestures, facial expressions, tone of voice, or points of inflection when communicating via computer-mediated communication, many of the senders' intentions are unknown. It has been suggested that these differences in perceptions of teasing may be even more pronounced with children (Kruger et al, 2006). Preschool and elementary age children may have limited abilities to take the perspective of others, compared to adolescents or adults (Epley, Carey & Keysar, 2004; Pillow & Mash, 1998; Pillow & Henrichon, 1996), and may therefore be more prone to misunderstanding the intentions of a teaser.

Even if children experience more difficulty than adults in discerning the intentions of others, certainly not every child will assume negative intentions behind a tease from a schoolmate. So what makes an individual more or less prone to misunderstanding and miscommunicating through computer-mediated communication? Social anxiety is defined as a tendency for individuals to fear, avoid, or have excessive worries about various social situations that may lead to potential humiliation, rejection, or scrutiny from others (American Psychiatric Association, 2013). In face-to-face communication, we know that individuals who are higher in social anxiety are more prone to perceiving neutral facial expressions as more threatening than are those who are less socially anxious (Bradley, Mogg & Millar, 2000; Foa et al., 1996; Mansell et al., 1999; McClure & Nowicki, 2001; McManus et al., 2000; Perowne & Mansell, 2002;

Philippot & Douilliez, 2004; Rapee & Heimberg, 1997; Stopa & Clark, 2000; Winton et al., 1995). Would these findings compare to computer-mediated communication as well?

According to Endo (2007), social skill level plays an important role among university students in perceiving humour when being teased. Often the intentions of teasers can be ambiguous; the target may not know if the teasing is meant to be taken as a joke or if the teaser truly intends to hurt the target. This incongruity can be distressing for individuals who perceive a tease as a serious attempt at being insulted. Endo (2007) found that university students equipped with a higher level of social skill, as measured by self-report, were more prone to perceive a tease as a joke and be less offended than were students who had lower self-reported social skills. Of course, individuals' self-reported social skill levels may not always accurately reflect how others view their social skill levels. Even so, it appears that those who perceive themselves as having higher social skill levels may have a protective interpretation bias that lends itself to feeling offended less often when interpreting teases through computer-mediated communication. Furthermore, students with lower social skills reported feeling more negatively toward their teaser when recalling the teasing event at a later date than did those with higher social skills, who did not report a change in their feelings toward their teaser. Similarly, those with poorer social skills felt that their teaser's feelings toward them had worsened following the event, while those with higher social skills did not report a change in perception of their teaser's feelings toward them.

Along similar lines, Lieberman and Rosenthal (2001) reported that extroverts, because of their better social skills, are better able to decode nonverbal cues than are introverts. If this is indeed the case, it might also be true that less socially anxious

children who are also more extroverted would be more likely to accurately decode messages via computer-mediated communication than would more socially anxious children that are also introverted. In addition, Igarashi and colleagues (2008) found that, among high school students, those who used the Internet excessively for social contact were more likely to score higher on personality measures of neuroticism. These individuals were also found to be more sensitive to the way individuals responded to their text messages. Related to the present study, socially anxious children who may exhibit more neurotic tendencies compared to less socially anxious children may be more prone to misinterpret the intentions of computer-mediated communication users as more negative than intended by the sender.

Kokin, Younger, Gosselin, and Vaillancourt (2016) conducted a study on interpretation bias among shy youth (ages 12-14) and examined the mediating effects of rejection sensitivity using an emotion recognition task. Shyness did not play a role in the accuracy with which children were able to identify various emotions. However, shy children did endorse more negative interpretations of various facial expressions of emotion than did non-shy children. Moreover, rejection sensitivity, which is defined as the tendency for some individuals to anticipate rejection and experience anxiety as a result of the anticipated rejection (Feldman & Downey, 1994), had a significant mediating effect on shy children's negative interpretation bias of the stimuli. Taken together, while shyness and social anxiety are not entirely identical constructs, they share the presence of negative interpretation bias and also are likely to share a similar relation with the mediating effects of rejection sensitivity.

Socially Anxious Children and Attribution Bias

Attribution bias is the tendency of some individuals to interpret events or situations in a given causal way, such as hostile or negative (Miers et al., 2008; Teglash & Spitz-Fagin, 1984). Specifically, hostile attribution bias refers to the tendency to interpret an event or situation as hostile, when in fact no hostile intent exists (Baron & Richardson, 1994). Several researchers have identified certain types of individuals who have a greater tendency to use this bias in everyday life. For instance, Dodge and colleagues (Dodge et al., 1984; Dodge & Somberg, 1987) found that unpopular, aggressive children tended to use this bias in social situations. Similarly, Bell-Dolan (1995) found that socially anxious elementary school children tend to misinterpret non-hostile or ambiguous self-relevant social cues as being hostile or threatening. This is not surprising, given that socially anxious individuals tend to be highly concerned with negative evaluation from others (Bradley et al., 2000; McManus et al., 2000; Mogg & Bradley, 2002; Philippot & Douilliez, 2005; Rapee & Heimberg, 1997). Moreover, Bell-Dolan (1995) found that socially anxious children, when perceiving neutral events as hostile, were significantly more likely to employ maladaptive strategies in response to these events compared to non-socially anxious children. Negative attribution bias (also referred to as depressive attribution bias) is the tendency to interpret ambiguous social cues as negative, and is common among individuals with social anxiety (Miers et al., 2008).

Melfsen and Florin (2002) examined whether socially anxious children had an inherent bias to decode positive and neutral facial expressions as negative. In this study, children were shown faces displaying the emotions of joy, anger, disgust, and sadness on

a computer screen and were asked to categorize each facial expression into positive, negative, or neutral categories by pressing the appropriate button on a keyboard. Surprisingly, the researchers did not find any differences between socially anxious and non-socially anxious children in their abilities to correctly distinguish between positive, negative, or neutral facial expressions. There were, however, some limitations that should be taken into account when considering the results of this study. First, the sample size was inadequate for drawing compelling conclusions. Even when the researchers used less restrictive selection criteria, only 50 socially anxious or socially phobic and 25 non-socially anxious and non-socially phobic participants were included in the study. Also, participants (aged 8-12) were shown faces of children as young as 5 and adults whose age range was not specified. This could negatively affect the results, given that participants were not matched in age with the stimuli they were decoding. Finally, asking participants to categorize faces into discrete positive, negative, and neutral categories may have eliminated a considerable amount of potentially useful data. If these categories had instead been conceptualized as continuous scores, such as through a range on a Likert rating scale, more informative data might have been drawn from the task. For instance, socially anxious children might have indicated that positive facial expressions were perceived as slightly less positive compared to their non-socially anxious counterparts. The more sensitive Likert scale might have allowed some differences to be found where the categorical structure may have eliminated them.

In a study with university students, Mogg and Bradley (2002) found that socially anxious students displayed attentional biases to threatening faces compared to neutral faces. When threatening and non-threatening faces were displayed together, socially

anxious individuals directed more attention toward the threatening faces. Similar results were found by Gilboa-Schectman, Foa and Amir (1999), who asked participants with generalized social phobia and non-anxious controls to choose positive, negative, or neutral faces out of a crowd. Participants with social phobia picked out faces displaying negative emotions (e.g., angry) more frequently than faces displaying positive emotions (e.g., happy). Bradley and colleagues (2000) found that level of social anxiety (high, medium, low) was concordant with degree of attentional biases to threatening stimuli. These researchers found that the more symptoms of social anxiety experienced by participants, the more quickly they would respond to the threatening stimuli.

Given the previously described ambiguity inherent in computer-mediated communication (Kruger et al., 2005) combined with the tendency for socially anxious children to infer hostile or negative intent in ambiguous or non-hostile situations (Bell-Dolan, 1995), we might expect children high in social anxiety to overly perceive hostile or negative intent in computer-mediated communication compared to their less socially anxious counterparts. Research also indicates that girls experience higher levels of social anxiety compared to boys (Bell-Dolan, 1995). Thus, it may well be that, overall, girls who are socially anxious will perceive neutral or positive stimuli even more negatively than will boys who are socially anxious.

Social Anxiety and Computer-Mediated Communication

Over the last several years, researchers have begun to examine the relation between social anxiety and the use of computer-mediated communication. Given the potential concerns described above, researchers have investigated both the benefits and drawbacks of computer-mediated communication for individuals with social anxiety.

Among the benefits, many argue that socially anxious individuals experience a greater sense of connectedness and fewer symptoms of anxiety when engaging in computer-mediated communication compared to face-to-face or voice conversations (Lundy & Drouin, 2015). Socially anxious individuals commonly experience anxiety about their appearance, their ability to converse naturally and find the right words, and their ability to accurately send and interpret nonverbal cues (Weidman et al., 2012). The anonymity of computer-mediated communication coupled with the asynchronicity with which socially anxious individuals can communicate online may greatly reduce the common fears they face when communicating with others.

Lundy and Drouin (2015) found that socially anxious undergraduate students did indeed capitalize on these features of computer-mediated communication to communicate with important others (e.g., friends and family) far more often than through other means of communication (e.g., face-to-face or over the phone). Nevertheless, the socially anxious students did not experience any significant increase in interpersonal connectedness when asked to communicate with strangers through instant messaging compared to voice or face-to-face conversation. Students low in social anxiety, however, experienced significantly less interpersonal connectedness after communicating with strangers via computer-mediated communication compared to communicating over the phone or in person. These results suggest that, while the form of communication has no bearing on levels of connectedness for socially anxious individuals (despite their preference for use of computer-mediated communication), individuals low in social anxiety reap more benefits in terms of interpersonal connectedness when communicating in person or over the phone rather than through instant messaging.

Research has led to the conclusion that computer-mediated communication allows for reduced symptoms of social anxiety for socially anxious individuals, and therefore results in the increased use of this medium compared to other means of communication. However, whether this phenomenon actually leads to more positive outcomes for socially anxious individuals rather than possibly introducing more harmful consequences is open for debate. Lee and Stapinski (2011) reported, for example, that social anxiety is in fact a precursor to "problematic internet use" (Davis, 2001), even after controlling for moderating factors such as depression, general anxiety, and stress. Indeed, Weidman and colleagues (2012) found that while socially anxious undergraduate students used computer-mediated communication to compensate for other forms of interaction and felt more comfortable with this form of communication, these individuals actually showed increased symptoms of depression and lower overall quality of life than did individuals who communicate online less frequently.

Following up on the aforementioned study by Weidman et al. (2012), Casale, Lecchi and Fioravanti (2014) investigated the specific predictors related to undergraduate students' well-being that contribute to the motivation for socially anxious individuals to regulate their anxious symptoms by choosing computer-mediated communication in place of other means of communication. Overall, these researchers' findings indicated once again that low psychological well-being (e.g., the presence of social anxiety) may lead to problematic use of the Internet and computer-mediated communication. In addition, factors that contributed specifically to lower well-being and problematic internet use were low levels of Autonomy (e.g., looking to others for approval and having low confidence in one's own thoughts and opinions), Environmental Mastery (e.g., poor

time management, inability to manage one's own negative emotions, lack of control over external world), and Positive Relations with Others (e.g., good quality and satisfying relationships with others).

Bautista and Hope (2015) provided high and low socially anxious undergraduate students with positive and negative feedback using computer-mediated communication. These researchers found that those high in social anxiety experienced significantly more state anxiety, negative thoughts, and self-focused thoughts than did students low in social anxiety. Moreover, those high in social anxiety paid significantly more attention to the negative feedback and discounted the positive feedback they were given. These findings supported the social-information processing bias (e.g., attribution bias) that is posited in cognitive theories of social anxiety (e.g., Allred & Smith, 1991). In a similar vein, Kingsbury and Coplan (2015) studied whether attribution bias among socially anxious individuals carried through to computer-mediated communication among undergraduate students. These researchers focused on how socially anxious individuals *interpret* messages received through computer-mediated communication rather than focusing on the way these individuals use and access computer-mediated communication. Kingsbury and Coplan (2015) found that socially anxious undergraduate students endorsed a negative attribution bias when receiving ambiguous text messages significantly more often than did non-anxious undergraduate students, and that socially anxious women endorsed a negative attribution bias more often than socially anxious men.

The Present Research

Kingsbury and Coplan's (2015) findings are highly relevant to the research conducted in the current thesis. The present study consisted of two components. The first

part of the study focused on the frequency of miscommunication among 8- to 12-year-old socially anxious versus non-socially anxious children as nonverbal cues become less available, as in computer-mediated communication. Children were asked to complete a questionnaire that assessed their level of social anxiety, as well as a measure that assessed their attribution style (positive or negative). They were then asked to identify the emotions communicated through various messages delivered in one of three conditions: audio-visual, audio-only, and text-only. Each message in the three conditions was attached to one of the six original universally recognized emotions (anger, fear, sadness, disgust, surprise, happiness). Contempt was not included among the emotional stimuli, as previous research has found this emotion to be more difficult for children to recognize and identify compared to adults (Izard, 1971; Widen & Russell, 2010; Nelson & Russell, 2016).

Children were scored on the accuracy with which they were able to decode each message in each of the three conditions. Based on the literature reviewed (van der Meij, 2007), we expected that girls in the present study would have an advantage over boys in decoding the emotions associated with messages in the audio-visual and audio-only conditions. When these nonverbal channels were removed in the text-only condition, we examined whether girls would maintain this advantage in accurately decoding the emotionally toned messages.

This study differs from others in that the few studies that have looked at similar phenomena have used adults as their sample group (e.g., Bautista & Hope, 2015; Kingsbury & Coplan, 2015; Kruger et al., 2005). Additionally, only one of these studies has looked at individual differences, such as social anxiety and interpretation bias, in the

individual's ability to accurately decode and interpret emotionally toned messages from audio-visual, audio-only, and computer-mediated communication settings. In a similar study with adults, Kruger and colleagues (2005) studied participants' ability to accurately identify various emotionally toned messages through email or voice-only conditions. As hypothesized, accuracy levels in decoding messages were higher for those in the voice-only condition compared to the e-mail condition. Based on the current literature, there is enough evidence to suggest that similar results would be found for children. Therefore, the current study extrapolated beyond this theory and looked specifically at the differences in children's ability to decode messages accurately using various levels of nonverbal cues, with social anxiety as a predictive factor.

The second part of the study focused on whether children who were higher in social anxiety would perceive communications delivered via text-based media differently than would children who were lower in social anxiety. We examined whether the influence of social anxiety and negative interpretation bias carried over to situations using computer-mediated communication among children. If this were the case, there would be considerable implications for children in this new digitally dominant world. If it is difficult enough for individuals in general and children in particular to convey a message, emotion, or thought via computer-mediated communication without being misunderstood by the receiving party, it may be particularly difficult for children who are socially anxious to interpret a message accurately without assuming that there is hostile or negative intent behind a seemingly ambiguous or non-hostile message.

No research conducted to date has explored how accurately socially anxious children decode messages through computer-mediated communication in the absence of

verbal and nonverbal cues. Kingsbury and Coplan (2015) used young adults to demonstrate that interpretation bias among socially anxious individuals does indeed carry over into the digital world of computer-mediated communication. The present research not only examined the same phenomenon in children, it also compared between messages presented in a text-only condition, an audio-only condition, and an audio/visual condition in order to draw more direct comparisons between accuracy of interpreting emotionally toned messages in the presence or absence of nonverbal cues and social anxiety. The current study also went beyond previous research in which positive, negative, and neutral stimuli were compared categorically (Melfsen &Florin, 2002), by using a broader ranged, 5-point Likert scale to assess positive and negative interpretations of the emotionally toned stimuli. The 5-point Likert scale served to increase the sensitivity of the scale to identify potentially more subtle differences between socially anxious and non-socially anxious children in their interpretations of the emotion recognition stimuli.

Hypotheses

Hypothesis 1. Participants in the audio-visual condition would show the highest accuracy in decoding emotions, followed by those in the audio-only condition, while those in the text-only condition would be least accurate at decoding emotions.

Hypothesis 2. Children higher in social anxiety in each of the three conditions would make a greater number of errors decoding emotions accurately compared to those lower in social anxiety.

Hypothesis 3. Girls would perform better in the text message condition than boys. However, girls who were higher in social anxiety would display more errors in decoding

emotions in each of the three conditions than would boys who were higher in social anxiety.

Hypothesis 4. Children higher in social anxiety would perceive all stimuli through computer-mediated communication more negatively than children lower in social anxiety.

Hypothesis 5. Social anxiety would be correlated with attribution bias, such that children higher in social anxiety would endorse a more negative attribution bias.

Method

Prior to beginning data collection for the main study, extensive pilot research was undertaken to validate the stimuli that were created for this study. As a result, this section has been divided into two components, describing the Methodology for both the Pilot Research phases and the Main Study.

Pilot Research: Participants & Procedures

Phase 1: Focus group. In order to obtain the sentences used in the main study, a focus group was held with six children (5 girls, 1 boy, ages 9-11) in a testing room at the University Ottawa. The goal of the focus group was to generate potential sentences for inclusion in the main study by exploring what types of events and situations in the lives of children within this age range contribute to the targeted emotions under study. For each of the emotion categories of interest (happy, sad, angry, disgust, surprise, fear), the children were asked, "What types of events would make someone your age feel _____?". At the end of the pilot session, a number of potential sentences for inclusion in the main study were generated.

Phase 2: Recording Stimuli. One male and one female child actor (both aged 11 years) were recruited after distributing flyers to local theatres in the Ottawa region. The actors were audio-visually recorded while reciting various emotionally toned sentences, generated from the focus group in Phase 1. The actors were instructed to display a given affect (e.g., happy, sad, angry, disgusted, scared, surprised) for each sentence that was deemed typical for average face-to-face conversation. Girls in the main study were exposed to messages recited by the female child actor, while boys were exposed to messages from the male child actor.

Phase 3: Attractiveness ratings of actors. Attractiveness has been shown to have an influence on how a person may interpret a message, as well as the positivity or negativity of the message the person is conveying. For example, Tracy and Beall (2011) reported that happiness displayed by females was the most attractive emotion perceived, while happiness displayed by males was among the least attractive perceived emotions. Moreover, these differences tend to be consistent across age ranges (Tracy & Beall, 2011). Overall, it is posited that average attractiveness of actors is ideal when having participants complete emotion recognition tasks. In order to reduce the confound of attractiveness of the actors that would be presenting the stimuli in the present study, 20 raters (10 men, 10 women) rated the attractiveness of the actor of their same gender on a Likert rating scale from 1 (unattractive) to 5 (very attractive) using convenience sampling methods at the University of Ottawa campus.

Phase 4: Sentences for inclusion in main study. Once audio-visual recordings were prepared, a pilot group of seven boys and eight girls aged 8-12 years watched the recordings of the same-sex actor and selected from a list which of the six universal emotions corresponded with each sentence in the recording. In order for a sentence to be included in the main study, raters had to identify the correct emotion at least 80% of the time for both genders. Frequency statistics were generated using SPSS in order to determine the level of accuracy for each stimulus for raters of both sexes. A minimum inclusion of three sentences per emotion (happy, sad, angry, disgusted, fearful, and surprised) was required in order to move on to the proposed study. Equal numbers of sentences for each emotion was the goal for use in the final study.

Main Study

Sample and Effect Size

In order to determine a sample size for the present study that would provide an appropriate effect size, previous research was consulted. According to Green (1991), an appropriate sample size when conducting a regression analysis is to have 50 + 8K, where K is equal to the number of predictors, or independent variables, in the study. In the current study, there are 11 predictor variables. This equation suggested that a conservative overall sample size required for a medium effect size would be 138.

A study that examined a similar phenomenon was also used as a guide to determine an appropriate sample size for a given effect size in the current study. Battaglia et al.'s (2004) study of how children endorsing varying levels of social anxiety discriminate between emotional facial expressions reported a regression analysis that produced an R^2 of .086. By performing the f^2 ratio, where R^2 is divided by 1-R^2, this translates into an effect size of *f* squared = .094. Using G*Power 3.1, the total sample size required for a regression with an effect size of .094, an alpha level of $p = .05$, power of .80 and using 2 predictors (gender and social anxiety) is 106 (Faul, Erdfelder, Buchner, & Lang, 2009). Because the number of predictors in the present study was greater than what was used in the study by Battaglia et al., a sample size larger than 106 was intended for the present study. In order to have equally weighted groups, the goal was to recruit 40 participants per condition, for a total of 120 participants.

Given the limitations of receiving permission to recruit students from various school boards at the time of the study, we were unable to obtain this large a sample size. The risk with running multiple regression analyses with a smaller sample size is that

power becomes significantly reduced. Low power increases the risk of committing Type II error, which is incorrectly accepting the null hypothesis that no significant relation exists between the independent and dependent variables when in fact one does. Therefore, results from the present study should be interpreted with caution.

Participants

Students. Participants were a non-clinical sample of Anglophones recruited from fourth-, fifth-, and sixth-grade classrooms from two private English schools within the city of Ottawa: Ashbury College (n = 38) and Turnbull School (n = 60). All children in grades 4-6 were eligible to participate, unless they had hearing or vision damage that could not be corrected (e.g., legally blind or deaf). No participants were excluded from the study as a result of permanent, uncorrected hearing or vision damage. Across the two schools, the distribution of children in each grade was relatively equal (grade 4: n = 29; grade 5: n = 39; grade 6: n = 30). This sample was chosen because of the frequency with which this age group, as well as older youth, communicate through computer-mediated communication (Cassidy, Jackson, & Brown, 2009) and because the norms of the measures that were used have been empirically validated for the age group (Beidel, Turner, & Morris, 1995; Crick, 1995; Gladstone & Kaslow, 1995; Thompson, Kaslow, Weiss, & Nolen-Hoeksema, 1998). In addition, this age group has been largely understudied in research investigating usage of computer-mediated communication. Students ranged in age from 8- to 12-years-old, with a mean age of 10.05 (*SD* = .82). There were about twice as many boys in the study (n = 67) than girls (n = 31). For the distribution of boys and girls in each grade and school, refer to Table 1.

Once approval was obtained from both schools, principals were given a brief outline of the proposed study and then met with in person to review the study in detail. The research was conducted in accordance with the protocols of the Research Ethics Board of the University of Ottawa.

Table 1

Number of Boys and Girls in Each School and Grade Level.

n	Grade 4	Grade 5	Grade 6
Ashbury	Boys = 7 Girls = 3	Boys = 7 Girls = 8	Boys = 8 Gils = 5
Turnbull	Boys = 11 Girls = 8	Boys = 18 Girls = 6	Boys = 16 Girls = 1

Data Collection

In order to begin recruitment, the primary investigator introduced herself to the students in fourth-, fifth-, and sixth-grade classes at both participating schools at the beginning of the school year in September, 2014. The study was introduced in broad terms to the students and all students were given an information letter and consent form to take home to their parents or legal guardians (see Appendix E, F). The research was described as an investigation of how individuals decode different types of messages through computer-mediated communication. Only children for whom we received informed parental consent participated in the study. In addition, participating children were also asked for their assent prior to beginning the study.

Measures

Demographics. Some basic demographic information was collected from each participant, including age, sex, and grade. In order to follow the protocols outlined by the Research Ethics Board at the University of Ottawa, information on ethnicity and socioeconomic status was not gathered from participants because it was not a specific variable of interest.

Social Anxiety Questionnaire. The Social Phobia and Anxiety Inventory for Children (SPAI-C; Beidel et al., 1995) was used to assess social anxiety. The SPAI-C is a 26-item self-report measure that assesses social phobia and social anxiety in children between the ages of 8-14. The maximum score on the SPAI-C is 52, indicating that the responder experiences high levels of anxiety in a variety of social situations. The original scale was normed on a sample population of children from the United States. As well as measuring a total score for overall symptoms of social anxiety, the scale also measures three separate subcategories related to social anxiety; assertiveness/general conversation (factor 1), traditional social encounters (factor 2), and public performance (factor 3). The measure suggests a cut-off score (e.g., 18) based on the overall social anxiety score, which indicates whether a child experiences clinically significant symptoms of social anxiety.

The scale possesses good psychometric qualities, with an alpha coefficient of .95 and test-retest reliability coefficient of $r = .86$, $p < .001$ after 2 weeks and $r = .63$, $p < .01$ after 10 months (Beidel et al., 1995). For each of the separate factors that the SPAI-C measures, the test-retest reliability coefficients were $r = .72$ (factor 1), $r = .91$ (factor 2) and $r = .73$ (factor 3), all $ps < .001$. The SPAI-C also has good concurrent validity when

compared with other scales measuring similar constructs, such as the Trait subscale of the State-Trait Anxiety Inventory for Children (Spielberger, 1973), the Internalizing subscale from parent ratings on the Child Behavior Checklist (Achenbach & Edelbrock, 1983) and several subscales on the Fear Survey Schedule for Children - Revised (Ollendick, 1983; as stated in Beidel et al., 1995). SPAI-C scores indicating high levels of social phobia also correlate with parental observations of children's experiences of fear and social activity (Beidel et al., 1995). For use in the present study, participants' scores on the SPAI-C were used as a continuous variable, with higher scores indicating higher levels of social anxiety. In the present study, Cronbach's alpha for the SPAI-C was .94.

Attribution Bias. The Children's Attributional Style Questionnaire - Revised (CASQ-R; Thompson et al., 1998) was used to assess children's positive or negative attribution style. This is a 24-item, forced-choice measure, revised from the full 48-item CASQ questionnaire (Seligman, Peterson, Kaslow, Tanenbaum, Alloy, & Abramson, 1984). Each item describes an event (e.g., "You fail a test"), and children must choose what they believe to be the reason the event occurred (e.g., "All tests are hard" vs. "Only some tests are hard"). The measure produces composite scores for positive and negative attribution style. Subtracting the composite negative (CN) from the composite positive (CP) score produces an overall composite score, which was used in the present study. The lower the overall composite score, the higher the child's *negative/depressive* attribution style.

The CASQ-R was originally normed on 1,086 children in grades 3-6 (ages 9-12 years) in public schools in the United States. The measure showed good reliability with an alpha coefficient of .61 for overall composite scores (Thompson et al., 1998). Over a

6-month period, the test-retest reliability coefficient for the overall composite scores of the CASQ-R was .53, and there was also evidence of criterion-related validity when measured against the Vanderbilt Depression Inventory (VDI), r = - .40 (Greening, Stoppelbein, Dhossche, & Martin, 2005). Because the overall composite score for this measure was used in the present study, it was coded as a continuous variable. Cronbach's alpha for overall composite scores in the present study with 96 participants was .49. The lower alpha found in our study likely reflects our smaller sample size compared to the sample on which the measure was originally normed (n = 1,086).

Procedure

Data collection took place from November, 2014 to January, 2015. Participation in the study occurred during class time. Eligible students were escorted individually to a separate room within their school by the principal investigator. The principal investigator then described the study to each participant and explained what he or she would be asked to do. Participants were told that there would be two components to the study:

1. A computerized task in which participants would be randomly assigned to one of three conditions: audio-visual, audio-only, or text message. In these conditions, they would be required either to watch, listen to, or read from a laptop screen various sentences one at a time, and choose which emotion they perceive that message as conveying (happiness, sadness, surprise, disgust, fear, anger) from among options that would appear in a list beside each sentence on the computer screen. Participants were also told they would be asked to rate how positively or negatively they perceived each message to be, by responding on a 5-point scale (-2 = extremely negative, 0 = neutral, +2 = extremely positive).

2. A task that involved their filling out three self-report questionnaires; the brief demographics questionnaire, the SPAI-C, and the CASQ-R. Students were asked to fill out these questionnaires as honestly as they could. They were instructed not to put their names on the questionnaires in order to maintain anonymity. Participants were reminded of the approximate amount of time that testing should take (approximately 30 minutes), the voluntary nature of their participation, and that should they wish to withdraw at any point, their information would remain confidential and there would be no penalty to do so. Prior to beginning testing, students were read the assent form and asked whether they wished to participate in the study. Once students finished all questionnaires, they returned to their classroom.

Sentence-Rating Task

All messages were presented to participating children on a Macintosh laptop computer, using the SuperLab 4.5 computer program. To control for possible order effects, messages were presented in randomized order to each participant in each condition (audio/visual, audio only, text message). There was no time limit to respond to each message. Once participants had identified which emotion corresponded to each message, they were automatically directed to the task in which they rated how positive or negative the message was. Once they had rated the message, they were instructed to press a button on the laptop that presented with the next stimulus.

Self-Report Measures

After completing the sentence-rating task, participants completed the brief demographic questionnaire, the SPAI-C, and the CASQ-R. The questionnaires were

completed following the sentence-rating task in order to avoid any possible contamination of the sentence ratings by the content of the questionnaires. After participants completed these questionnaires, they were given a package including a debriefing form to take home and a pack of sugar-free gum. They were then escorted back to their classroom. The debriefing form thanked participants for their participation and explained the study in greater detail. This form also provided the researcher's contact information; including name, university affiliation, and a phone number as well as the contact information for the Research Ethics Board at the University of Ottawa in the event that students or parents had any questions regarding the study.

Results: Pilot Research

Phase 1: Focus Group

Participants generated a number of potential sentences for inclusion in the main study. Sentences included the following emotions: 18 Happy, 14 Sad, 20 Angry, 20 Disgusted, 13 Surprised, and 10 Scared sentences.

Phase 3: Attractiveness Ratings of Actors

Results from an independent samples t-test revealed no significant difference in ratings of attractiveness of the girl ($\bar{x} = 3.4$, $SD = 0.52$) and boy actor (mean = 3.05, SD = 0.37), $t\ (18) = -1.74$, $p = .10$.

Pilot Phase 4: Sentences for Inclusion in Main Study

Five sentences conveying the emotion "happy" were retained, with both boys and girls identifying the target sentences as "happy" with 100% accuracy. Five sentences conveying the emotion "sad" were also retained, with both boys and girls identifying the target sentences as "sad" with 100% accuracy. For sentences conveying the emotion "angry", five sentences were retained with boys identifying the target sentences as "angry" with a minimum of 85.7% accuracy and girls achieving at least 87.5% accuracy for the same sentences. Five sentences conveying the emotion "disgust" were retained, with both boys and girls identifying the target sentences as "disgust" with 100% accuracy. Four sentences conveying the emotion "scared" were retained, with boys identifying the target sentences as "scared" with a minimum accuracy of 85.7% and girls identifying the same sentences with a minimum accuracy of 87.5%. Only three of the sentences conveying the emotion "surprise" could be retained for participants of each sex, and these sentences were not identical due to the large degree of inaccuracy in

identifying these sentences during pilot research. As such, boys and girls received one shared 'surprised' message, and obtained two different messages conveying surprise. Overall, boys identified the target sentences as "surprise" with a minimum accuracy of 85.7% and girls identified the same sentences with 100% accuracy (see Appendix I for tables outlining accuracy ratings of pilot sentences for boys and girls and sentences used for each emotion category).

Results: Main Study

Preliminary Analyses

Data were screened for univariate outliers by reviewing each variable and plotting it on a histogram. Descriptive statistics were observed to see how much outliers deviated from the normal curve. For all outliers with the exception of those pertaining to reaction time, values were winsorized and reduced to +/- 2.58 standard deviations from the mean (reduced to the most extreme value within +/- 2.58 standard deviations from the mean). For reaction time, values that exceeded a certain cutoff (specific for each emotion) were deleted. The following cutoffs for each emotion were established based on when the values began to deviate noticeably from the normal curve:

- Happy: 1.5 seconds
- Sad: 1.5 seconds
- Angry: 1.8 seconds
- Scared: 2 seconds
- Surprised: 2.5 seconds
- Disgusted: 2.3 seconds

Composite scores were then calculated based on mean scores for each emotion. After computing mean composite scores for each emotion's reaction time, distributions were looked at once again and both Scared and Surprised reaction times required winsorizing to +/- 2.58 standard deviations from the mean.

One participant was dropped from analyses pertaining to accuracy of interpreting emotionally toned sentences since he did not participate in a major component of the experiment. For missing data, values were not imputed due to the nature of the variables in the experiment and their sensitivity to individual differences. Since less than 1% of the overall data were missing, listwise deletion of cases was used for regression analyses. For analyses that determined accuracy of emotion recognition, proportion of responses was used to calculate accuracy rather than total score. For example, if a participant only responded to 4 out of 5 stimuli for happy sentences then his or her accuracy was calculated out of 4 rather than 5. On some occasions, program malfunction during certain days of testing resulted in some participants missing the first stimulus presented. In other cases, participants indicated that they missed the message being conveyed and had to skip that stimulus.

The dataset was screened for any bimodal or skewed distributions that would cause the data to be non-normally distributed. When analyzing data related to accuracy of judging happy emotionally toned sentences, there was an extreme skew due to a high number of subjects accurately identifying this emotion. As a result, this variable was dichotomized, which led to a 30/67 split. This variable was then analyzed as the dependent variable in a binary logistic regression. For all other skewed variables (composite accuracy ratings for sad, angry, disgusted, and scared emotionally toned sentences; composite Likert ratings for happy and angry emotionally toned sentences; composite reaction time ratings for happy, angry, and disgusted emotionally toned sentences), Templeton's (2011) two-step procedure was used to normalize their distribution. Linearity between two pairs of continuous variables was verified by

examining a series of scatterplots in order to determine through visual inspection whether any linear relations existed. All pairs of continuous variables in the multiple regression analyses met the assumption of linearity. Multicollinearity between predictor variables was screened and the predictor variables were not found to be highly correlated with one another. Finally, assumptions for homoscedasticity of residuals in each regression analysis were met.

Since the sample was drawn from two different schools, there was concern that sample characteristics might vary across schools. To evaluate this hypothesis, independent samples t-tests were conducted to analyze whether there were differences in the independent variables across schools. No significant differences were observed. Given these results, it was decided that school did not need to be taken into account in the following analyses. Age was also not included in the main analyses, as it was initially run as a covariate in a series of 18 factorial ANCOVAs for the main analyses, and was found to be non-significant in all cases. As a result, age was dropped as a covariate and standard multiple regression was used to analyze the data.

In our correlation analysis, attribution bias was found to be significantly correlated with social anxiety, $r = -.34$, $p < .01$. Relating to *Hypothesis* 5, the null hypothesis was rejected. Children who were more socially anxious did endorse a more negative attribution bias more frequently than those who were lower in social anxiety. Given the small sample size and the number of predictor variables already involved in the main analyses, we decided to retain as many degrees of freedom as possible to increase power and did not include attribution bias as a predictor variable in the multiple regression analyses.

The main analyses are separated into three sets of multiple regression analyses. The first set of multiple regressions examined the relation between emotion recognition accuracy among participants and the independent variables of interest (sex, condition, social anxiety). The second set of regressions examined the relation between Likert ratings of each composite emotion to see whether there were differences in how positively or negatively participants rate various emotions, given the same predictor variables of interest. Lastly, while reaction time was not initially a variable of interest, the availability of the data led to a third set of multiple regressions exploring whether there were differences in reaction time when making judgments about the emotional tone of a stimulus, given participants' sex and whether they are socially anxious. Since participants were not primed to respond as quickly as possible, these results need to be interpreted with caution. In addition, reaction time was measured after the stimulus was presented. As participants in the text message condition had to read their stimuli rather than listen to or watch them, they were expected to have higher reaction times across emotions. Therefore, these results are not elaborated on when condition appears as a significant main effect for analyses involving reaction time.

For the purposes of interpretation, the measure of anxiety was centered and then multiplied by relevant independent variables to obtain the interaction terms for the regression analysis. For example, the Anxiety by Sex interaction term involved multiplying the centered anxiety variable by the dichotomous sex term. A similar approach was used to create the other interaction terms involving anxiety in the following analyses. Furthermore, the three levels of condition to which participants were randomly assigned (text message, audio-only, and audio-visual) were dummy coded in order to be

used in the multiple regression analyses. With the text message condition as the reference group, dummy code 1 (dum1) refers to the relation between the text message condition and the audio-only condition, whereas dummy code 2 (dum2) refers to the relation between the text message condition and the audio-visual condition. Since this set of dummy coded variables did not permit a direct comparison between the audio-visual and audio-only conditions, a second set of dummy coded variables was organized with the audio-visual condition as the reference group. Dummy code 3 (dum3) refers to the relation between the audio-only and the audio-visual condition. Thus, for each dependent variable, two regressions were performed. Analysis 1 used dum1 and dum2 to account for condition, while Analysis 2 used dum3 and dum4. Since dum2 and dum4 represent equal comparisons, only the results concerning dum3 will be presented when discussing Analysis 2. After running Analysis 2 for each dependent variable, it was observed that while the total variance accounted for by condition did not change between the two sets of dummy coded variables, the way the variance was partitioned across main effects and interaction terms changed drastically from one set of dummy codes to the next. As a result, only the main effect of the dummy coded variable that represents the relation between the audio-only and audio-visual condition is reported in the analyses that follow, and is represented as dummy code 3 (dum3).

Given the small sample size and the exploratory nature of the present study, the following statistics were more concerned about Type II error than Type I error. Therefore, it was deemed that a Bonferroni correction was not necessary in the following analyses (e.g., Perneger, 1998; Rothman, 1990). Table 2 shows the means and standard deviations for the measures used in the study, as well as their inter-correlations.

Table 2

Means, Standard Deviations and Inter-Correlations of Measures by Sex

Sex		Means	Standard Deviation	Inter-correlation
Males	CASQ-R	4.7	2.9	-.31*
	SPAIC	14.7	7.4	
Females	CASQ-R	5.5	2.2	-.52**
	SPAIC	15.9	8.1	

** $p \leq .01$; * $p \leq .05$

Main Analyses 1 (Accuracy)

In order to determine accuracy of emotion recognition, Wagner's (1993) *unbiased hit rate* was used. Unbiased hit rate, unlike hit rate, takes into account the response bias and/or false alarms a given participant may have when making judgments about emotion recognition. For example, a participant who rated all 27 stimuli as surprised would obtain a perfect score for the surprised category, but he or she would also be misidentifying other non-surprised stimuli as surprised. Therefore, a participant who misses one stimulus in the surprised category but has no false alarms has a better "surprised" emotion recognition accuracy percentage than the former participant in the example.

A correlation matrix of the emotion recognition variables can be found in Table 1.1. In order to determine accuracy of emotion recognition, a multiple linear regression was conducted for each emotion category. When looking at graphical representations of interactions, error bars were not used since we were looking at trends and not mean comparisons.

Table 1.1

Pearson Correlation 2-tailed Variables in Analysis 1 (Accuracy)

	1	2	3	4	5	6
1. Happy	1	0.11	0.16	-0.06	0.29**	0.12
2. Sad		1	0.69**	0.27**	0.33**	0.44**
3. Angry			1	0.18	0.37**	0.30**
4. Disgusted				1	0.21*	0.15
5. Surprised					1	.22*
6. Scared						1

*p ≤ 0.05. **p ≤ 0.01.

Happy. A binary logistic regression was performed with accuracy of judging happy emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. In the initial model, the three-way interaction between social anxiety, sex and text-message versus audio-visual condition (dum2) produced standard errors that were so large that it suggested the presence of multicollinearity. However, preliminary diagnostics indicated that multicollinearity was not present among the variables. Given this statistical discrepancy, we decided to run a hierarchical logistic regression and dropped the three-way interaction that was producing higher standard errors in order to interpret the results more meaningfully. Table 1.2 displays the coefficients, Wald statistic, odds ratio, and confidence limits for the predictor variables and their interactions when predicting the accuracy of judging happy emotionally toned sentences. The Wald statistic generates a chi-square value, which tests the null hypothesis that two coefficients

are simultaneously equal to zero. The odds ratio then indicates whether a given coefficient will have higher or lower odds of predicting the dependent variable. The Hosmer and Lemeshow Test was nonsignificant, χ^2 (8) = 2.70, $p > .05$. With respect to goodness of fit the Cox and Snell $R^2 = .06$ whereas the Nagelkerke $R^2 = .08$. Therefore, of the 10 predictor variables, only a maximum of 8% of the variance in the dependent variable, accuracy of judging happy emotionally toned sentences, was accounted for in the model. Moreover, no one variable accounted for sufficient unique variance to be considered statistically significant.

Sad. Analysis 1 involved predicting accuracy of judging sad emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition. Table 1.3 displays the inter-correlations, means, and standard deviations for continuous variables (accuracy of judging sad emotionally toned sentences [DV; normalized] and social anxiety). Table 1.4 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the accuracy of judging sad emotionally toned sentences.

For analysis 1, the overall *R* value of .71 was significantly different from zero, F (11,85) = 7.90, $p < .001$, with R^2 at .51 and 95% confidence limits from .28 to .59. The adjusted R^2 of .44 indicates that approximately half of the variability in accuracy of judging sad emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors.

Table 1.2

Regression Coefficients (B), Wald Statistic, Odds Ratio, and 95% Confidence Intervals for the Predictor Variables and their Interactions When Predicting Accuracy of Judging Happy Emotionally Toned Sentences

				95% CI	
Variables	***B***	**Wald statistic**	**Odds ratio**	**Lower**	**Upper**
Sex	-.98	1.40	.38	.08	1.90
Text vs. Audio (dum1)	-.62	.77	.54	.14	2.14
Text vs. AV (dum2)	-.44	.39	.64	.16	2.59
Audio vs. AV (dum3)	-.18	.08	.84	.24	2.94
Anxiety (centered)	.02	.08	.78	.89	1.17
Anxiety*Dum1	.05	.21	1.05	.86	1.27
Anxiety*Dum2	-.03	.11	.97	.82	1.15
Sex*Dum1	.86	.52	2.35	.23	24.10
Sex*Dum2	2.41	2.86	11.18	.68	184.01
Anxiety*Sex	.004	.002	1.00	.84	1.20
Anxiety*Sex*Dum1	-.08	.36	.92	.70	1.21
Constant	1.21	4.93	3.35		

*$p \leq 0.05$. **$p \leq 0.01$.

Of the 11 predictors entered into the regression, only two -- dum1 and dum2 -- accounted for sufficient unique variance to be considered statistically significant. Together these two variables accounted for 47% of the variance in the dependent variable, accuracy of judging sad emotionally toned sentences. The other 9 predictors

contributed an additional 4% with no one variable accounting for a sufficient amount of unique variance to be considered statistically significant.

Table 1.3

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Accuracy of Judging Sad Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Sad Accuracy (norm) (DV)**	**Social Anxiety (centered)**
Anxiety (centered)	-.02	*
Means	.003	.10
Standard Deviations	.94	7.58

The regression coefficients for dum1 and dum2 were 1.14 (95% confidence interval ranging from .71 to 1.58) and 1.60 (95% confidence interval ranging from 1.17 to 2.04), respectively. The size and direction of the relations suggested that having more cues available (e.g., verbal and nonverbal), as in the audio-only and audio-visual condition resulted in significantly higher accuracy of judging sad emotionally toned sentences compared to the text message condition. Between the two, the increased amount of verbal and nonverbal cues available in the audio-visual condition accounted for twice as much unique variance as the audio-only condition, as indicated by the squared semipartial correlations of .31 for text versus audio-visual condition (dum2) compared to .16 for text versus audio-only condition (dum1). Analysis 2 revealed that there was a main effect of audio-only versus audio-visual condition (dum3), such that children in the audio-visual group had significantly higher accuracy in judging sad emotionally toned sentences compared to those in the audio-only group. The regression

coefficient for dum3 in the second regression analysis was -.46 (95% confidence interval ranging from -.88 to -.04).

Table 1.4

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Accuracy of Judging Sad Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.02	.01	.000
Text versus Audio (dum1)	1.14**	.58	.16
Text versus AV (dum2)	1.60**	.81	.31
Audio versus AV (dum3)	-.46*	-.23	.03
Anxiety (centered)	-.004	-.04	.000
Anxiety*Dum1	.009	.04	.000
Anxiety*Dum2	-.03	-.15	.007
Sex*Dum1	.26	.08	.003
Sex*Dum2	-.38	-.12	.006
Anxiety*Sex	-.01	-.06	.000
Anxiety*Sex*Dum1	-.02	-.08	.002
Anxiety*Sex*Dum2	.01	.02	.000
Intercept	-.90		
		$R^2 = .51$[a]	
		Adjusted $R^2 = .44$	
		$R = .71$**	

** $p < .001$, * $p < .05$

[a] Unique variability = .47; shared variability = .03, 95% confidence limits from -.28 to .59

Relating to *Hypothesis 1*, the null hypothesis was rejected. Participants in the audio-visual condition did in fact show higher accuracy in decoding sad emotionally toned sentences than participants in both the audio-only and the text message condition.

Angry. Analysis 1 involved predicting accuracy of judging angry emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition. Table 1.5 displays the inter-correlations, means, and standard deviations for continuous variables (accuracy of judging angry emotionally toned sentences [DV; normalized] and social anxiety). Table 1.6 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the accuracy of judging angry emotionally toned sentences.

Table 1.5

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Accuracy of Judging Angry Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Angry Accuracy (norm) (DV)**	**Social Anxiety (centered)**
Anxiety (centered)	.10	*
Means	.02	.10
Standard Deviations	.97	7.58

For Analysis 1, the overall *R* value of .74 was significantly different from zero, $F(11,85) = 9.17$, $p < .001$, with R^2 at .54 (95% confidence limits from .35 to .60) and adjusted R^2 of .48. The variance accounted for indicated that approximately half of the variability in accuracy of judging angry emotionally toned sentences was predicted by

sex, social anxiety, condition (dum1 and dum2) and all possible two and three-way interactions among those predictors.

Table 1.6

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Accuracy of Judging Angry Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.13	.06	.001
Text versus Audio (dum1)	.75**	.37	.07
Text versus AV (dum2)	1.80**	.88	.38
Audio versus AV (dum3)	-1.04**	-.51	.13
Anxiety (centered)	.02	.18	.006
Anxiety*Dum1	-.04	-.18	.009
Anxiety*Dum2	-.04	-.19	.01
Sex*Dum1	.49	.16	.009
Sex*Dum2	-1.00*	-.31	.04
Anxiety*Sex	-.008	-.04	.000
Anxiety*Sex*Dum1	-.002	-.004	.000
Anxiety*Sex*Dum2	.11	.21	.02
Intercept	-.80		
		$R^2 = .54$[a]	
		Adjusted $R^2 = .48$	
		$R = .74$**	

** $p \leq .001$, * $p \leq .05$

[a]Unique variability = .49; shared variability = .06, 95% confidence limits from .35 to .60

Figure 1.1. *Interaction of sex (X-axis) and text message (TM) versus audio-visual (AV) condition on accuracy of judging angry emotionally toned sentences.*

Of the 11 predictors entered into the regression, four accounted for sufficient unique variance to be considered statistically significant. A significant two-way interaction was observed between sex and dum2 when predicting accuracy of judging angry emotionally toned sentences, F (11, 85) = -2.56, $p \leq .05$. As can be seen in Figure 1.1, accuracy in interpreting angry emotionally toned messages was improved for both boys and girls when nonverbal cues were more available, such as in the audio-visual condition, compared to children's accuracy in interpreting angry messages through computer-mediated communication. Nevertheless, in the audio-visual condition, girls still made more errors in their interpretation of angry emotionally toned messages compared to boys. The regression coefficient for the two-way interaction was -.97 with confidence limits from -1.72 to -.22. The regression coefficient for dum2, which was embedded in the two-way interaction described above, was 1.79 (95% confidence interval ranging from 1.36 to 2.23). Finally, the remaining regression coefficient that differed significantly from zero was the text versus audio-only (dum1) condition. The coefficient for this significant main effect was .75 (95% confidence interval ranging from .32 to 1.18).

Together these four variables accounted for 49% of the variance in the dependent variable, accuracy of judging angry emotionally toned sentences. The two-way interaction contributed slightly to the shared variability (3%). Dum1, the contrast between the text message and audio-only conditions, contributed an additional 6% to the shared variability, while dum2, the contrast between text message and audio-visual conditions, contributed to the largest portion of the variance in accuracy of judging angry emotionally toned sentences (38%). The other 7 predictors contributed an additional 5% with no one variable accounting for a sufficient amount of unique variance to be considered statistically significant.

The size and direction of the relation between dum1 and the dependent variable suggests that having more verbal and paralinguistic cues available, as in the audio-only condition, results in significantly higher accuracy of judging angry emotionally toned sentences compared to the text message condition.

Analysis 2 also revealed that there was a main effect of dum3 (audio-only versus audio-visual condition), such that individuals in the audio-visual group had significantly higher accuracy in judging angry emotionally toned sentences compared to individuals in the audio-only group. The regression coefficient for dum3 in the second regression analysis was -1.04 (95% confidence interval ranging from -1.46 to -.63).

Relating to *Hypothesis 1*, the null hypothesis was rejected. Participants responding to the audio-visual condition displayed the highest accuracy in interpreting angry emotionally toned sentences compared to those in the audio-only and text message condition.

Disgust. Analysis 1 involved predicting accuracy of judging disgusted emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition. Table 1.7 displays the inter-correlations, means, and standard deviations for continuous variables (accuracy of judging disgusted emotionally toned sentences [DV; normalized] and social anxiety). Table 1.8 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the accuracy of judging disgusted emotionally toned sentences.

Table 1.7

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Accuracy of Judging Disgusted Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Disgust Accuracy (norm) (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.02	*
Means	-.004	.10
Standard Deviations	.92	7.58

For Analysis 1, the overall *R* value of .48 was significantly different from zero, $F(11,85) = 2.25$, $p < .05$, with R^2 at .23 and 95% confidence limits from .02 to .27. The adjusted R^2 of .13 indicates that 13% of the variability in accuracy of judging disgusted emotionally toned sentences is predicted by sex, social anxiety, condition (dum1 and dum2) and all possible two and three-way interactions among those predictors.

Table 1.8

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Accuracy of Judging Disgusted Emotionally Toned Sentences

Variables	*B*	*β*	sr^2 (unique)
Sex	.50	.26	.02
Text versus Audio (dum1)	1.06**	.55	.15
Text versus AV (dum2)	.82*	.42	.09
Audio versus AV (dum3)	.24	.13	.008
Anxiety (centered)	-.01	-.10	.002
Anxiety*Dum1	.000	.001	0
Anxiety*Dum2	.02	.09	.003
Sex*Dum1	-.45	-.15	.008
Sex*Dum2	-.14	-.05	.000
Anxiety*Sex	-.02	-.11	.003
Anxiety*Sex*Dum1	-.003	-.01	.000
Anxiety*Sex*Dum2	.02	.04	.000
Intercept	-.73		
		$R^2 = .23$[a]	
		Adjusted $R^2 = .13$	
		$R = .48$*	

** $p \leq .001$, * $p < .05$

[a]Unique variability = .23; shared variability = -0.006, 95% confidence limits from .02 to .27

Of the 11 predictors entered into the regression, only two, dum1 and dum2, accounted for sufficient unique variance to be considered statistically significant. Together these two variables accounted for almost 24% of the variance in the dependent

variable, accuracy of judging disgusted emotionally toned sentences. None of the other 9 predictors accounted for a sufficient amount of unique variance to be considered statistically significant.

The regression coefficients for dum1 and dum2 were 1.06 (95% confidence interval ranging from .54 to 1.6-) and .82 (95% confidence interval ranging from .29 to 1.35), respectively. The size and direction of the relation suggested that having more verbal and nonverbal cues available, as in the audio-only and audio-visual conditions, resulted in significantly higher accuracy of judging disgusted emotionally toned sentences compared to the text message condition. Between the two, the verbal cues alone in the audio-only condition were almost 70% more important than the verbal and nonverbal cues available in the audio-visual condition, as indicated by the squared semipartial correlations of .15 for dum1 and .09 for dum2. There was no significant difference found in Analysis 2 comparing the audio-only group to the audio-visual group when measuring accuracy of judging disgusted emotionally toned sentences.

Relating to *Hypothesis 1*, these results allowed us to once again reject the null and conclude that it appears participants in the text message condition did show more errors in accurately interpreting disgusted emotionally toned sentences compared to the audio-only and audio-visual conditions.

Surprised. Analysis 1 involved predicting accuracy of judging surprised emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition. Table 1.9 displays the inter-correlations, means, and standard deviations for continuous

variables (accuracy of judging surprised emotionally toned sentences [DV; normalized] and social anxiety). Table 1.10 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the accuracy of judging surprised emotionally toned sentences.

Table 1.9

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Accuracy of Judging Surprised Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Surprised Accuracy (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.15	*
Means	.08	.10
Standard Deviations	.05	7.58

For Analysis 1, the overall *R* value of .52 was significantly different from zero, $F(11,85) = 2.83$, $p < .05$, with R^2 at .27 and 95% confidence limits from .06 to .32. The adjusted R^2 of .17 indicates that almost one fifth of the variability in accuracy of judging surprised emotionally toned sentences is predicted by sex, social anxiety, condition (dum1 and dum2) and all possible two and three-way interactions among those predictors. Of the 11 predictors entered into the regression, only one, dum2 (text message versus audio-visual condition), accounted for sufficient unique variance to be considered statistically significant, $F(11, 85) = 3.31$, $p = .001$. This variable accounted for 9% of the variance in the dependent variable; accuracy of judging surprised emotionally toned sentences. Despite the remaining 18% of variance accounted for in the model, the other

10 predictors did not account for a sufficient amount of unique variance to be considered statistically significant.

Table 1.10

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Accuracy of Judging Surprised Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.02	.15	.007
Text versus Audio (dum1)	.001	.007	.000
Text versus AV (dum2)	.05**	.44	.09
Audio versus AV (dum3)	-.05**	-.44	.10
Anxiety (centered)	-.002	-.27	.01
Anxiety*Dum1	.000	-.04	.000
Anxiety*Dum2	.002	.15	.000
Sex*Dum1	.003	.02	.000
Sex*Dum2	.004	.02	.008
Anxiety*Sex	.000	-.009	.000
Anxiety*Sex*Dum1	.002	.11	.003
Anxiety*Sex*Dum2	-.001	-.03	.000
Intercept	.06		
		$R^2 = .27$[a] Adjusted $R^2 = .17$ $R = .52$	

** $p \leq .001$

[a]Unique variability = .09; shared variability = .18, 95% confidence limits from .06 to .32

The regression coefficient for dum2 (comparing text message to audio-visual condition) was .05, with 95% confidence limits from .02 to .08. The size and direction of

the relation suggested that having the added paralinguistic cues available in the audio-visual condition resulted in higher accuracy of judging surprised emotionally toned sentences compared to the text message condition. Analysis 2 also revealed that there was a significant main effect of dum3 (audio-only versus audio-visual condition), such that individuals in the audio-visual condition had significantly higher accuracy in judging angry emotionally toned sentences compared to individuals in the audio-only group. The regression coefficient for dum3 in the second regression analysis was -.05 (95% confidence interval ranging from -.08 to -.02).

Relating to *Hypothesis 1*, the null hypothesis was once again rejected. Participants in the text message condition had more errors in accurately interpreting surprised emotionally toned sentences compared to the audio-visual condition, but not compared to the audio-only condition. However, participants in the audio-only condition had significantly more errors than those in the audio-visual condition when interpreting disgusted emotionally toned sentences.

Scared. Analysis 1 involved predicting accuracy of judging scared emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition. Table 1.11 displays the inter-correlations, means, and standard deviations for continuous variables (accuracy of judging scared emotionally toned sentences [DV; normalized] and social anxiety). Table 1.12 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the accuracy of judging scared emotionally toned sentences.

Table 1.11

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Accuracy of Judging Scared Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Scared Accuracy (norm) (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.21	*
Means	-.006	.10
Standard Deviations	.91	7.58

For Analysis 1, the overall *R* value of .41 was significantly different from zero, $F(11,85) = 1.54$, $p = .13$, with R^2 at .17 and 95% confidence limits from 0 to .19. The adjusted R^2 of .06 indicates only 6% of the variability in accuracy of judging scared emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, only one, dum1, accounted for sufficient unique variance to be considered statistically significant, $F(11, 85) = 2.10$, $p < .05$. This variable accounted for 4% of the variance in the dependent variable; accuracy of judging scared emotionally toned sentences. The other 10 predictors together accounted for 13% of the variance in the dependent variable; however, no one variable accounted for a sufficient amount of unique variance to be considered statistically significant.

The regression coefficient for dum1, the contrast of text message and audio-only condition, was .57, with 95% confidence limits from .03 to 1.12. The size and direction of the relation suggested that having the added verbal and paralinguistic cues available in

the audio-only condition resulted in higher accuracy of judging scared emotionally toned sentences compared to the text message condition.

Table 1.12

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Accuracy of Judging Scared Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.50	.26	.02
Text versus Audio (dum1)	.57*	.30	.04
Text versus AV (dum2)	.51	.27	.03
Audio versus AV (dum3)	.06	.03	.000
Anxiety (centered)	-.03	-.27	.01
Anxiety*Dum1	-.02	-.08	.002
Anxiety*Dum2	.008	.04	.000
Sex*Dum1	-.38	-.13	.006
Sex*Dum2	-.13	-.04	.000
Anxiety*Sex	-.01	-.05	.000
Anxiety*Sex*Dum1	.02	.05	.000
Anxiety*Sex*Dum2	.08	.16	.01
Intercept	-.47		
		$R^2 = .17$[a]	
		Adjusted $R^2 = .06$	
		$R = .41$	

* $p < .05$, ** $p < .01$

[a]Unique variability = .04; shared variability = .13, 95% confidence limits from 0 to .19

There was no significant difference found in Analysis 2 comparing the audio-only group to the audio-visual group when measuring accuracy of judging scared emotionally toned sentences.

Relating to *Hypothesis 1*, the null hypothesis was rejected. Participants in the text message condition made more errors in accurately interpreting scared emotionally toned sentences compared to those in the audio-only condition, but not compared to the audio-visual condition.

Main Analyses 2 (Positive and Negative Interpretations)

In order to determine the degree to which participants interpreted each emotionally toned sentence as positive or negative, a series of multiple linear regressions was conducted to evaluate the effect of sex, social anxiety, text message versus audio – only condition (dum1), text message versus audio-visual condition (dum2), and all possible two- and three-way interactions among the variables on composite scores of Likert ratings of emotionally toned sentences. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition for each emotion. Ranges for non-normalized Likert ratings are expressed from zero (very negative) to 20 (very positive). For normalized Likert ratings, ranges are expressed from -1.80 to 2.16. A correlation matrix of the emotion recognition variables can be found in Table 2.1. A multiple linear regression was conducted for each emotion.

***Happy*.** Analysis 1 involved predicting Likert ratings of happy emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis.

Table 2.1

Pearson Correlation 2-tailed Variables in Analysis 2 (Positive and Negative Interpretations)

	1	2	3	4	5	6
1. Happy	1	-.11	-.26**	-.23*	-.10	-.25*
2. Sad		1	.38**	.52**	.58**	.36**
3. Disgusted			1	.43**	.31**	.38**
4. Angry				1	.38**	.57**
5. Scared					1	.31**
6. Surprised						1

**$p \leq 0.01$; * $p \leq 0.05$

Table 2.2 displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of happy emotionally toned sentences [DV; normalized] and social anxiety). Table 2.3 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the Likert ratings of happy emotionally toned sentences.

Table 2.2

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Happy Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Normalized Happy Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.08	*
Means	-.002	.005
Standard Deviations	.90	7.60

For Analysis 1, the overall *R* value of .35 was not significantly different from zero, F (11,86) = 1.12, p = .36, with R^2 at .13 and 95% confidence limits from 0 to .14. The adjusted R^2 of .01 indicates that only 1% of the variability in Likert ratings of happy emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, only one, the three-way interaction between social anxiety, sex, and dum2 (text message versus audio-visual condition), accounted for sufficient unique variance to be considered statistically significant, F (11,86) = 2.01, $p \leq .05$ (see *Figure* 2.1). This variable accounted for 4% of the variance in the dependent variable, Likert ratings of happy emotionally toned sentences. The other 10 predictors together accounted for 9% of the variance in the dependent variable; however, no one variable among these accounted for a sufficient amount of unique variance to be considered statistically significant.

The regression coefficient for the three-way interaction was .14, with 95% confidence limits from .001 to .27. In Figure 2.1, the upper panel demonstrates that for boys in the text message condition, ratings of how positively they perceived happy emotionally toned sentences increased only slightly with increasing levels of social anxiety. However, boys in the audio-visual condition perceived these happy sentences as equally positive regardless of their level of social anxiety. The lower panel shows that in the text message condition girls who were higher in social anxiety rated happy emotionally toned sentences much less positively than did girls who were lower in social anxiety. Conversely, girls in the audio-visual condition rated happy sentences much more positively when their social anxiety level was higher. Analysis 2 revealed no significant

differences when comparing the audio-only group to the audio-visual group's Likert ratings of happy emotionally toned sentences.

Table 2.3

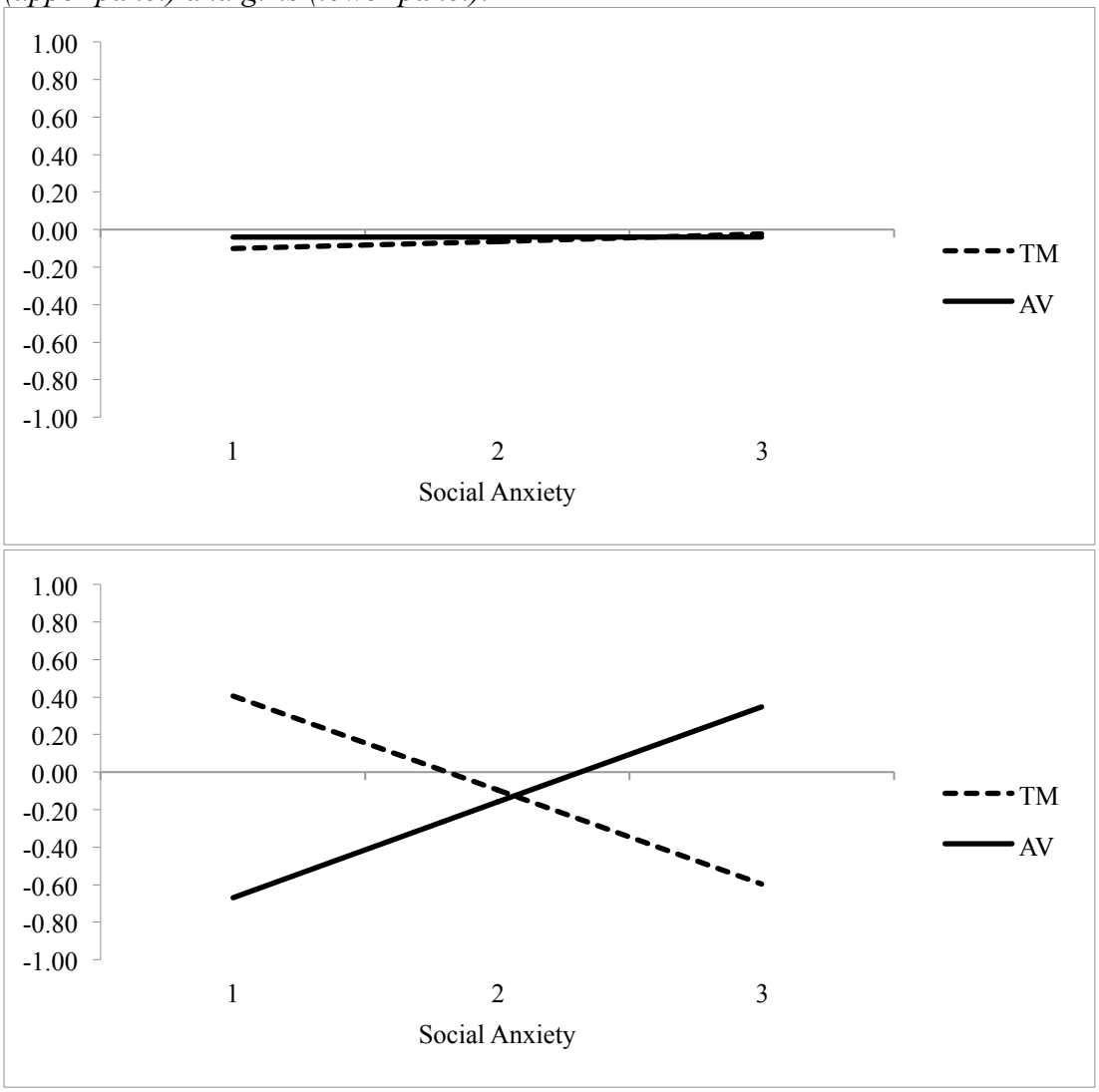
Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Happy Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	-.03	-.02	.000
Text versus Audio (dum1)	.38	.20	.02
Text versus AV (dum2)	.02	.01	.000
Audio versus AV (dum3)	.36	.19	.02
Anxiety (centered)	.005	.04	.000
Anxiety*Dum1	-.007	-.03	.000
Anxiety*Dum2	-.005	-.02	.000
Sex*Dum1	-.61	-.21	.02
Sex*Dum2	-.09	-.03	.000
Anxiety*Sex	-.07	-.35	.03
Anxiety*Sex*Dum1	.05	.15	.006
Anxiety*Sex*Dum2	.14*	.29	.04
Intercept	-.06		
		$R^2 = .13^a$ Adjusted $R^2 = .01$ $R = .35$	

* $p < .05$

[a]Unique variability = .04; shared variability = .09, 95% confidence limits from 0 to .14

Figure 2.1 *Interaction of social anxiety (X-axis) and text message (TM) versus audio-visual (AV) condition on Likert ratings of happy emotionally toned sentences for boys (upper panel) and girls (lower panel).*



Sad. Analysis 1 involved predicting Likert ratings of sad emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis. Table 2.4 displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of sad emotionally toned sentences [DV] and social anxiety). Table 2.5 displays the regression coefficients (*B*), beta values, and unique variance accounted for

(sr^2) for the predictor variables and their interactions when predicting the Likert ratings of sad emotionally toned sentences.

Table 2.4

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Sad Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Sad Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.03	*
Means	4.25	.005
Standard Deviations	2.11	7.60

For Analysis 1, the overall *R* value of .32 was not significantly different from zero, F (11,86) = .92, p = .53, with R^2 at .11 and 95% confidence limits from 0 to .11. The adjusted R^2 of -.01 indicates that none of the variability in Likert ratings of sad emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Moreover, none of the 11 predictor variables accounted for sufficient unique variance to be considered statistically significant. Analysis 2 revealed no significant differences when comparing the audio-only group to the audio-visual group's Likert ratings of sad emotionally toned sentences.

Angry. Analysis 1 involved predicting Likert ratings of angry emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis.

Table 2.5

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Sad Emotionally Toned Sentences

Variables	*B*	*β*	sr^2 (unique)
Sex	.85	.19	.01
Text versus Audio (dum1)	-.09	-.02	.000
Text versus AV (dum2)	1.15	.23	.03
Audio versus AV (dum3)	-1.24	-.28	.04
Anxiety (centered)	.02	.07	.000
Anxiety*Dum1	-.005	-.01	.000
Anxiety*Dum2	.01	.02	.000
Sex*Dum1	-1.43	-.21	.01
Sex*Dum2	-2.15	-.31	.04
Anxiety*Sex	-.03	-.07	.001
Anxiety*Sex*Dum1	-.03	-.04	.004
Anxiety*Sex*Dum2	-.06	-.05	.001
Intercept	4.03		
		$R^2 = .11$[a]	
		Adjusted $R^2 = -.01$	
		$R = .32$	

* $p < .05$, ** $p < .01$

[a]Unique variability = 0; shared variability = .11, 95% confidence limits from 0 to .11

Table 2.6 displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of angry emotionally toned sentences [DV; normalized] and social anxiety). Table 2.7 displays the regression coefficients (*B*), beta values, and unique

variance accounted for (sr^2) for the predictor variables and their interactions when predicting the Likert ratings of angry emotionally toned sentences.

Table 2.6

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Angry Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Normalized Angry Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	.04	*
Means	.03	.005
Standard Deviations	.97	7.60

For Analysis 1, the overall *R* value of .32 was not significantly different from zero, F (11,86) = 1.32, p = .23, with R^2 at .15 and 95% confidence limits from 0 to .16. The adjusted R^2 of .04 indicates that 4% of the variability in Likert ratings of angry emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. However, none of the 11 predictor variables accounted for sufficient unique variance to be considered statistically significant. Analysis 2 revealed no significant differences when comparing the audio-only group to the audio-visual group's Likert ratings of angry emotionally toned sentences.

Disgusted. Analysis 1 involved predicting Likert ratings of disgusted emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis. Table 2.8

displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of disgusted emotionally toned sentences [DV] and social anxiety).

Table 2.7

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Angry Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.27	.13	.005
Text versus Audio (dum1)	-.47	-.23	.03
Text versus AV (dum2)	.04	.02	.000
Audio versus AV (dum3)	-.50	.28	.03
Anxiety (centered)	.001	.005	.000
Anxiety*Dum1	-.02	-.08	.002
Anxiety*Dum2	.05	.22	.02
Sex*Dum1	-.47	-.15	.008
Sex*Dum2	-.45	-.14	.008
Anxiety*Sex	.006	.03	.000
Anxiety*Sex*Dum1	.02	.04	.000
Anxiety*Sex*Dum2	-.01	-.02	.000
Intercept	.18		
		$R^2 = .15^a$ Adjusted $R^2 = -.04$ $R = .38$	

* $p < .05$, ** $p < .01$

[a]Unique variability = 0; shared variability = .15, 95% confidence limits from 0 to .16

Table 2.9 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the Likert ratings of disgusted emotionally toned sentences.

Table 2.8

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Disgusted Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Disgust Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	.04	*
Means	.03	.005
Standard Deviations	.97	7.60

For Analysis 1, the overall *R* value of .30 was not significantly different from zero, $F\ (11,86) = .77$, $p = .67$, with R^2 at .09 and 95% confidence limits from 0 to .08. The adjusted R^2 of -.03 indicates that none of the variability in Likert ratings of disgusted emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Moreover, none of the 11 predictor variables accounted for sufficient unique variance to be considered statistically significant. Analysis 2 revealed no significant differences when comparing the audio-only group to the audio-visual group's Likert ratings of disgusted emotionally toned sentences.

Surprised. Analysis 1 involved predicting Likert ratings of surprised emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text

versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis.

Table 2.9

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Disgusted Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	-.66	-.13	.006
Text versus Audio (dum1)	-.03	-.005	.000
Text versus AV (dum2)	-1.01	-.20	.02
Audio versus AV (dum3)	.98	.20	.02
Anxiety (centered)	.01	.03	.000
Anxiety*Dum1	-.08	-.14	.006
Anxiety*Dum2	.11	.19	.01
Sex*Dum1	-.09	-.01	.000
Sex*Dum2	.94	.12	.006
Anxiety*Sex	.06	.12	.003
Anxiety*Sex*Dum1	-.05	-.06	.001
Anxiety*Sex*Dum2	-.16	-.13	.008
Intercept	6.99		
		R^2 = .09[a]	
		Adjusted R^2 = -.03	
		R = .30	

* $p < .05$, ** $p < .01$

[a]Unique variability = 0; shared variability = .09, 95% confidence limits from 0 to .08

Table 2.10 displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of surprised emotionally toned sentences [DV] and

social anxiety). Table 2.11 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the Likert ratings of surprised emotionally toned sentences.

Table 2.10

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Surprised Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Surprised Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.09	*
Means	4.71	.005
Standard Deviations	1.99	7.60

For Analysis 1, the overall *R* value of .59 was significantly different from zero, $F(11,86) = 4.19$, $p < .001$, with R^2 at .35 and 95% confidence limits from .13 to .41. The adjusted R^2 of .27 indicates that over one quarter of the variability in Likert ratings of surprised emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, four accounted for sufficient unique variance to be considered statistically significant.

A significant three-way interaction was observed between social anxiety, sex and text versus audio-visual condition (dum2), $F(11,86) = -2.82$, $p < .01$. This variable accounted for 6% of the variance in the dependent variable, Likert ratings of surprised emotionally toned sentences. The regression coefficient for the three-way interaction was -.37 with 95% confidence limits from -.63 to -.11.

Table 2.11

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Surprised Emotionally Toned Sentences

Variables	*B*	*β*	sr^2 (unique)
Sex	1.96**	.46	.07
Text versus Audio (dum1)	-.50	-.12	.007
Text versus AV (dum2)	1.02	.24	.03
Audio versus AV (dum3)	-1.53*	-.37	.07
Anxiety (centered)	-.10*	-.39	.03
Anxiety*Dum1	.002	.005	.000
Anxiety*Dum2	.23**	.49	.08
Sex*Dum1	-.43	-.07	.002
Sex*Dum2	-.84	-.13	.006
Anxiety*Sex	.11	.25	.01
Anxiety*Sex*Dum1	-.05	-.08	.002
Anxiety*Sex*Dum2	-.37**	-.35	.06
Intercept	4.05		
		$R^2 = .35$[a]	
		Adjusted $R^2 = -.27$	
		$R = .59$**	

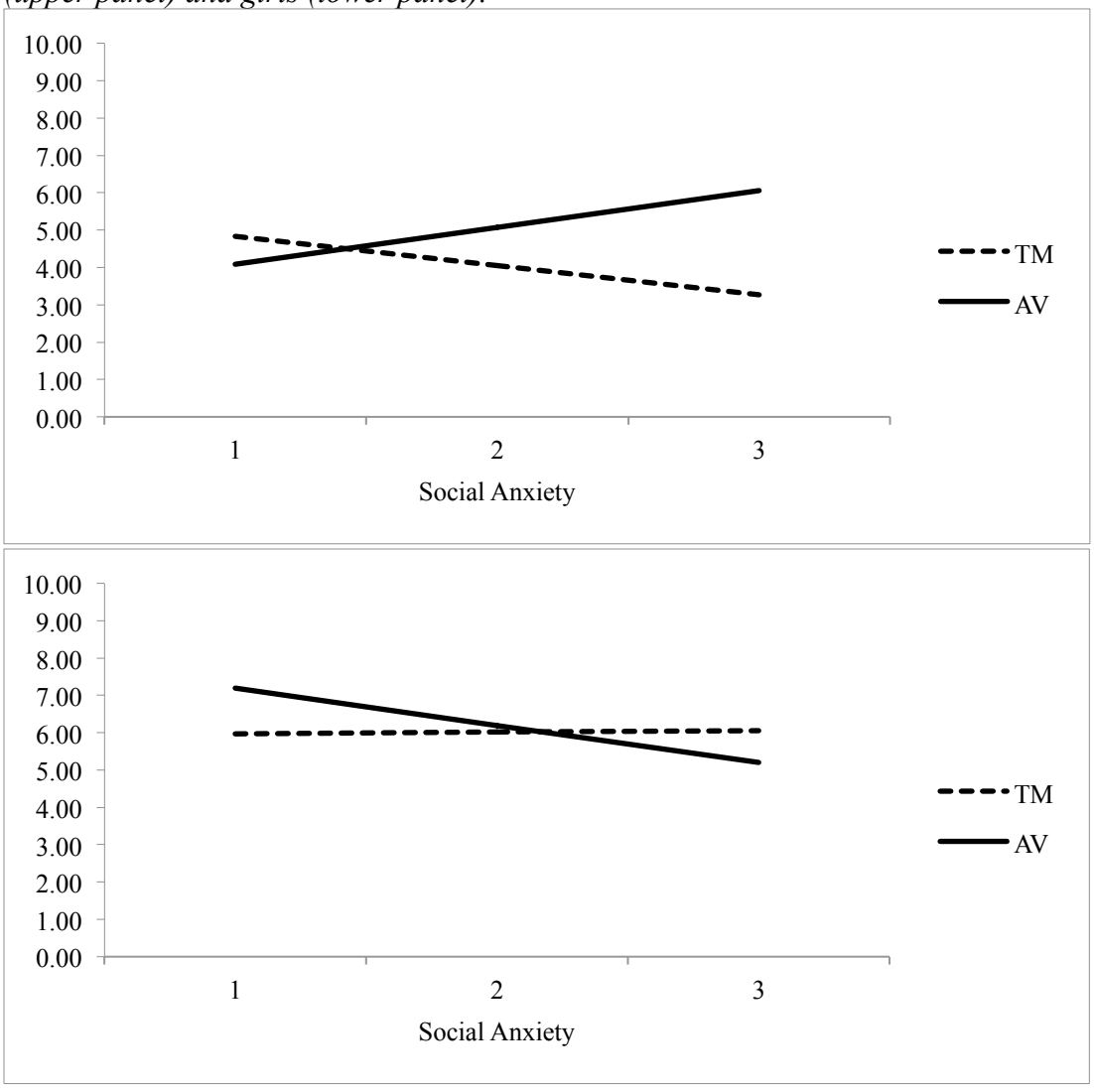
* $p < .05$, ** $p < .001$

[a]Unique variability = .24; shared variability = .11, 95% confidence limits from .13 to .41

Graphs that illustrate this relation are pictured in Figure 2.2. These graphs demonstrate that for boys in the text message condition, higher levels of social anxiety were associated with less positive ratings of surprised emotionally toned sentences. For boys in the audio-visual condition, surprised emotionally toned sentences were rated

more positively as social anxiety levels increased. For girls in the text message condition, surprised emotionally toned sentences were rated as equally positive regardless of social anxiety. In the audio-visual condition, findings with girls showed an effect that was opposite to those observed with boys in the same condition. As social anxiety levels increased, ratings of surprised emotionally toned sentences made by girls were more negative.

Figure 2.2 *Interaction of social anxiety (X-axis) and text message (TM) versus audio-visual (AV) condition on Likert ratings of surprised emotionally toned sentences for boys (upper panel) and girls (lower panel).*



There was also a significant two-way interaction between social anxiety and dum2, t (11,86) = 3.33, $p \leq .001$. This variable accounted for an additional 8% of the unique variance in the dependent variable. The regression coefficient for the significant two-way interaction was .23 with 95% confidence limits from .09 to .37. Since this interaction is embedded in the three-way interaction described above, it is not illustrated or elaborated on here. Finally, the two remaining regression coefficients that differed significantly from zero were social anxiety, F (11,86) = -1.98, $p \leq .05$ and sex, F (11, 86) = 3.01, $p < .01$. Together, these coefficients contributed to an additional 10% of the unique variability in the dependent variable. The regression coefficients for these variables were -.10 and 1.96, respectively, with 95% confidence limits for social anxiety from -.21 to .001, and those for sex from .67 to 3.26. These main effects are also embedded in the aforementioned three-way interaction and will not be elaborated on further.

Analysis 2 revealed a significant main effect of dum3 (audio-only versus audio-visual condition), such that individuals in the audio-visual condition rated surprised emotionally toned sentences as significantly more positive than individuals in the audio-only group. The regression coefficient for dum3 in the second regression analysis was -1.53 (95% confidence interval ranging from -2.55 to -.51).

Related to *Hypothesis 4*, boys who were higher in social anxiety did in fact rate surprised emotionally toned sentences as more negative than did boys who were less socially anxious in the text message condition. In addition, girls who were higher in social anxiety rated surprised emotionally toned sentences as more negative than did girls who were lower in social anxiety in the audio-visual condition.

Scared. Analysis 1 involved predicting Likert ratings of scared emotionally toned sentences from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Analysis 2 substituted dum3 and dum4 as the dummy coded variables for condition using the same analysis. Table 2.12 displays the inter-correlations, means, and standard deviations for continuous variables (Likert ratings of scared emotionally toned sentences [DV] and social anxiety). Table 2.13 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the Likert ratings of scared emotionally toned sentences.

Table 2.12

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Likert Ratings of Scared Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Scared Interpretations (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.07	*
Means	4.66	.005
Standard Deviations	2.01	7.60

For Analysis 1, the overall *R* value of .40 was not significantly different from zero, $F\,(11,86) = 1.51$, $p = .14$, with R^2 at .16 and 95% confidence limits from 0 to .19. The adjusted R^2 of .06 indicates that 6% of the variability in Likert ratings of scared emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. However, none of the 11 predictor variables accounted for sufficient unique variance to be

considered statistically significant. Alternatively, Analysis 2 revealed that there was a significant main effect of dum3 (audio-only versus audio-visual condition), such that individuals in the audio-visual condition rated scared emotionally toned sentences as

Table 2.13

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Likert Ratings of Scared Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	-.63	-.15	.007
Text versus Audio (dum1)	-.18	-.04	.000
Text versus AV (dum2)	1.17	.28	.04
Audio versus AV (dum3)	-1.35*	-.32	.05
Anxiety (centered)	-.03	-.13	.003
Anxiety*Dum1	.08	.18	.009
Anxiety*Dum2	.04	.08	.002
Sex*Dum1	-.10	-.02	.000
Sex*Dum2	-1.47	-.22	.02
Anxiety*Sex	-.07	-.15	.005
Anxiety*Sex*Dum1	.03	.05	.000
Anxiety*Sex*Dum2	-.01	-.01	.000
Intercept	4.65		
		$R^2 = .16$[a]	
		Adjusted $R^2 = .06$	
		$R = .40$	

* $p \leq .05$, ** $p < .01$

[a]Unique variability = 0; shared variability = .16, 95% confidence limits from 0 to .19

significantly more positive than individuals in the audio-only group. The regression coefficient for dum3 in the second regression analysis was -1.35 (95% confidence interval ranging from -2.51 to -.19)

Main Analyses 3 (Reaction Time)

In order to determine the degree to which reaction times of participants making judgments of emotionally toned sentences differed across emotions, a series of multiple linear regressions was conducted to evaluate the effect of sex, social anxiety, text message versus audio–only condition (dum1), text message versus audio-visual condition (dum2), and all possible two and three-way interactions among the variables on reaction times of judging emotionally toned sentences. Reaction times that are not normalized (sad, surprised, scared) are expressed in milliseconds in the analyses described below, and range from 795 to 12721. For normalized reaction times (happy, angry, disgusted), ranges are expressed from -2.32 to 3.09. Main effects of dummy codes for condition were not reported due to the nature of requiring the text message condition to read rather than listen to the stimuli being presented. For this reason, the second analysis using an additional set of dummy coded variables comparing the audio-only to the audio-visual condition was not analyzed. All other significant main effects and all interactions are reported below. In addition, ANOVA results are presented in order to understand the relationship between reaction times across each of the three conditions. In cases where there are significant differences across conditions, these results are presented in tables. A correlation matrix of reaction time variables can be found in Table 3.1.

Table 3.1

Pearson Correlation 2-tailed Variables in Analysis 3 (Reaction Times)

	1	2	3	4	5	6
1. Happy	1	.53**	.61**	.58**	.53**	.49**
2. Angry		1	.63**	.63**	.59**	.70**
3. Sad			1	.71**	.68**	.71**
4. Scared				1	.55**	.65**
5. Surprised					1	.64**
6. Disgusted						1

**$p \leq 0.01$.

Happy. ANOVA results did not indicate any significant difference in participants' reaction times to judging happy emotionally toned sentences across conditions, F (2,95) = 2.34, p = .10. Table 3.2 displays the means and standard deviations of reaction times for judging happy emotionally toned sentences across conditions. A standard multiple regression was performed with reaction times of judging happy emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Table 3.3 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging happy emotionally toned sentences [DV; normalized] and social anxiety). Table 3.4 displays the regression coefficients (B), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the reaction times of judging happy emotionally toned sentences.

Table 3.2

Means and Standard Deviations of Reaction Times for Judging Happy Emotionally Toned Sentences Across Conditions

Condition	Mean	Standard Deviation
Audio-visual	-.15	.78
Audio-only	-.08	1.09
Text Message	.32	1.08

Table 3.3

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Happy Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	Normalized Reaction Time for Happy Sentences (DV)	Social Anxiety (centered)
Social Anxiety (centered)	.11	*
Means	.03	.005
Standard Deviations	1.01	7.60

The overall R value of .35 was not significantly different from zero, F (11,86) = 1.12, p = .36, with R^2 at .13 and 95% confidence limits from 0 to .14. The adjusted R^2 of .01 indicates that only 1% of the variability in reaction times of judging happy emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible tow and three-way interactions among those predictors. Moreover, of the 11 predictors, no one variable accounted for sufficient unique variance to be considered statistically significant.

Table 3.4

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Happy Emotionally Toned Sentences

Variables	*B*	*β*	sr^2 (unique)
Sex	.46	.21	.01
Text versus Audio (dum1)	-.39	-.18	.02
Text versus AV (dum2)	-.48	-.23	.02
Anxiety (centered)	.02	.14	.004
Anxiety*Dum1	.02	.08	.002
Anxiety*Dum2	-.04	-.16	.008
Sex*Dum1	-.47	-.14	.007
Sex*Dum2	-.12	-.04	.000
Anxiety*Sex	.006	.03	.000
Anxiety*Sex*Dum1	.01	.03	.000
Anxiety*Sex*Dum2	.06	.11	.006
Intercept	.22		
		$R^2 = .13^a$ Adjusted $R^2 = .01$ $R = .35$	

* $p \leq .05$, ** $p < .01$

[a]Unique variability = 0; shared variability = .13, 95% confidence limits from 0 to .14

Sad. ANOVA results indicated significant differences in participants' reaction times to judging sad emotionally toned sentences across conditions, F (2,95) = 6.16, $p <$ .01. Results highlighting these differences can be found in Table 3.5. Table 3.6 displays the means and standard deviations of reaction times for judging sad emotionally toned sentences for each condition. A standard multiple regression was performed with reaction

times of judging sad emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Table 3.7 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging sad emotionally toned sentences [DV] and social anxiety). Table 3.8 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the reaction times of judging sad emotionally toned sentences.

The overall *R* value of .40 was not significantly different from zero, F (11,86) = 1.50, p = .15, with R^2 at .16 and 95% confidence limits from 0 to .19. The adjusted R^2 of .05 indicates that 5% of the variability in reaction times of judging sad emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Apart from the dummy coded variables (relating to condition), none of the predictor variables accounted for sufficient unique variance to be considered statistically significant.

Table 3.5

Mean Differences in Reaction Time of Sad Emotionally Toned Sentences Across Conditions

Condition	**Condition**	**Mean Difference**	**Standard Error**	**Significance**
Audiovisual	Audio	-368	500	.463
	Text Message	-1663*	500	.001
Audio	Audiovisual	368	500	.463
	Text Message	-1295*	496	.010
Text Message	Audiovisual	1663*	500	.001
	Audio	1295*	496	.010

* $p < .05$

Table 3.6

Means and Standard Deviations of Reaction Times for Judging Sad Emotionally Toned Sentences Across Conditions

Condition	Mean	Standard Deviation
Audio-visual	3955	1786
Audio-only	4323	2111
Text Message	5618	2118

Table 3.7

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Sad Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	Reaction Time for Sad Sentences (DV)	Social Anxiety (centered)
Social Anxiety (centered)	-.04	*
Means	4639	.005
Standard Deviations	2118	7.60

Angry. ANOVA results indicated significant differences in participants' reaction times to judging angry emotionally toned sentences across conditions, F (2,95) = 7.26, p = .001. Results highlighting these differences can be found in Table 3.9. Table 3.10 displays the means and standard deviations of reaction times for judging angry emotionally toned sentences for each condition. A standard multiple regression was performed with reaction times of judging angry emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions.

Table 3.8

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Sad Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	397	.09	.003
Text versus Audio (Dum1)	-1246	-.28	.04
Text versus AV (Dum2)	-1933	-.43	.09
Anxiety (centered)	12	.04	.000
Anxiety*Dum1	15	.03	.000
Anxiety*Dum2	-54	-.11	.004
Sex*Dum1	-414	-.06	.001
Sex*Dum2	807	.12	.005
Anxiety*Sex	-24	-.05	.000
Anxiety*Sex*Dum1	46	.06	.001
Anxiety*Sex*Dum2	149	.13	.009
Intercept	5496		
		$R^2 = .16$[a]	
		Adjusted $R^2 = .05$	
		$R = .40$	

* $p \leq .05$, ** $p < .01$

[a]Unique variability = .13; shared variability = .03, 95% confidence limits from 0 to .19

Table 3.11 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging angry emotionally toned sentences [DV; normalized] and social anxiety). Table 3.12 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the reaction times of judging angry emotionally toned sentences.

Table 3.9

Mean Differences in Reaction Time of Angry Emotionally Toned Sentences Across Conditions

Condition	Condition	Mean Difference	Standard Error	Significance
Audiovisual	Audio	750	513	.147
	Text Message	-1176*	513	.024
Audio	Audiovisual	-750	513	.147
	Text Message	-1926*	509	.000
Text Message	Audiovisual	1176*	513	.024
	Audio	1926*	509	.000

* $p < .05$

Table 3.10

Means and Standard Deviations of Reaction Times for Judging Angry Emotionally Toned Sentences Across Conditions

Condition	Mean	Standard Deviation
Audio-visual	-.02	.91
Audio-only	-.37	.86
Text Message	.49	1.08

Table 3.11

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Angry Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	Normalized Reaction Time for Angry Sentences (DV)	Social Anxiety (centered)
Social Anxiety (centered)	.03	*
Means	.03	.005
Standard Deviations	1.01	7.60

The overall R value of .50 was significantly different from zero, F (11,86) = 2.65, $p <$ .01, with R^2 at .25 and 95% confidence limits from .05 to .30.

Table 3.12

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Angry Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.63	0.29	.03
Text versus Audio (Dum1)	-.87*	-.41	.08
Text versus AV (Dum2)	-.59*	-.27	.04
Anxiety (centered)	.03	.21	.008
Anxiety*Dum1	-.02	-.06	.001
Anxiety*Dum2	-.02	-.08	.002
Sex*Dum1	-.26	-.08	.002
Sex*Dum2	.12	.04	.000
Anxiety*Sex	.008	.04	.000
Anxiety*Sex*Dum1	.005	.01	.000
Anxiety*Sex*Dum2	-.10	-.19	.02
Intercept	.35		
		R^2 = .25[a]	
		Adjusted R^2 = .16	
		R = .50	

* $p \leq .05$, ** $p < .01$

[a]Unique variability = .12; shared variability = .13, 95% confidence limits from .05 to .30

The adjusted R^2 of .16 indicates that almost one fifth of the variability in reaction times of judging angry emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those

predictors. Of the 11 predictors, only the two dummy coded variables relating to condition accounted for sufficient unique variance to be considered statistically significant and therefore are not reported here.

Disgust. ANOVA results indicated significant differences in participants' reaction times to judging disgusted emotionally toned sentences across conditions, F (2,95) = 14.02, $p < .001$. Results highlighting these differences can be found in Table 3.13. Table 3.14 displays the means and standard deviations of reaction times for judging disgusted emotionally toned sentences for each condition. A standard multiple regression was performed with reaction times of judging disgusted emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions.

Table 3.13

Mean Differences in Reaction Time of Disgusted Emotionally Toned Sentences Across Conditions

Condition	**Condition**	**Mean Difference**	**Standard Error**	**Significance**
Audiovisual	Audio	-100	671	.882
	Text Message	-3112*	671	.000
Audio	Audiovisual	100	671	.882
	Text Message	-3012*	666	.000
Text Message	Audiovisual	3112*	671	.000
	Audio	3012*	666	.000

* $p < .05$

Table 3.15 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging disgusted emotionally toned sentences [DV; normalized] and social anxiety). Table 3.16 displays the regression coefficients (B), beta values, and unique variance accounted for (sr^2) for the predictor variables and their

interactions when predicting the reaction times of judging disgusted emotionally toned sentences.

Table 3.14

Means and Standard Deviations of Reaction Times for Judging Disgusted Emotionally Toned Sentences Across Conditions

Condition	Mean	Standard Deviation
Audio-visual	-.32	.94
Audio-only	-.27	.82
Text Message	.68	.95

Table 3.15

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Disgusted Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	Normalized Reaction Time for Disgusted Sentences (DV)	Social Anxiety (centered)
Social Anxiety (centered)	.04	*
Means	.03	.005
Standard Deviations	1.01	7.60

The overall R value of .53 was significantly different from zero, F (11,86) = 3.11, $p < .01$, with R^2 at .29 and 95% confidence limits from .07 to .34. The adjusted R^2 of .19 indicates that nearly one fifth of the variability in reaction times of judging disgusted emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, only the two dummy coded variables relating to condition accounted for

sufficient unique variance to be considered statistically significant and therefore are not reported here.

Table 3.16

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Disgusted Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	.41	.19	.01
Text versus Audio (Dum1)	-1.02**	-.48	.11
Text versus AV (Dum2)	-1.02**	-.48	.11
Anxiety (centered)	.01	.10	.002
Anxiety*Dum1	.02	.07	.001
Anxiety*Dum2	-.03	-.12	.005
Sex*Dum1	-.06	-.02	.000
Sex*Dum2	-.15	-.044	.000
Anxiety*Sex	.04	.18	.007
Anxiety*Sex*Dum1	-.06	-.16	.007
Anxiety*Sex*Dum2	.02	.04	.000
Intercept	.60		
		$R^2 = .29$[a]	
		Adjusted $R^2 = .19$	
		$R = .53$	

* $p \leq .05$, ** $p < .001$

[a]Unique variability = .22; shared variability = .07, 95% confidence limits from .07 to .34

Surprised. ANOVA results indicated significant differences in participants' reaction times to judging surprised emotionally toned sentences across conditions, $F(2,95) = 9.90$, $p < .001$. Results highlighting these differences can be found in Table 3.17.

Table 3.18 displays the means and standard deviations of reaction times for judging surprised emotionally toned sentences for each condition.

Table 3.17

Mean Differences in Reaction Time of Surprised Emotionally Toned Sentences Across Conditions

Condition	**Condition**	**Mean Difference**	**Standard Error**	**Significance**
Audiovisual	Audio	839	667	.212
	Text Message	-2027*	667	.003
Audio	Audiovisual	-839	667	.212
	Text Message	-2866*	662	.000
Text Message	Audiovisual	2027*	667	.003
	Audio	2866*	662	.000

* $p < .05$

Table 3.18

Means and Standard Deviations of Reaction Times for Judging Surprised Emotionally Toned Sentences Across Conditions

Condition	**Mean**	**Standard Deviation**
Audio-visual	6079	2681
Audio-only	5240	2480
Text Message	8106	2891

A standard multiple regression was performed with reaction times of judging surprised emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions. Table 3.19 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging surprised emotionally toned sentences [DV] and social anxiety).

Table 3.19

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Surprised Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	**Reaction Time for Surprised Sentences (DV)**	**Social Anxiety (centered)**
Social Anxiety (centered)	-.04	*
Means	6479	.005
Standard Deviations	2925	7.60

Table 3.20 displays the regression coefficients (*B*), beta values, and unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the reaction times of judging surprised emotionally toned sentences.The overall *R* value of .50 was significantly different from zero, $F\ (11,86) = 2.65$, $p < .01$, with R^2 at .25 and 95% confidence limits from .05 to .30. The adjusted R^2 of .16 indicates that nearly one fifth of the variability in reaction times of judging surprised emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, only one aside from the two dummy coded variables relating to condition accounted for sufficient unique variance to be considered statistically significant. The interaction term between social anxiety and dum2 was statistically significant, $F\ (11, 86) = -2.11$, $p < .05$. The regression coefficient for the significant reaction term was -232, with 95% confidence limits from -451 to -13 (*see Figure* 3.1).

Table 3.20

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Surprised Emotionally Toned Sentences

Variables	*B*	*β*	sr^2 (unique)
Sex	243	.04	.000
Text versus Audio (Dum1)	-3114**	-.51	.12
Text versus AV (Dum2)	-2577**	-.42	.08
Anxiety (centered)	103	.27	.01
Anxiety*Dum1	-2.87	-.004	.000
Anxiety*Dum2	-232*	-.33	.04
Sex*Dum1	-334	-.04	.000
Sex*Dum2	1231	.13	.006
Anxiety*Sex	-48	-.07	.001
Anxiety*Sex*Dum1	15	.02	.000
Anxiety*Sex*Dum2	97	.06	.002
Intercept	8226		
		$R^2 = .25$[a]	
		Adjusted $R^2 = .16$	
		$R = .50$	

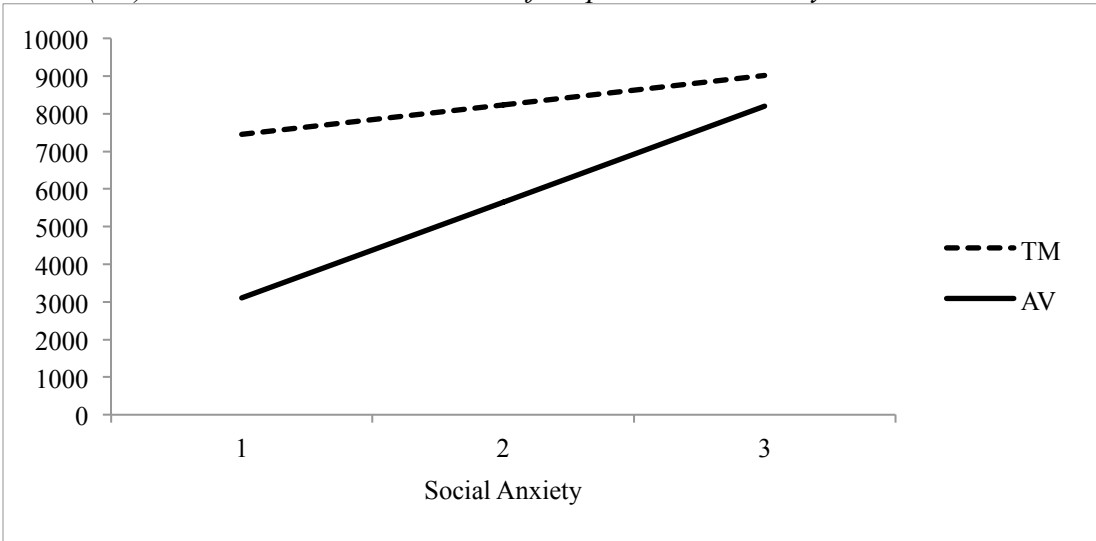
**$p < .01$; *$p < .05$

[a]Unique variability = .24; shared variability = .01, 95% confidence limits from .05 to .30

Figure 3.1 shows that for participants in the text message condition, reaction times to surprised emotionally toned sentences increased as social anxiety levels increased. For participants in the audio-visual condition, on the other hand, their reaction times to surprised emotionally toned sentences were faster as social anxiety levels increased. Of

the remaining 8 predictor variables, no single variable accounted for sufficient unique variance to be considered statistically significant.

Figure 3.1 *Interaction of social anxiety (X-axis) and text message (TM) versus audio-visual (AV) condition on reaction times of surprised emotionally toned sentences.*



Scared. ANOVA results indicated significant differences in participants' reaction times to judging scared emotionally toned sentences across conditions, F (2,95) = 11.92, $p < .001$. Results highlighting these differences can be found in Table 3.21.

Table 3.21

Mean Differences in Reaction Time of Scared Emotionally Toned Sentences Across Conditions

Condition	**Condition**	**Mean Difference**	**Standard Error**	**Significance**
Audiovisual	Audio	738	585	.211
	Text Message	-2003*	585	.001
Audio	Audiovisual	-738	585	.211
	Text Message	-2741*	581	.000
Text Message	Audiovisual	2003*	585	.001
	Audio	2741*	581	.000

* $p < .05$

Table 3.22

Means and Standard Deviations of Reaction Times for Judging Scared Emotionally Toned Sentences Across Conditions

Condition	Mean	Standard Deviation
Audio-visual	5102	2456
Audio-only	4365	2184
Text Message	7105	2430

Table 3.22 displays the means and standard deviations of reaction times for judging scared emotionally toned sentences for each condition. A standard multiple regression was performed with reaction times of judging scared emotionally toned sentences predicted from sex, social anxiety, text versus audio-only condition (dum1), text versus audio-visual condition (dum2), and their interactions.

Table 3.23

Inter-correlations among the Variable Social Anxiety, and the Dependent Measure, Reaction Times of Judging Scared Emotionally Toned Sentences, Along With Their Means and Standard Deviations

Variables	Reaction Time for Scared Sentences (DV)	Social Anxiety (centered)
Social Anxiety (centered)	.03	*
Means	5528	.005
Standard Deviations	2611	7.60

Table 3.23 displays the inter-correlations, means, and standard deviations for continuous variables (reaction times of judging scared emotionally toned sentences [DV] and social anxiety). Table 3.24 displays the regression coefficients (*B*), beta values, and

unique variance accounted for (sr^2) for the predictor variables and their interactions when predicting the reaction times of judging scared emotionally toned sentences.

Table 3.24

Regression Coefficients (B), Beta values, and Unique Variance Accounted for (sr^2) for the Predictor Variables and Their Interactions When Predicting Reaction Times of Judging Surprised Emotionally Toned Sentences

Variables	***B***	***β***	***sr*^{2} (unique)**
Sex	1420	.25	.02
Text versus Audio (Dum1)	-2631**	-.48	.11
Text versus AV (Dum2)	-1940*	-.35	.06
Anxiety (centered)	84	.25	.01
Anxiety*Dum1	-83	-.14	.006
Anxiety*Dum2	-47	-.07	.002
Sex*Dum1	-964	-.11	.004
Sex*Dum2	-644	-.08	.002
Anxiety*Sex	-66	-.11	.003
Anxiety*Sex*Dum1	131	.14	.006
Anxiety*Sex*Dum2	104	.08	.003
Intercept	6779		
		$R^2 = .26$[a]	
		Adjusted $R^2 = .17$	
		$R = .51$	

**$p \leq .001$; *$p \leq .01$

[a]Unique variability = .17; shared variability = .09, 95% confidence limits from .05 to .31

The overall R value of .51 was significantly different from zero, F (11,86) = 2.79, $p < .01$, with R^2 at .26 and 95% confidence limits from .05 to .31. The adjusted R^2 of .17 indicates that nearly one fifth of the variability in reaction times of judging scared

emotionally toned sentences was predicted by sex, social anxiety, condition (dum1 and dum2), and all possible two and three-way interactions among those predictors. Of the 11 predictors, only the two dummy coded variables relating to condition accounted for sufficient unique variance to be considered statistically significant and therefore are not reported here.

Discussion

Summary of Primary Results, Strengths, and Global Implications

The present study examined whether social anxiety in children is associated with poorer emotion recognition accuracy when nonverbal cues are less available across communication media. Social presence theory (Short et al., 1976), which dictates that different modes of communication require different levels of interpersonal contact, such as being face-to-face, speaking over the phone, or texting through cell phones, led us to predict that as nonverbal cues became less available to children in each of the three experimental conditions (audio-visual, audio-only, text message), misinterpretation would become more prevalent (*Hypothesis 1)*. These effects were predicted to be even more pronounced for children higher in social anxiety (*Hypothesis 2)*. Cognitive theories of social anxiety postulate that socially anxious children tend to interpret ambiguous or non-hostile social cues from others as hostile or negative in nature (Bell-Dolan, 1995; Miers et al., 2008; Kingsbury & Coplan, 2015). This interpretation bias tends to be more pronounced for girls and women given their tendency to experience higher levels of social anxiety (Bell-Dolan, 1995). In view of this evidence, we predicted that girls who are more socially anxious would show more errors in accurately interpreting emotions in the audio-only and audio-visual conditions compared to socially anxious boys. However, because females tend to use computer-mediated communication more than do males, we predicted that girls in the text message condition would be more accurate at interpreting emotions in this condition compared to boys *(Hypothesis 3).* Moreover, children higher in social anxiety were expected to be more likely to show a negative attribution bias and, as

a result, rate sentences as more negative overall than would children who were lower in social anxiety (*Hypothesis 4)*.

Relating to *Hypothesis 1*, nonverbal and paralinguistic cues played a significant role in children's abilities to accurately interpret most of the universal emotions, including sadness, anger, disgust, surprise, and fear. However, these added cues did not play a significant role in children's ability to accurately interpret the emotion happiness, since it was a very well recognized emotion both in the presence and absence of nonverbal and paralinguistic cues. This finding has some empirical support in the literature, as referenced in the meta-analysis by Elfenbein and Ambady (2002), which found that happiness was the most accurately recognized emotion across cultures. In most emotion recognition studies, non-clinical participants tended to be able to identify happiness with the highest level of accuracy compared to all other emotions (e.g., Du & Martinez, 2011; Mohn et al., 2010; Smith & Schyns, 2009). This was also the case in the present study and led to a unique analysis to accommodate the level of accuracy children displayed in the recognition of happiness. Happiness is a highly polarized emotion, meaning that its presentation is nonambiguous, easily distinguished and carries a purely positive connotation compared to other emotions (e.g., Amminger et al., 2012; Barrera & Maurer, 1981; In-Albon, Ruf, & Schmid, 2015; Chronaki et al., 2015; Shiroma, Thuras, Johns, & Lim, 2014). Although some sentences that were used as stimuli contain features of happiness (e.g., a pleasant or happy *surprise*), "happy" is non-neutral and therefore more "pure" in its presentation compared to many other emotions (e.g., Barkl et al., 2014; Chronaki et al., 2015; Lydon & Nixon, 2014).

When interpreting sadness, children displayed an obvious decrease in accuracy as nonverbal and paralinguistic cues became less available. Children in the audio-visual condition were shown to have the highest accuracy in correctly interpreting sad emotionally toned sentences, followed by children in the audio-only condition. Those in the text message condition displayed the lowest accuracy in identification of sadness through computer-mediated communication. Sadness has highly identifiable verbal and nonverbal cues associated with its presentation (e.g., a frown, quieter voice that may tremble or quiver) (Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007; Paulmann & Uskul, 2014), which could not be conveyed in the text message condition. Perhaps this lack of distinct cues led to more confusion regarding the emotional intention of a sad message.

Children benefited greatly from the added nonverbal and paralinguistic cues when making judgments about the universal emotion, anger. Children in the audio-visual condition had the highest accuracy in correctly identifying anger, followed by those in the audio-only condition, while children in the text message group made the most errors in recognizing anger. Moreover, boys benefited even more than girls from the added nonverbal and paralinguistic cues available to them in the audio-visual condition when decoding an angry message. The aforementioned findings support previous research, which posits that anger is more easily identified verbally (as in the audio-only and audio-visual condition) than nonverbally (as in the text message condition) (Elfenbein & Ambady, 2002).

When making judgments about disgusted emotionally toned sentences, children took advantage of the added cues available in the audio-only and audio-visual conditions

to make more accurate identifications than did children who made judgments in the absence of these cues. However, the added nonverbal cues available in the audio-visual condition were no more helpful than the verbal and paralinguistic cues available in the audio-only condition. Perhaps the unique verbal characteristics (e.g., altered pitch and tone) are sufficient for accurate identification of disgust, without the need for the easily distinguishable disgusted nonverbal facial cues. It may also be that the "disgusted" stimuli selected for inclusion in the present study were more easily identifiable through verbal and nonverbal/paralinguistic cues (high level of detection through audio-visual means was a requirement for stimulus inclusion) compared to the average "disgusted" sentence, which may rely more heavily on nonverbal facial cues for accurate interpretation.

For surprised emotionally toned sentences, we observed that the nonverbal visual cues available in the audio-visual condition in particular were crucial for accurate interpretation. Those in the audio-visual group had significantly fewer errors compared to those in both the audio-only and text message group. However, the text message and audio-only groups had about the same levels of accuracy, indicating that the added verbal and paralinguistic cues present in the audio-only condition did not add any significant value beyond simply reading the same statement through text-based media when making interpretations of surprised emotionally toned stimuli. Given that surprise is considered a more ambiguous emotion (as compared to the less ambiguous emotions of happiness and anger; Amminger et al., 2012; In-Albon, Ruf, & Schmid, 2015; Chronaki et al., 2015), it would follow that children may make more mistakes and therefore misinterpret surprised

emotionally toned messages more frequently when they have fewer nonverbal cues available to them to decode this emotion.

When making judgments of fearful emotionally toned sentences, we found that children in the audio-only condition interpreted these sentences with significantly higher accuracy compared to those in the text message condition. Surprisingly, there was no significant difference in children's ability to make accurate interpretations of fearful emotionally toned sentences in the audio-visual compared to the text message condition or the audio-visual compared to the audio-only condition. These findings point to the presence of a unique quality about the added value of the verbal and paralinguistic cues available in the audio-only condition compared to the complete absence of added cues available in the text message condition in the accurate interpretation of fearful emotionally toned sentences. Fear is also considered to be a more ambiguous universal emotion, as compared to happiness or sadness (Mohn, Argstatter, & Wilker, 2012). Perhaps children found that the distinctive verbal qualities (e.g., pitch, tone) and paralinguistic cues that are used to express fear were the most useful in accurately interpreting this emotion. On the other hand, the nature of the dynamic emotion recognition stimuli in the audio-visual condition (e.g., moving mouth as opposed to still-face photographs) may have created some confusion with emotions that share facial features with fear (e.g., furrowed eyebrows and downturned mouth while expressing fear may also be perceived as sadness).

Overall, it appears that for all emotions with the exception of happiness, nonverbal cues are especially important in contributing to the accuracy with which children are able to interpret emotionally laden messages from same-age peers. For

emotions that are more ambiguous, such as surprise and fear, nonverbal, verbal, and/or paralinguistic cues play an especially important role in contributing to higher accuracy of interpretation among children.

We had not expected to find a lack of difference across conditions for happy emotionally toned sentences; however, the literature supports this finding. While happiness tends to be the most easily and accurately identifiable universal emotion in emotion-recognition studies (e.g., Du & Martinez, 2011; Mohn et al., 2010; Smith & Schyns, 2009), we anticipated that the lack of verbal and nonverbal cues in the text message condition would create some level of misinterpretation. It appears that the context of a purely "happy" message delivered through computer-mediated communication does not require any additional cues to inform its correct interpretation. Relating to *Hypothesis 1*, we can conclude that the added verbal, nonverbal, and paralinguistic cues present in the audio-only and audio-visual condition increased accuracy of interpretation for all emotions with the exception of happiness in some way, compared to the absence of these cues in the text message condition.

Our predictions for *Hypothesis 2* indicated that children higher in social anxiety in each of the three conditions would make a greater number of errors in their interpretation of all emotions compared to those lower in social anxiety. Unfortunately, we did not find any significant relationships between social anxiety and the accurate interpretation of emotions as nonverbal and paralinguistic cues became less available to children. There are several methodological reasons for this lack of statistically significant findings relating to social anxiety. Firstly, our sample size was unrepresentative in its ratio of male to female participants. In the general population, females and males are generally equal in

distribution; however, the present study had twice as many males compared to females participating. We also know that females are twice as likely to receive a diagnosis of social anxiety disorder in their lifetime (e.g., Bell-Dolan, 1995; Di Blasi et al., 2015). With girls making up only 30% of the sample, it is likely that social anxiety was underrepresented. Moreover, socially anxious children are generally less likely to participate voluntarily in research. With a consent rate of just under 50%, we have to acknowledge that there could very well have been difference between the boys and girls who volunteered to participate and those who did not. Perhaps this barrier was the presence of social anxiety, and a contributing factor in the overrepresentation of non-socially anxious boys in the sample. With a greater number of boys than girls in our sample, overall levels of social anxiety were lower than in the general population. This may have muted any potential findings related to social anxiety and how it impacts children's accurate interpretations of emotionally toned messages as nonverbal and paralinguistic cues become less available, perhaps particularly for girls.

At a conceptual level, our lack of significant findings relating to social anxiety and accuracy of emotion recognition across conditions may have been related to the high intensity of the emotions being expressed. We used sentences that were reliably associated with each emotion at accuracy hit rates of 80% or greater. It is possible that socially anxious children might have misinterpreted messages in which there had been more ambiguity in terms of the emotion expressed. Lower levels of intensity in emotional expression would create more ambiguity, which would likely have resulted in more significant findings.

Hypothesis 3 stated that girls would perform better in the text message condition than would boys overall; however, girls who were higher in social anxiety would make more errors decoding emotions in each of the three conditions compared to boys who were also higher in social anxiety. The only emotion that interacted with sex when predicting emotion recognition accuracy in the present study was anger. Both boys and girls benefited from the added nonverbal and paralinguistic cues available in the audio-visual condition; however, boys benefited to an even greater extent than girls. The lack of nonverbal and paralinguistic cues available in the text message condition likely increased the level of ambiguity when making interpretations of angry emotionally toned messages. Despite our predictions, social anxiety did not interact with any other predictor variables in terms of children's accuracy of interpreting various emotionally toned messages. Indeed, for most emotionally toned messages boys and girls did not differ significantly in their ability to accurately decode messages through computer-mediated communication, regardless of their level of social anxiety.

The second set of analyses examined children's interpretation of the emotionally toned messages delivered in each of the three conditions as positive or negative, and how these interpretations related to sex and social anxiety. *Hypothesis 4* predicted that children higher in social anxiety would interpret all messages delivered through computer-mediated communication as more negative than would less socially anxious children. Interestingly, for only two emotions -- happy and surprise – were there interactions between social anxiety, sex, and text message condition in terms of how positively or negatively children interpreted these emotionally toned messages. For the more ambiguous emotion, surprise, the present findings supported our hypothesis for

boys only. That is, higher self-reported levels of social anxiety for boys were associated with more negative interpretations of surprised messages when delivered through computer-mediated communication. For girls, social anxiety did not have any effect on how positively or negatively surprised messages were interpreted through computer-mediated communication. However, girls higher in social anxiety tended to interpret surprised emotionally toned messages as more negative in the audio-visual condition. Boys experienced the reverse effect in the audio-visual condition, such that higher levels of social anxiety were associated with more positive ratings of surprised sentences.

When looking at children's interpretations of happy emotionally toned messages as positive or negative, we observed unexpected results, particularly between sexes. For boys in the text message condition, higher levels of social anxiety were associated with slightly more positive interpretations of these messages. For boys in the audio-visual condition, their ratings of happy messages did not change regardless of condition. For girls, we observed that as social anxiety levels increased, they rated happy messages as significantly less positive in the text condition. Alternatively, girls in the audio-visual condition who were higher in social anxiety rated happy messages as more positive than did less socially anxious girls in the same condition. Perhaps socially anxious girls, as a result of their increased awareness toward emotional cues, experience nonambiguous emotions that carry positive connotations as significantly more positive than do less socially anxious girls, who may not attend as diligently to the same emotional cues. This finding is only relevant when the added nonverbal and paralinguistic cues are available to help decode a message, such as in the audio-visual condition.

Given the findings described above, we can draw some tentative conclusions about how socially anxious children interpret both distinct and more ambiguous emotions through computer-mediated communication. For the more distinct, nonambiguous positive emotions, such as happiness, we may expect to see a much less positive interpretation of the emotion for girls higher in social anxiety. For more ambiguous emotions, such as surprise, we observed an opposite sex effect. We saw that boys higher in social anxiety in the text message condition interpreted these messages as less positive compared to boys lower in social anxiety in the same condition. For girls in the text message condition, their interpretations of surprised messages as positive or negative did not change as a result of their level of social anxiety.

Perhaps for boys who are higher in social anxiety, their heightened awareness of the nonverbal and paralinguistic cues delivered through the audio-visual condition may have actually contributed to more positive interpretations of surprise. Alternatively, girls in the text message condition who were higher in social anxiety did not have access to the nonverbal and paralinguistic cues when decoding surprised messages. Their decreased access to cues of the more ambiguous emotion, surprise, may have actually been protective in allowing them to rate surprised messages as equally positive without their being influenced by social anxiety. For boys higher in social anxiety, the increased ambiguity inherent in the text message condition may have contributed to more negative interpretations of an already ambiguous emotion. Therefore, it appears that for boys, higher levels of social anxiety call for more nonverbal cues in order to make positive interpretations of ambiguous stimuli, such as surprise. For girls who are higher in social anxiety, the availability of added nonverbal cues actually leads to more negative

interpretations of ambiguous stimuli. Therefore, it is important to consider not only *what* message is communicated through various channels, but also *how* and to *whom* these messages are being communicated.

When looking at interpretations of fearful emotionally toned sentences as positive or negative, we found that children in the audio-visual group perceived these sentences as significantly more positive than did children in the audio-only group. This finding does not relate back to our original predictions; however, it is interesting to explore. These observations suggest that the added nonverbal and paralinguistic cues present in the audio-visual condition provided children with a significantly more positive experience of the more ambiguous "fearful" messages compared to children in the audio-only group, who received fewer verbal and paralinguistic cues to make interpretations of these messages.

For sentences expressing sad, angry, and disgusted content, no significant relations were observed between any of the predictor variables and Likert ratings of these sentences. According to research, females experience higher levels of social anxiety than do males (Bell-Dolan, 1995; Di Blasi et al., 2015). Unfortunately, there was not an equal representation of boys and girls in our sample. As such, the effects of social anxiety as a predictor variable may have been masked to some degree because of the small number of participating girls. Alternatively, the present study measured social anxiety but no other forms of anxiety. According to the Diagnostic and Statistical Manual, 5th Edition (DSM-5; American Psychiatric Association, 2013), females are twice as likely to develop generalized anxiety disorder than are males. In the present study, boys and girls did not appear to differ significantly in their levels of social anxiety. However, had we had as

many girls as boys in our sample, we might have seen that female participants were more socially anxious overall as compared to male participants. As a result, Likert ratings of sad, angry, and disgusted sentences might have uncovered greater differences than those observed with our unequal sex distribution.

Reaction time for judging the various emotionally toned sentences was an additional set of analyses undertaken as a post hoc, exploratory component of the study. It is important to keep in mind, however, that participants were not aware that reaction time was being measured and were therefore not primed to respond as quickly as possible. Consequently, reaction-time results must be interpreted with caution. Additionally, reaction time was measured following the presentation of each stimulus, and there were important differences in how stimuli were presented in the three conditions. In particular, participants in the text message condition had to read their stimuli rather than watch or listen to the stimuli, as in the audio-visual and audio-only conditions. Thus, manner of presentation is a confounding variable in the interpretation of reaction time results. As such, results were not reported and could not be explored further when condition was the only significant main effect.

Notably, social anxiety interacted with condition when reaction time was considered for surprised messages, but not for any other emotionally toned stimuli. In fact, the interaction between social anxiety and text message condition compared to audio-visual condition for reaction times to surprised emotionally toned stimuli was the only significant predictor that emerged. For surprised emotionally toned messages, as social anxiety increased, participants took significantly longer to react to the stimuli in the text message condition. Conversely, participants in the audio-visual condition tended

to react to surprised emotionally toned messages more quickly as social anxiety levels increased. We know that children higher in social anxiety have a heightened awareness of the emotional nonverbal and paralinguistic cues (especially negative) being conveyed by others (e.g., Bradley et al., 2000; Gilboa-Schectman et al., 1999; Mogg & Bradley, 2002). This heightened awareness may have resulted in faster recognition of the emotion being conveyed when that emotion is ambiguous, as is surprise.

Our final prediction for *Hypothesis 5* was that socially anxious children would endorse a more negative attribution bias. Unfortunately, we were unable to include attribution bias as a predictor variable in the main analyses because of the number of participants in the study. Nevertheless, examination of the correlation between social anxiety and negative attribution bias revealed that these two variables were positively correlated. Children who were higher in social anxiety endorsed a more negative attribution bias, adding support to *Hypothesis 5*. This finding is important because it suggests that children who are higher in social anxiety may tend to perceive social interactions with others as more negative than do children lower in social anxiety.

In summary, the findings from the present research suggest that children rely heavily on nonverbal and paralinguistic cues in order to make accurate interpretations about the emotions being conveyed by same-age peers. As these cues become less available (e.g., moving from audio-visual to audio-only to text message), children show a general trend towards making more errors identifying the emotion being conveyed, especially for more ambiguous emotions like fear and surprise. The only emotion for which this was not the case was happiness. Regardless of the presence or absence of

verbal, nonverbal, and paralinguistic cues, children were able to identify happiness at above-chance levels.

When looking at how social anxiety and sex interact with condition, only messages conveying anger appeared to be impacted significantly by these variables, and not in ways that we had originally anticipated. We observed that social anxiety actually played a "protective" role for boys and girls when identifying anger through computer-mediated communication, resulting in higher accuracy of its interpretation. An interesting sex effect appeared when we looked at how easily participants were able to identify anger across conditions. For girls in the audio-visual condition, social anxiety maintained its "protective" role and was related to higher accuracy in girls' interpretation of angry messages. For boys, the opposite effect was observed. Boys' accuracy in identifying anger actually decreased when they had more nonverbal and paralinguistic cues available to them. When observing how positively or negatively more socially anxious and less socially anxious children interpret various emotionally-toned messages, ambiguity of the emotion being rated plays an especially important role, particularly between sexes, as described above.

A major strength of the present study was the development, validation, and use of dynamic emotion recognition stimuli with same-age children as the stimuli for the emotion recognition tasks. Whereas static, still photographs of children's facial expressions have been used in previous research to detect emotion recognition accuracy among children, a measure that captures the dynamic nature of emotional expression and relates more realistically to real life interactions among children has not previously been used in the literature. Currently, only five studies have validated the use of dynamic facial

expression recognition stimuli -- the Amsterdam Dynamic Facial Expression Set (ADFES; Van der Schalk, Hawk, Fischer, & Doosje, 2011), the Amsterdam Dynamic Facial Expression Set – Bath Intensity Variations (ADFES-BIV; Wingenbach, Ashwin, & Brosnan, 2016), Geneva Multimodal Emotion Portrayals (GEMEP; Bänziger, Mortillaro, & Scherer, 2012), Multimodal Emotion Recognition Test (MERT; Bänziger, Grandjean, & Scherer, 2009), and MPI Facial Expression Database (Kaulard, Cunningham, Bülthoff, & Wallraven, 2012). All five studies used adult actors and studied emotion recognition among same-age adults. The present study was the first to use dynamic facial expression stimuli with child actors and child participants. Development and validation of reliable stimuli is a rigorous undertaking, and was a major contribution of the thesis. These stimuli may now be used by other researchers and replicated in future studies in order to strengthen their reliability and validity.

An additional strength of the present study is the examination of how the lack of nonverbal cues, as in the case with computer-mediated communication, can lead to misinterpretations for children decoding text-based messages, despite the presence of contextual clues that have been previously validated as belonging to a particular emotion. Text messaging and other forms of computer-mediated communication are increasingly utilized tools in today's world among adults, children, and all ages in between (Crosswhite, Rice, & Asay, 2014; Lenhart et al., 2010). Many studies in the last decade have examined how adults and adolescents use computer-mediated communication; however, very few have looked at the use of these text-based media among the population of younger, school-age children. Moreover, the relation between children's use of computer-mediated communication and the presence of social-emotional disorders,

such as social anxiety, has not previously been explored in the literature. Findings from the present study suggest unique and important implications for socially anxious children using computer-mediated communication.

The results of the present study may have important real life as well as clinical implications. For most emotions (sad, angry, disgust, fear, and surprise), there was a significant relation between condition and accuracy of interpretation. In most cases, the observed trends were such that participants in the text message condition made more errors interpreting the target emotion compared to the audio-only or audio-visual conditions (or both). This finding provides evidence for the importance of nonverbal cues in the ability of children to accurately interpret a message, even for emotions that are cross-culturally recognized *and* unambiguous.

In terms of clinical implications, these results can help to inform clinicians, parents and educators about individual and group risk factors when teaching children effective ways to communicate through text-based media. Having some knowledge about how girls and boys differ in their interpretations of some messages that differ in their level of ambiguity may help clinicians to work with children in teaching perspective-taking as well as social skills training. A major component of therapy involves teaching clients how to identify, label, and express their emotions in an effective way. We should now be paying equal attention to how this translates to the computer-mediated communicative environment given the frequency with which children and youth are communicating and interacting with peers via text-based media. Helping children to understand the importance of effective communication through these online media and the factors that may contribute to ineffective communication or misinterpretation is a

crucial first step to reducing the risk factors inherent in children's use of computer-mediated communication, particularly for more vulnerable youngsters, such as those with social anxiety.

Limitations and Future Directions

Despite the unique contribution of the present research to the scientific community, several limitations of the research impact the conclusions that can be drawn from its results. The challenge of obtaining access to the sample population was the most significant obstacle. The location from which one might derive the greatest numbers of school-age children of a specified age range is within the schools themselves. However, it is becoming increasingly difficult for researchers to gain access to schools for research purposes.

In the present study, we initially sought a total of 150 participants to be able to randomly assign equal numbers of each sex to each of the three conditions. However, we were unable to secure permission from three school boards in and around Ottawa, a difficulty that many researchers also face. We were fortunate that two private schools in Ottawa, neither of which had yet been overwhelmed by requests for research, welcomed our project into their schools. Nevertheless, these schools were not large, which affected our sample size. Moreover, although participants did not differ on basic demographic information across the two private schools (e.g., age, sex, grade), there are some implied differences between students attending these private schools and those attending public schools. Detailed demographic information was not collected in the present study; however, it is likely that socioeconomic status would differentiate participants in private schools from those in public schools. Students attending private schools are likely to have

a higher mean family income than families whose children attend public schools. Whether such differences also affect how social anxiety is reflected among students is unknown.

The sample population in the present study was also unrepresentative of the population in its distribution of boys and girls, which led to some challenges with generalizing to the greater population. Despite measures taken in the analyses to help control for these differences, the analyses themselves likely suffered from this unrepresentative sample since girls made up approximately 30 percent of the sample population. DSM-V indicates that in the general population, females are twice as likely as males to develop an anxiety disorder at some point in their lifetime (American Psychiatric Association, 2013). Many of these anxious tendencies present themselves in childhood; however, the sample population may have underrepresented the amount of social anxiety that would be seen in the larger population, given the underrepresentation of girls. Future research would benefit from obtaining a larger, more representative sample in order to better generalize to the population of school-age boys and girls.

When conducting experimental research, there is an inherent trade-off between maintaining statistical rigor by controlling for Type I error, and identifying potentially groundbreaking trends in new research areas by controlling for Type II error. This trade-off can be more obvious with modest as opposed to large sample sizes, such as in the present study. As an important contribution to this new field of research, we felt that the potential of committing Type I error would be more harmful than the potential of committing Type II error had we used a more stringent alpha in our analyses. Therefore, results should be interpreted with caution. Readers may wish to use these results to

inform future research rather than to draw confident cause and effect conclusions about the variables under study.

Another limitation to the present study was our inability to conduct more rigorous validation of the stimuli, given the scope of the present research. For example, it was decided that using a boy and girl child actor to present the stimuli to participants of their respective genders would reduce several confounding variables that may have presented themselves had a single actor been used for both sexes. For example, girls may perceive angry emotionally toned sentences from a male actor as more negative than would boys. Thus, it would have been difficult to determine whether a "sex difference" might have resulted from the sex of the stimulus, the sex of the participant, or the interaction of the two. Our use of separate stimuli for each sex helped reduce this potential confound. In addition, attractiveness of the person delivering a message has an impact on perceptions and interpretations in emotion recognition tasks (e.g., Tracy & Beall, 2011). By collecting ratings of attractiveness of the two actors, we were able to determine that they did not differ significantly in attractiveness. Nevertheless, only two child actors were used. It would be useful in further studies to engage several actors of both sexes.

In addition to using more than just two actors, a useful direction for future research would be to also develop dynamic emotion recognition stimuli of varying intensities. Some research has examined individual differences, such as shyness, in children's ability to accurately decode facial expressions when stimuli are presented with increased ambiguity, such as at 50% rather than 100% intensity. For example, Kokin (2015) found that shy boys had particular difficulty recognizing sadness when presented at 50% intensity, compared to shy girls. In order to meet the inclusion criteria for the

present study, pilot stimuli required that both sexes gave accuracy ratings of 80% or higher for any given stimulus. In all cases, stimuli with the highest accuracy and agreement ratings between sexes were included in the study. As a result, these stimuli would likely be related to intensity thresholds of 100% not only for the facial expressions, but also for the content of the sentences. In future research, it would be interesting to examine how facial expressions and messages that are less "intense" might influence children's perceptions, and how such differences in intensity might interact with social anxiety. Particularly interesting would be the association between social anxiety and medium of presentation when stimuli are presented at 50% intensity for both ambiguous and unambiguous emotions. The ADFES-BIV was the first study to include validated video recordings of their stimuli at high, medium, and low intensities (Wingenbach, Ashwin, & Brosnan, 2016). Given that the present study is the first to use video recordings of male and female child actors, the next logical step for future research would be to adapt these stimuli to include similar variations in intensity.

Future research may also benefit from an understanding of how to facilitate accurate interpretations of text-based communication based on discourse markers and use of emoticons or emojis. We know very little about children's use of emoticons to enhance the likelihood of accurate interpretations of their messages, and even less so about how these emoticons are interpreted by receivers. However, these types of communication tools can be very effective in clarifying the tone of a message. Since the trend toward online communication among children and youth is becoming more and more prevalent, an understanding of how we can facilitate emotionally accurate communication within the online realm will become increasingly important. That said, it is equally important to

consider the inherent difficulties in conducting research involving online communication. From the time that a research question is conceptualized, operationalized, conducted, analyzed, and disseminated to the public and research community, the landscape of how people are communicating online is likely to have already changed drastically. This area of research is a constant moving target, which makes understanding it all the more important and, at the same time, complex.

The implications of the current findings are particularly important. We learned from Weidman and colleagues (2012) that socially anxious university students felt more comfortable using text-based modes of communication because it reduced their symptoms of anxiety when communicating with others. However, these researchers also reported a significant relation between increased use of computer-mediated communication and symptoms of depression alongside lower quality of life. Our findings suggests that boys who are higher in social anxiety tend to interpret messages that are ambiguous as significantly more negative than do less socially anxious boys when using computer-mediated communication (e.g., text message condition). Should the findings by Weidman and colleagues generalize to younger boys, we may conclude that socially anxious boys who engage heavily in computer-mediated communication to ease their symptoms of social anxiety may be at particular risk for misinterpreting ambiguous messages from their peers. This may exacerbate socially anxious boys' risk for developing subsequent mood-related difficulties and to report an overall lower quality of life, much like for the university students in Weidman and colleagues' (2012) research. Our research also found that girls who were more socially anxious tended to interpret positive messages, such as happy emotionally toned sentences, as significantly less

positive when delivered through computer-mediated communication. Extrapolating from the same research by Weidman et al., socially anxious girls who engage heavily in computer-mediated communication may be at a particularly high risk of reporting lower quality of life if they experience their interactions as significantly less positive than do less socially anxious girls.

The current research has provided us with some important insight into how socially anxious children may differ from non-socially anxious children in the accuracy with which they interpret emotional cues across various modes of communication, as well as how they may differ in their interpretation of these messages as positive or negative across these methods of communication. The general understudied nature of this area of research was another important limitation to consider; however, this may also be interpreted as a strength given the number of future directions that may inform subsequent research, as described above.

Conclusions

The present research achieved its goal of conducting a comprehensive examination of how the lack of verbal, nonverbal, and paralinguistic cues available in computer-mediated communication relates to misinterpretations of emotional expression for children. Specifically, for five of the six universal emotions (sadness, anger, disgust, fear, and surprise), children in the text message condition made significantly more errors in their interpretations of emotional tone compared to children who received more nonverbal and paralinguistic cues, such as those in the audio-only and/or the audio-visual conditions. Social anxiety was found to play a role in how children interpret emotionally toned stimuli for angry messages.

Interestingly, interpretations of emotionally toned messages as positive or negative showed some gender-specific relations to social anxiety and sex that should be explored further. Results from the current research also underline the importance of educating children, especially those at-risk, such as socially anxious, shy, victimized and/or depressed youngsters, on effective communication through text-based media. Hopefully, education models targeting these skills will reduce the potential for children to make misinterpretations in others' meanings, thereby reducing the likelihood of negative interactions that contribute to feelings of anxiety, humiliation, rejection, low mood or victimization.

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Appendix A

Phase 1: Information Letter and Consent Form for Parents/Guardians of Pilot Group

(Printed on University of Ottawa letterhead)

Consent form and Information letter for parents (or primary guardians)

Primary investigator: Laura Doey, Ph.D. Candidate, Clinical Psychology, supervised by Dr. Alastair Younger, Department of Psychology, Faculty of Social Sciences, University of Ottawa, 11 Marie-Curie, room 6025, Ottawa University, Ottawa, Ontario, K1N 9A4, Tel.:(613) 562-5800, extension 4466.

Dear parents (or primary guardians of the child),

I am a doctoral student of the Clinical Psychology program at the University of Ottawa, and I am conducting research in the area of child development. Currently, I am planning a focus group to discuss various examples and themes in children's lives between the ages of 8-11 that contribute to feelings of happiness, sadness, anger, fear, surprise or disgust. This project will be the first phase of my doctoral thesis, the goal of which will be to determine how accurately children interpret emotionally-toned messages when nonverbal cues become less available. The results of this research will help to further the understanding of how children understand messages in today's world of online communications.

Your child has been invited to participate in the abovementioned research study. This project has received ethics approval from the University of Ottawa Research Ethics Board. Your child's participation will require one-time participation limited to 60 minutes. Children will be asked to meet as a group with me in a small, casual, round-table discussion on a weekend afternoon at the University of Ottawa. During the 60-minute period, children will talk about examples of imaginative situations that could contribute to various emotions in other children's lives of a similar age, such as happiness, sadness, anger, fear, surprise or disgust. Audio recordings will be used to tape the discussion for purposes of reviewing the data. This discussion will be held on a weekend afternoon in a conference room at the University of Ottawa, the date of which will be determined after consent forms have been returned.

Your child's participation in this study will entail that he/she volunteer examples of situations that contribute to various emotions in other children in a group. This may cause your child to feel mild emotional or social discomfort if he/she associates some of his/her responses with his/her own personal experiences, or if he/she is shy about contributing to group discussion. You are assured that the researcher will make every effort to minimize these risks by detailing the goal of the discussion to children. Children will also be offered an alternative activity to participate in with a colleague authorized to work with children in a separate room should they feel any discomfort during the discussion. Many children find the experience of participating in a research project at the university a fun and interesting activity. The goal is that your child's participation will help us to understand how different types of children interpret messages using on-line communication.

Anonymity and confidentiality of children's responses will be strictly maintained. Only the primary investigator and my thesis supervisor will have access to the data derived from this study, which will be locked away in a safe place. Names of participants will be changed to a numerical code for the purposes of data analysis, and any identifying information will be locked away as well. In addition, the results of the study will be presented in the form of group themes that emerge only; no individual data will be used. However, given the nature of the group participation there will be some limits to confidentiality. All participating children will be asked to keep the content of the group discussions confidential. The data from this study will be conserved for 5 years in a secure manner; paper and audio recordings will be locked in a filing

cabinet in my supervisor's research lab and computer files will be kept on password-protected computers with all data encrypted. Only the primary investigator and the supervisor will have access to these data at any time. After 5 years, the data will be destroyed by shredding papers, securely erasing audio recordings, and securely deleting computer files.

Your child is under no obligation to participate and should he/she choose to participate, he/she can withdraw from the study at any time and/or refuse to answer any questions, without suffering any negative consequences. If your child chooses to participate in a separate activity for the duration of the discussion, colouring or drawing materials will be provided. If your child chooses to withdraw, all data gathered until the time of withdrawal will be used as group data.

It will be possible to receive a copy of a summary of the results of the study upon request. If you have any questions concerning the study you can contact me at the telephone number listed above. For any information concerning your right as the parent of a child participating in a research study, you can contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: (613) 562-5387, ethics@uottawa.ca.

I ask you to please discuss the idea of participating in this study with your child. If you and your child both agree on your child's participation please sign and keep this form for yourself. Please also sign and complete the consent form that is attached to this letter and mail it back to me in the self-addressed and stamped envelope that is provided within the next few days.

I, _____, give permission for my child to participate in the research conducted by Laura Doey. I have also discussed this with my child to verify that he or she is willing to participate in this research.

Parent signature: _____

Date:___/___/___

Appendix B

Phase 1: Child Assent Form for Pilot Group

Assent form for children

I want to tell you about a research study I am doing. A research study is a way to learn more about something. We would like to find out more about what types of situations make other children your age feel happy, sad, angry, scared, surprised, and disgusted. You are being asked to join the study because I think you might have some good ideas about what makes other kids your age feel these kinds of emotions.

If you agree to join this study, you will be asked to use your imagination to talk about situations that could make other kids your age feel different types of emotions and feelings. We will talk about these things in a group with other kids your age. Everyone is invited to share their ideas as much as they want. There are no wrong answers. Please do not share what we talk about to people outside this group. We will be talking together today for one hour. I will be audio recording this discussion so that I can review it later.

If you do not like what we are talking about at any time during the conversation, just tell me and we can stop. I have a friend waiting outside this room in case you want to go to a different room to draw or colour until your mom or dad comes back to get you. Also, if you tell us something that makes us think you or another boy or girl is being hurt by an adult, we will have to talk to mom and dad about that.

You do not have to join this study. It is up to you. You can say okay now and change your mind later. All you have to do is tell us you want to stop. No one will be mad at you if you don't want to be in the study or if you join the study and change your mind later and stop.

Before you say **yes or no** to being in this study, we will answer any questions you have. If you join the study, you can ask questions at any time. Just tell me that you have a question.

If you have any questions about this study please feel free to call me, Laura Doey, at:(613) 562-5800, extension 4466.

Name: _____ **YES** **NO** (Circle one)

Researcher: _____ Date: _____

Appendix C

Phase 2: Information Letter and Consent Form for Child Actors

(Printed on University of Ottawa Letterhead)

Information letter and Consent form for parents (or primary guardians)

Primary investigator: Laura Doey, Ph.D. Candidate, Clinical Psychology, supervised by Dr. Alastair Younger, School of Psychology, Faculty of Social Sciences, University of Ottawa, 136 Jean-Jacques Lussier, room 6025, University of Ottawa, Ottawa, Ontario, K1N 6N5, Tel.: (613) 562-5800, extension 4466.

Dear parents (or primary guardians of the child),

I am a doctoral student of the Clinical Psychology program at the University of Ottawa, and I am conducting research in the area of child development. Currently, I am working on a project that will help to determine how accurately children interpret emotionally-toned messages when nonverbal cues become less available. The results of this research will help to further the understanding of how children understand messages in today's world of online communications. This project has received ethics approval from the University of Ottawa Research Ethics Board.

I would like to request your permission for your child to participate in this research study. Your child's participation will require a maximum of two recording sessions that may last up to two hours each. Your child will be asked to come to the University of Ottawa for recording sessions. During this period, your child will be asked to deliver various sentences with emotional tones such as happy, sad, angry, disgusted, surprised, and scared. Audio-visual recordings will be used to tape the presentation of these sentences. These audio-visual recordings will be used in the final research project, which will require participants to watch or listen to these recordings and determine which emotion is being portrayed for each sentence. These recordings will be kept securely by the primary investigator and may be distributed to future researchers who wish to further contribute to the field of psychology. Your child will receive a $100 gift certificate to the Rideau Centre as a token of gratitude for your child's participation.

There are no foreseeable risks associated with your child's participation. Many children find the experience of participating in a research project at the university a fun and interesting activity. The goal is that your child's participation will help us to understand how different types of children interpret messages using on-line communication.

Anonymity of your children will be maintained, in that the name of your child will not be shared with any participants without your consent. Only the primary investigator and her thesis supervisor will have access to your child's identifying information, which will be kept securely in a locked filing cabinet in a locked office. Given the nature of the participation there will be some limits to confidentiality. Obviously, anyone who recognizes your child will know of your child's participation.

Your child is under no obligation to participate and should he/she choose to participate, he/she can withdraw from the study at any time and/or refuse to answer any questions, without there being any negative consequences.

It will be possible to receive a copy of a summary of the results of the final study upon request. If you have any questions concerning the study you can contact me at the telephone number listed above. For any information concerning your right as the parent

of a child participating in a research study, you can contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: (613) 562-5387, ethics@uottawa.ca.

I ask you to please discuss the idea of participating in this study with your child. If you and your child both agree on your child's participation please sign both forms in the spaces indicated below, and keep one copy for your records.

I, _____ give permission for my child to participate in the aforementioned research conducted by Laura Doey. I have also discussed this with my child to verify that he or she is willing to participate in this research.

Section to be filled in by parent/primary guardian of the child:

Name of child: _____

Date of birth: _____

Parent Signature: _____

Date: _____

Telephone: _____

Section to be filled in by participating child:

Name: _____

I am willing to participate in the project described above. (Circle one) Yes No

Section to be filled in by primary investigator:

Signature: _____ Date: _____

Phase 3: Information Letter and Consent Form for Judges of Attractiveness Ratings

(Printed on University of Ottawa Letterhead)

Information letter and Consent form for participants

Primary investigator: Laura Doey, Ph.D. Candidate, Clinical Psychology, supervised by Dr. Alastair Younger, School of Psychology, Faculty of Social Sciences, University of Ottawa, 136 Jean-Jacques Lussier, room 6025, University of Ottawa, Ottawa, Ontario, K1N 9A4, Tel.:(613) 562-5800, extension 4466.

Dear participant,

I am a doctoral student of the Clinical Psychology program at the University of Ottawa, and I am conducting research in the area of child development. Currently, I am developing a research stimulus that will help to determine how accurately children interpret sentences expressing various emotions when nonverbal cues become less available. The results of this research will help to further the understanding of how children understand messages in today's world of online communications. This project has received ethics approval from the University of Ottawa Research Ethics Board.

You are invited to participate in the abovementioned research study. Your participation will require one-time participation limited to 10 minutes. You will be asked to rate attractiveness levels of various children of the same gender on a Likert-style rating scale from 1-5. Attractiveness is known to be universal and spans age, gender, and ethnicity alike (Swami, 2008). The goal will be to select a boy and girl actor who are matched on attractiveness level, regardless of the actual attractiveness rating.

There are no foreseeable risks associated with this task. Your participation will ultimately help us to understand how different types of children interpret messages using on-line communication.

You are under no obligation to participate, however, should you choose to participate, anonymity and confidentiality of your responses will be strictly maintained. Only the primary investigator and my thesis supervisor will have access to the data derived from this study, which will be locked away in a safe place. Your data will be anonymous and no identifying information except for your age and gender will be gathered. The data from this study will be conserved for 5 years in a secure manner; paper recordings will be locked in a filing cabinet in my supervisor's research lab and computer files will be kept on password-protected computers with all data encrypted. Only the primary investigator and the supervisor will have access to these data at any time. After 5 years, the data will be destroyed by shredding papers, securely erasing audio recordings, and securely deleting computer files.

It will be possible to receive a copy of a summary of the results of the final study upon request. If you have any questions concerning the study you can contact me at the telephone number listed above. For any information concerning your right as the parent of a child participating in a research study, you can contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: (613) 562-5387, ethics@uottawa.ca.

Section to be filled in by participant:

Sex: _____

Age: _____

Signature: _____

Date: _____

Section to be completed by the primary investigator:

Signature: _____ Date: _____

Appendix E

Information Letter for Parents/Guardians for Main Study

(Printed on University of Ottawa Letterhead)

Information letter for parents (or primary guardians)

Primary investigator: Laura Doey, Ph.D. Candidate, Clinical Psychology, supervised by Dr. Alastair Younger, School of Psychology, Faculty of Social Sciences, University of Ottawa, 136 Jean-Jacques Lussier, room 6025, University of Ottawa, Ottawa, Ontario, K1N 6N5, Tel.:(613) 562-5800, extension 4466.

Dear parents (or primary guardians of the child),

I am a doctoral student of the Clinical Psychology program at the University of Ottawa, and I am conducting research in the area of child development. Currently, I am researching how accurately children interpret emotionally-toned messages when nonverbal cues become less available. The results of this research will help to further the understanding of how children understand messages in today's world of online communications. This project has received ethics approval from the University of Ottawa Research Ethics Board.

I would like to invite your child to participate in the this research study. Your child's participation will require one-time participation limited to 30 minutes. During this period, your child will be met with individually and asked to participate in a sentence-decoding and sentence-rating computerized task. This will involve the presentation of sentences that express various emotions through audio-visual, audio-only, or text-only modalities. Your child will be asked to detect, from a list, which emotion he or she believes the sentence to be conveying. Your child will also be asked to rate how positive or negative he or she believes each sentence to be. Your child will then be asked to fill out questionnaires asking him or her how comfortable he or she feels in interactions with others, how he or she perceives other children's behaviours, and how he or she feels from day to day. Participation will take place within your child's school during class time at the convenience of the classroom teacher. As a thank you for your child's participation, he or she will be given a pack of sugar-free gum upon return to his or her classroom.

It is possible that the contents of the questionnaires may cause your child to feel mild emotional discomfort if he or she relates negatively to any of the questions. You are assured that the researcher will make every effort to minimize these risks by monitoring your child's comfort levels throughout the duration of their participation. Your child will be reminded that they may pause at any time and are not obligated to answer questions they do not want to answer. Many children find the experience of participating in a research project a fun and interesting activity. The goal is that your child's participation will help us to understand how different types of children interpret messages using on-line communication.

Anonymity and confidentiality of your child's responses will be strictly maintained. Only the primary investigator and thesis supervisor will have access to the data derived from this study, which will be locked away in a safe place. Names of participants will be changed to a numerical code for the purposes of data analysis, and any identifying information will be locked away as well. The data from this study will be conserved for 5 years in a secure manner; paper recordings will be locked in a filing cabinet in my supervisor's research lab and computer files will be kept on password-protected computers with all data encrypted. Only the primary investigator and the supervisor will

have access to these data at any time. After 5 years, the data will be destroyed by shredding papers, securely erasing audio recordings, and securely deleting computer files.

Your child is under no obligation to participate and should he or she choose to participate, he/she can withdraw from the study at any time and/or refuse to answer any questions, without suffering any negative consequences. Given that the research stimuli require audio and visual components, children with permanent visual and/or hearing impairments will not be eligible to participate.

It will be possible to receive a copy of a summary of the final results of the study upon request. If you have any questions concerning the study you can contact me at the telephone number listed above. For any information concerning your right as the parent of a child participating in a research study, you can contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: (613) 562-5387, ethics@uottawa.ca.

I ask you to please discuss the idea of participating in this study with your child. If you and your child both agree on your child's participation please sign the attached consent form and have your child sign the attached assent form. Please keep this letter for your records.

Sincerely,

Laura Doey
PhD Candidate, University of Ottawa

Signature: _____ Date: _____

Appendix F

Consent Form for Parents/Guardians for Main Study

Consent form for parents (or primary guardians)

My child, _____ has been invited to participate in the aforementioned research study conducted by Laura Doey of the School of Psychology, Faculty of Social Sciences at the University of Ottawa, under the supervision of Dr. Alastair Younger. I, _____ acknowledge that I have read the attached information letter and understand the nature of my child's participation in this research study. I, _____ give my child permission to participate in this research project. I have also discussed this with my child to verify that he or she is willing to participate in this research.

Section to be filled in by a parent/primary guardian of the child:

Name of child: _____ Sex: _____

Date of birth: _____

Parent signature: _____ Date:_____

Telephone: _____

Section to be completed by the primary investigator:

Signature: _____ Date: _____

Appendix G

Phase 4: Assent Form for Children in Main Study

Assent form for children

I want to tell you about a research study I am doing. A research study is a way to learn more about something. We would like to find out more about how children understand messages using verbal and nonverbal cues.

If you agree to join this study, you will be asked to either watch, listen to, or read various messages people are saying. You will be asked to guess which emotion each message is expressing. You will also be asked to rate how positive or negative you think each message is. Afterward, you will be asked to fill out some questionnaires about how comfortable you feel in interactions with peers, how you perceive other children's behaviours, and how you feel from day to day. There are no wrong answers. We will be doing this activity together during class time for 30 minutes.

If you do not like the activity we are doing, just tell me and we can stop at any time. You can take pauses whenever you need, and you do not have to answer any questions that you don't want to.

You do not have to join this study. It is up to you. You can say yes now and change your mind later. All you have to do is tell me you'd like to stop. No one will be upset if you don't want to be in the study or if you join the study and change your mind later and stop.

Before you say **yes or no** to being in this study, I will answer any questions you have. If you join the study, you can ask questions at any time.

Name: _____

Do you agree to participate? **YES** **NO** (Circle one)

Date: _____

Section to be filled out by researcher:

Signature: _____ Date: _____

Appendix H

Debriefing Form for Parents/Guardians for Main Study

Miscommunication Among Children Through Text-Based Media and its Relation to Social Anxiety

The purpose of this research is to better understand how children decode messages in today's world of online communications. I only gave you a brief idea at the beginning of the study of the experiment's purpose. Sometimes when we are studying differences between people (as in this experiment), we don't give people a full description of what we are studying. That way we are able to get more natural responses. Not every psychology study does this. However, there are a few things about this experiment that I would like to explain.

Sometimes children experience anxiety in social situations. We know that when socially anxious children interact with others, they sometimes perceive that interaction as more negative or hostile than it was actually intended. This is called 'hostile attribution bias'. However, we do not know how this relates to online communication, or when nonverbal cues become less available during communication. The questionnaires you filled out assessed your level of social anxiety, attribution bias, sensitivity to rejection by others, and mood. These are all things that we predict would influence how children decode messages from others in face-to-face settings and online. We are interested specifically in seeing whether there are differences in how more socially anxious versus less socially anxious children decode messages as nonverbal cues become less available. There are no right or wrong answers for these questions. However, we did not talk about the social anxiety aspect of our study because we did not want children with anxiety to feel even more anxious about participating. We also did not want children without anxiety to feel that they needed to be socially anxious in order to participate or in order to get the questions 'right'.

We will be running this experiment for some time. We would really appreciate it if you would not talk to anyone about the study. Sometimes if people know what the study is about, that knowledge will affect their responses even when they don't mean for it to, and then the results are not valid.

If you have any complaints, concerns, or questions about this research, please feel free to contact: Laura Doey, Ph.D. Candidate, Clinical Psychology, supervised by Dr. Alastair Younger, Department of Psychology, Faculty of Social Sciences, University of Ottawa, 11 Marie-Curie, room 6025, Ottawa University, Ottawa, Ontario, K1N 9A4, Tel.:(613) 562-5800, extension 4466.

If you would like to learn more about this experiment and its results when they become available, please contact Laura Doey at the phone number above.

Thanks for helping us with this research!

Appendix I

Accuracy Ratings of Included Pilot Sentences for Each Emotion Category by Sex

Happy	
1.	School is ending early today.
Boys	100%
Girls	100%
2.	I graduate from elementary school today.
Boys	100%
Girls	100%
3.	I got exactly what I wanted for my birthday
Boys	100%
Girls	100%
4.	It's Christmas morning
Boys	100%
Girls	100%
5.	It's Friday
Boys	100%
Girls	100%

Sad	
1.	I got hurt at recess
Boys	100%
Girls	100%
2.	My best friend said something mean to me
Boys	100%
Girls	100%
3.	I didn't get to go on vacation this year
Boys	100%
Girls	100%
4.	My best friend told me he would come over this weekend but then changed his mind
Boys	100%
Girls	100%
5.	My grandma is really sick
Boys	100%
Girls	100%

Angry	
1.	My friend broke my iPad
Boys	100%
Girls	87.5%
2.	My older brother is always calling me names
Boys	100%
Girls	87.5%
3.	My friend got mad at me for no reason
Boys	87.5%
Girls	100%
4.	My computer crashed and everything was erased
Boys	100%
Girls	87.5%
5.	My best friend lied to me
Boys	100%
Girls	87.5%

Disgusted	
1.	Every time I open the basement door it smells like cat litter
Boys	100%
Girls	100%
2.	When I opened the fridge it smelled of rotten food
Boys	100%
Girls	100%
3.	There was a dead fish floating in the pond
Boys	100%
Girls	100%
4.	My parents made me try out a new food that turned out to be snails
Boys	100%
Girls	100%
5.	The public bathroom smells really bad
Boys	100%
Girls	100%

Scared	
1.	I don't want to go to school because then I will be bullied again
Boys	100%
Girls	100%
2.	I was on a plane and it was thundering and lightening
Boys	85.7%
Girls	87.5%
3.	My parents are driving home and the roads are really slippery
Boys	85.7%
Girls	100%
4.	I heard strange noises in the middle of the night
Boys	85.7%
Girls	87.5%

Surprised	
1.	I went into the bathroom and my little brother had made a huge mess
Boys	85.7%
Girls	100%
2.	My friend came up behind me and yelled in my ear
Boys	85.7%
	My best friend from British Colombia showed up without telling me
Girls	100 %
3.	The thunder woke me up in the middle of the night
Boys	100%
	My parents told me we are moving
Girls	100%

Appendix J

Basic Demographics Questionnaire

Basic Demographic Questionniare

Please take a moment to answer the following questions. If there is something you do not understand at any time, please ask the researcher for help.

Please circle your gender: Male Female

How old are you?: _____

When is your birthday?:
_____

What grade are you in?: _____

Please proceed to the next form.