EMOTION RECOGNITION IN CONTEXT

A Dissertation
Presented to
The Academic Faculty

By

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In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Philosophy in Psychology

Georgia Institute of Technology

August 2008

Emotion Recognition in Context

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ACKNOWLEDGEMENTS

I am grateful to my advisor, Fredda Blanchard-Fields, for intellectual and practical guidance, support, and advice. My immense growth as a researcher during this period is a direct result of her mentoring style of high standards combined with explicit strategies on how to succeed. It has truly been a pleasure to learn from such an expert in the field. I would also like to thank the members of my dissertation committee, Chris Hertzog, Ruth Kanfer, Paul Corballis, and Derek Isaacowitz for their engagement in the project and their service on the committee. My time at Georgia Tech would have been much less rich and informative without my "bigs", the graduate students who showed me the ropes and were always there for me: Michelle Horhota, Andy Mienaltowski, and Abby Coats. I was extremely lucky to join a lab with such generous and knowledgeable older graduate students. Thanks also to the post-docs: Julie Boron, Christiane Hoppmann, and Antje Stange, who were not only ready with advice and guidance, but are also good friends. None of my projects would have been possible without the support of the lab, especially Marisa Arroyo, Andy Day, and Whitney Sturgill.

I am indebted to my parents, Tim and Cindy Tehan, for all their love and support. In addition, my parents taught me the value of education, how to be persistent, and instilled in me the confidence to think I could do it! Mom and Dad, I cannot put into words what a gift I feel you have given me. I am also grateful to my two fantastic sisters, who are always available for encouragement, support, and comic relief, thank you Megan and Kelly! I am most thankful for the love and support from my husband, Ray. Every day is better because you are there.

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SUMMARY

In spite of evidence for increased maintenance and/or improvement of emotional experience in older adulthood, past work suggests that young adults are better able than older adults to identify emotions in others. Typical emotion recognition tasks employ a single-closed-response methodology. Because older adults are more complex in their emotional *experience* than young adults, they may approach such response-limited emotion recognition tasks in a qualitatively different manner than young adults. The first study of the present research investigated whether older adults were more likely than young adults to interpret emotional expressions (facial task) and emotional situations (lexical task) as representing a mix of different discrete emotions. In the lexical task, older adults benefited more than young adults from the opportunity to provide more than one response. In the facial task, however, there was a cross-over interaction such that older adults benefited more than young adults for anger recognition, whereas young adults benefited more than older adults for disgust recognition. A second study investigated whether older adults benefit more than young adults from contextual cues. The addition of contextual information improved the performance of older adults more than that of young adults. Age differences in anger recognition, however, persisted across all conditions. Overall, these findings are consistent with an age-related increase in the perception of mixed emotions in lexical information. Moreover, they suggest that contextual information can help disambiguate emotional information.

CHAPTER 1

INTRODUCTION

Perceiving emotional reactions in social partners is important for maintaining adaptive relationships (Carton, Kessler, & Pape, 1999). It follows that the ability to correctly recognize emotions in others is essential to this process. Thus, if older adults show impairments in the ability to recognize emotion they may be less adept at maintaining healthy relationships. Interestingly, the literature does not suggest this is a problem for older adults. In fact, older couples actually show gains in emotional communication when compared with young couples (Carstensen, Gottman, & Levenson, 1995; Levenson, 2000) and are better at avoiding interpersonal conflict (Birditt & Fingerman, 2003; Birditt, Fingerman, & Almeida, 2005). Thus, a seeming dissociation has emerged in the emotion and aging literature such that whereas the experience of emotion and emotion regulation is well preserved or even improves with age (e.g., Blanchard-Fields, 2007; Blanchard-Fields, Stein, & Watson, 2004; Gross et al., 1997; Lawton, Kleban, Rajagopal, & Dean, 1992), the perception and processing of emotional information does not appear to fare as well in older adulthood (e.g., Coats & Blanchard-Fields, 2008; Malatesta, Izard, Culver, & Nicolich, 1987).

Although the findings from these two literatures appear to be contradictory, they may not be. Age effects in emotion recognition and emotion regulation have been studied at different levels of analysis. Emotion recognition has been studied using relatively impoverished stimuli, devoid of context, whereas the emotion regulation studies use context-rich stimuli, such as vignettes. Thus, before we can investigate the relationship

between emotion recognition and emotion regulation we must first understand age-related changes in emotion recognition in context. Therefore the purpose of the present research is to investigate emotion recognition when more or less contextual information is available.

It may be that the ability to recognize emotions in the laboratory does not directly translate into recognizing emotions in daily life. For example, emotion recognition tasks in the laboratory may represent simple pattern recognition tasks (a perceptual ability) rather than recognizing emotions in the "real world." In the context of everyday life, emotion displays are the result of a confluence of factors, which together make up the social context of the event (e.g., auditory information, content, body language, and knowledge from past history with that partner). This suggests that the social context must be taken into consideration when examining the display of emotion in everyday life. In other words, the dissociation in the literature between the experience and the perception of emotions may be a result of varying levels of contextual information.

The thesis of the current paper is that this dissociation in the literature may be due to two conceptually related phenomena. First, older adults may read more than one emotion in the stimuli presented due to an age-related increase in the experience of a co-occurrence of emotions (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles, 2005; Ong & Bergeman, 2004). Put another way, because older adults have more experience in feeling two or more emotions simultaneously, they may be more likely to project multiple emotions on another when trying to interpret their emotions. Second, older adults may rely more on contextual cues to help them interpret emotional information in everyday life. That is, while older adults may have deficits in recognizing

emotion in an impoverished task in which only one modality of information (e.g., static facial expressions) is presented, the redundancy that occurs across channels in everyday life may result in no age-related loss in emotion recognition in daily life. This is because, in real world settings, both young and older adults draw on contextual cues to help them interpret the situation. In other words, adding contextual information to the typical emotion recognition task may attenuate age differences in emotion recognition while at the same time increasing the ecological validity of the task.

In the first sections of this paper, I will review the relevant literature on emotion recognition and aging, age-related changes in the experience of mixed emotions, and the role of social context in explaining age effects. Next, I will argue that a better understanding of the older adult's competence in perceiving and processing emotional information in daily life can be gauged by assessing these abilities in a more ecologically valid manner by increasing the contextual information in the task to better approximate real life situations.

CHAPTER 2

LITERATURE REVIEW

2.1 Emotion Recognition and Aging

2.1.1 Facial Expressions of Emotion

A number of studies have examined the extent to which there are age differences in the ability to recognize facial expressions of emotion. Importantly, as mentioned above, age differences are not found when participants are asked to broadly categorize each facial expression as positive, negative, or neutral (Keightley, Winocur, Burianova, Hongwanishkul, & Grady, 2006). Age effects are less optimistic, however, when the ability to recognize discrete emotions (i.e., anger, shame, fear, sadness, disgust, happiness), is tested. Older adults appear to be less accurate at recognizing facial expressions of anger (Moreno, Borod, Welkowitz, & Alpert, 1993; Phillips, MacLean, & Allen, 2002; Sullivan, Ruffman, & Hutton, 2007; Wong, Cronin-Golomb, & Neargarder, 2005), fear (Calder et al., 2003; Isaacowitz et al., 2007; Keightley et al., 2006; Wong et al., 2005), and sadness (Calder et al., 2003; Keightley et al., 2006; Moreno et al., 1993; Phillips et al., 2002; Suzuki, Hoshino, Shigemasu, & Kawamura, 2007; Wong et al., 2005), when compared to young adults. Age differences in recognizing facial expressions of anger and sadness are the most prevailing observations, followed by fear recognition (see Ruffman, Henry, Livingstone, & Phillips, 2008 for a review). There have also been studies that report that older adults are less able to recognize happiness and disgust, although these findings are less prevalent in the literature (Isaacowitz et al., 2007; Stanley, 2007). Indeed, older adults have also sometimes exhibited better recognition of

happiness (Moreno et al., 1993) and disgust (Calder et al., 2003; Suzuki et al., 2007; Wong et al., 2005) when compared to young adults.

Overall, these findings suggest that certain discrete emotions pose particular challenges to older adults. Namely anger, sadness, and fear appear to show the largest and most consistent age differences in the literature, with young adults consistently outperforming older adults in recognizing these discrete emotions.

2.1.2 Emotion Recognition in Other Modalities

One might wonder if these differences in the ability to recognize facial expressions of emotion are due to the well-documented loss of visual acuity or contrast sensitivity associated with age (Schneider & Pichora-Fuller, 2000). Whereas perceptual abilities likely account for some of the age-related variance, age-related impairments in recognizing emotion in other modalities speak against this interpretation as a full account of the age differences. Older adults show a similar pattern of differential decline in recognizing emotions in modalities other than facial expressions of emotion. For example, older adults are worse than young adults at recognizing sad and happy prosody in voices (Wong et al., 2005, Experiment 4). Older adults have also exhibited poorer performance on a lexical task than young adults when asked to identify the feeling state of the subject in a sentence. Specifically, older adults were worse than young adults at recognizing anger, disgust, happiness, surprise, sadness, and neutral in a lexical task (Isaacowitz et al., 2007). Moreover, older adults' reduced ability to identify negative emotion in facial expressions is relatively independent of age-related changes in other perceptual and cognitive domains (Keightley et al., 2006; Stanley, 2007; Sullivan & Ruffman, 2004). Thus, it appears that at least some component of these age-related

deficits in emotion recognition are independent of modality and may be related to changes in an "emotion factor" in higher order cognition. Indeed, in a study that examined the relationship between emotion recognition in facial, prosodic, and lexical channels, evidence for a general processor of emotional information was found (Borod et al., 2000).

2.1.3 Theoretical Accounts of Age-Related Differences in Emotion Recognition

Whereas the consistency in the literature pointing to an age-related decline in recognizing emotions is suggestive of an important aging phenomenon, the mechanism underlying this phenomenon is unclear. Now that a pattern of age differences has been established, the question becomes why are older adults impaired at recognizing specific emotions? There are several possible explanations for the mechanism(s) underlying these age-related differences in emotion recognition. The literature currently provides two broad levels of theoretical explanations: cognitive mechanisms and motivational accounts. I propose a third explanation by applying what we know about age-related changes in the *experience* of emotions to emotion recognition. Each of these three accounts is described below.

2.1.3.1 Cognitive Explanations

Because older adults have fewer cognitive resources and declining perceptual abilities (e.g., Salthouse, 2004; Schneider & Pichora-Fuller, 2000), they may be impaired at recognizing emotion (in all modalities, possibly for different reasons) because components of the task involve these resources to a greater extent than older adults have to devote. Several studies have investigated this possibility, only to find that age-related declines in cognitive abilities cannot fully account for age differences in emotion

recognition (Keightley et al., 2006; Stanley, 2007). For example, age-related decrements in recognizing sadness and fear are found after controlling for individual differences in visual perception of faces, face processing, and fluid intelligence (Sullivan & Ruffman, 2004). There appears to be a factor other than cognitive and perceptual abilities that contributes to these age effects in emotion recognition. Therefore, the focus of this paper is on the possible social and motivational explanations for age differences in emotion recognition.

2.1.3.2 Motivational Explanations

One motivational explanation for age-related differences in emotion recognition has been inferred via an application of socioemotional selectivity theory that suggests that older adults avoid negative information in their environment in order to regulate their emotions (Mather & Carstensen, 2003). This motivational account of age differences in emotional experience posits that there is an age-related shift to prioritize emotionally gratifying experiences as future time perspective becomes more limited. Although socioemotional selectivity theory describes changes in emotional *experience* across the lifespan, it might be indirectly applicable to the *perception* of emotions as well. For example, in an effort to regulate their emotional experience older adults may be attending less to the negatively-valenced facial expressions in an emotion recognition task and thus performing more poorly at identifying the emotion expressed. Thus, recognizing negative facial expressions may become an "unexercised" ability that shows up in the laboratory emotion recognition tasks as a deficit for older adults. This account only fits some of the data on age-related changes in emotion recognition. For example, older adults are less accurate than young adults at identifying some negative facial expressions (e.g., anger,

fear, sadness) but are equally able to (or better able to) recognize disgust, which is a negative facial expression. It may be that older adults avoid negative emotions that might damage interpersonal relationships (e.g., anger) but not other negative emotions (e.g., disgust). This possibility remains to be tested.

Thus, a related motivational account of the emotion recognition findings is that in service of maximizing emotionally-gratifying feelings, older adults are motivated to control anger experiences. Evidence for this account comes from research which shows that older adults report experiencing fewer anger situations in daily life (Birditt & Fingerman, 2003). This strategy may be adaptive for older adults because they are avoiding the toxic emotion of anger. It is posited that the toxicity of anger to the system is less tolerated with age (Blanchard-Fields, 2007; Labouvie-Vief, 2003) and so avoiding toxic emotions, such as anger, becomes increasingly salient with age. Similar to the more general account of older adults becoming less practiced with identifying negatively-valenced facial expressions; if older adults avoid anger in their daily lives they may become less adept at identifying this facial expression of emotion. In contrast, young adults may have more recent experience with identifying anger, resulting in better performance at identifying anger expressions when asked to do so in the laboratory.

This explanation would account well for the data showing age differences in the ability to recognize anger, but would not address the data that show age differences in recognizing other emotions (e.g., sadness and fear). In addition, one could argue that older adults need the ability to recognize anger (on some level) in order to avoid it. This extends to other negative emotions from which older adults may be motivated to divert attention away. There is evidence that early-processing of negative faces, such as

detecting an angry face an array of neutral faces, does not show age-related changes (Mather & Knight, 2006). Thus, for an angry face, older adults may detect it in early processing but are motivated to divert attention away from it in later processing, which results in less accurate emotion judgment responses. These motivational accounts of age-related differences in emotion recognition that are due to age-related shifts in prioritizing positive information over negative information are yet to be tested.

2.1.3.3 Age-Related Changes in the Experience of Mixed Emotions

As mentioned in the introduction of this paper, emotional experience enjoys developmental gains in middle and late adulthood. Due to increased life experience, several developmental theories of emotion predict a more complex emotional experience with advancing age. There are two primary ways to conceptualize emotional complexity. Labouvie-Vief describes emotional complexity as the cognitive understanding of emotional experience (Labouvie-Vief, 1994, 1997, 2000). This conceptualization of emotional complexity has been shown to peak in middle age and decline thereafter, exhibiting a curvilinear relationship with age. The other theories differ in how emotional complexity is conceptualized, but agree that there are age-related increases in emotional complexity. For example, differential emotions theory suggests that emotions become more complex in later adulthood (Izard, Ackerman, Schoff, & Fine, 1999; Magai, 2001). Research in this area is consistent with a linear age-related increase in the experience of mixed emotions (Carstensen et al., 2000; Ong & Bergeman, 2004). For example, Charles (2005) has found a greater *heterogeneity* of emotional experience, defined as a co-occurrence of negative emotions, in older adults compared to young adults. Despite differences in measurement, research in this area converges on the idea that emotional

experience may become more mixed, elaborate, and complex in later adulthood. This is the conceptualization of emotional complexity that will be the focus of the present research.

Importantly, it is thought that experiencing more mixed emotions, specifically a mix of positive and negative emotions at the same time, may be linked to greater resiliency following daily stressors (Ong & Bergeman, 2004). Other research has found that age-related increases in *poignancy*, the co-occurrence of feelings of positive and negative affect, are related to greater life satisfaction (Carstensen et al., 2000). Thus, not only do we find an age-related increase in the complexity of emotional experience, but it also appears that this developmental change may act as a buffer to stress, or benefit older adults in some other way. The most pertinent aspect of these findings for the current thesis is that older adults report experiencing several different discrete emotions simultaneously to a greater extent than young adults. These findings are critical to the socioemotional account of age-related differences investigated in the current research. In combination with a social context view, older adults' greater experience with mixed emotions suggests a number of factors involved in attenuating age differences in emotion recognition. Thus, the role of social context in explaining age effects is reviewed in the next section.

In sum, although it is yet to be determined what underlies age-related differences in emotion recognition; it is clear that older adults are worse than young adults at recognizing some discrete emotions. It is also apparent that cognitive and perceptual abilities cannot fully account for these age differences. The present research will investigate a third possible mechanism for age-related differences in emotion recognition;

namely, an age-related increase in the complexity of emotional perception. If this mechanism does account for age differences in the typical impoverished emotion recognition tasks, then it may also explain why adding contextual information attenuates age differences. That is, if older adults perceive more than one emotion in a facial expression, the addition of contextual information such as a sentence describing the situation may help to disambiguate which of the emotions perceived is the intended emotion. Thus, in the next sections, we turn to the role of social context in explaining age effects.

2.2 Role of Social Context in Explaining Age Effects

The study of age-related changes in emotion recognition is in its infancy, as exhibited by the relatively recent dates in the literature review above. Moreover, the majority of the research in this area has focused on assessing the perception of emotion in facial expressions in a contextual vacuum. While there have also been a few studies which have examined the perception of emotion in other modalities (e.g., lexical and prosody), this piecemeal investigation of age changes has rendered the general phenomena, as well as the mechanisms that account for the age differences, difficult to interpret. The cognitive and motivational accounts described above may be applicable in describing the age changes in the perception of emotion in isolated channels, but it remains to be seen whether these same theories will apply equally well to age-related changes in emotion recognition in daily life, across modalities.

2.2.1 The Importance of Taking a Lifespan Contextual Perspective

Taking a contextual perspective is not new to studies on adult development. Oftentimes, an examination of a process that includes contextual elements can eliminate

or attenuate age differences typically observed in laboratory tasks. Much of the research on contextual effects in aging research and can be described as exploring age effects in relation to older adults' 1) adaptation to changes in life stages and the changes in goals that accompany life stages (e.g., compensation for losses), 2) increased reliance on environmental support, or 3) qualitative differences in the ways in which they approach the task.

2.2.1.1 Compensation

The lifespan perspective of adult development described by Paul Baltes emphasizes the multidimensionality and multidirectionality of development at all points in the lifespan (Baltes, 1987). There is both growth and loss at every life stage, although the balance between growths and losses changes with age (i.e., more gains than losses in early development and more losses than gains in late adulthood). Important for the present topic, adults have been shown to adapt to losses using several different strategies. Research on compensation suggests that the performance of older adults may be the combined effects of age-related performance declines and the strategies that older adults are using to compensate for loss, sometimes in a separate domain (e.g., Li, Lindenberger, Freund, & Baltes, 2001).

2.2.1.2 Environmental Support

Much of the research on context effects in cognitive aging comes from studies of memory performance (see Hess, 2005 for a review). Age differences in memory can be attenuated, or even eliminated, when contextual elements of the study are manipulated by adding environmental support (Craik, 1983, 1986, 1990). For example, age differences in recall for paired associates are eliminated when the pairs of words are related, suggesting

that older adults are able to use the passive environmental support in the stimuli to boost their recall performance (Smith, Park, Earles, Shaw, & Whiting, 1998). This research suggests that older adults may develop strategies that rely on cues in the environment to compensate for age-related losses in cognitive and sensorimotor abilities, as in the case of environmental support.

Clearly, studying tasks in context facilitates a more complete understanding of age differences in emotion and cognition. In the next section, a different interpretation of context effects is suggested: changing a situation to make it more personally relevant, meaningful, or consistent with one's goals and beliefs may attenuate age differences.

2.2.1.3 Qualitative Differences in How They Approach the Task

A third category of context effects in the aging literature stems from the possibility that age differences are the result of qualitative differences in the ways in which older and younger adults approach the task. If older adults are approaching the task differently than young, then we may be underestimating the abilities of older adults. Thus, there may be age-related *differences* in emotion recognition, but not necessarily age-related *decline*. If older adults change the way they approach emotion recognition to better match their current life goals, this change would be considered adaptive. Adult developmental research in this tradition shows that growth does continue into adulthood, especially given appropriate motivation. Moreover, this growth may be characterized as adaptive responses to current life goals (Labouvie-Vief, 1985).

Qualitative age-related changes may be due to several factors. First, the ecological validity of the task may be more salient for older adults than young adults who are more accustomed to accepting the premise of a laboratory-like situation. Older adults may be

less willing to 'accept the premise' of the experimental task than young adults and thus may approach the task in a qualitatively different manner from young adults which may reflect differing motivational goals. Thus, a second factor for older adults approaching a task differently than young adults may be that the two age groups have different goals in mind as they complete the task. If the task is differentially meaningful to the two age groups, they may approach it differently, exerting more of less effort according to how meaningful the task is for them.

There are a number of studies that exemplify this qualitative shift in responding. For example, in a standard impression formation task, young adults were better at recalling inconsistent information about the person than older adults. When the task was placed in a more meaningful context by asking participants to evaluate the target person's suitability for a job, the age differences in person memory were attenuated (Hess, Follett, & McGee, 1998). These effects suggest that in the first version of the task, older adults may have been approaching the task in a qualitatively different manner from young adults. By placing the task into a realistic context, both age groups may have approached the task similarly, which improved the performance of older adults on the recall task.

Another example of the role of motivation on performance comes from a study in which older women were better at recalling a story when retelling it to a child compared to retelling it to an experimenter (Adams, Smith, Pasupathi, & Vitolo, 2002). Two possible influences of motivation may have been 1) that the child listener motivated better recall because older adults have goals of generativity, or 2) that the experimenter listener condition was too artificial to motivate older adults to engage in effortful

processing in order to recall the story. That is, the experimenter listener condition did not provide a meaningful context for the older adults.

Work by Adams, such as the study described above, has shown that changing the situation to decrease the artificiality of a task can redefine the situation for older adults. Unlike the context effects described in the previous sections, this research does not suggest that older adults need to compensate for losses or rely more on environmental support than young adults. Instead, the research suggests that the task itself is biased toward a young adult life stage by ignoring age-related changes in motivation and goals. Older adults may come into the task with different beliefs than young adults and thus appraise the task differently. By changing the task to make it match the goals of older adults, the task is no longer ambiguous. Although compensation cannot be ruled out in such cases, the theoretical argument here is that changing a task by adding context, for example, can create more of a match between the older adult's approach and the information in the situation (Mergler & Goldstein, 1983).

In sum, in contrast with typical context effects in the aging literature, the notion that some tasks may be more or less relevant for different age groups may result in young and older adults approaching the task in a qualitatively different manner. Each participant brings his or her own beliefs and predispositions to the task. For some tasks, these beliefs may consistently differ across the lifespan. In emotion recognition tasks, older adults may impose systematically different beliefs on the task from young adults due to documented age changes in emotional experience. Here, context is a tool for disambiguating the situation for older adults. These concerns translate well to the research on aging and emotion recognition, which is discussed in the following section.

2.3 The Role of Context in Explaining Age Differences in Emotion Recognition

Based on the influence of context effects on age differences in cognition, it is plausible that emotion recognition deficits in older adults may in part be due to the fairly impoverished task typically employed in emotion recognition studies. Indeed, emotion recognition is facilitated when context is added. For example, emotion recognition deficits appear to decrease as a function of the congruity between the age of the person displaying emotions and the age of the person recognizing the emotions; exhibiting an own-age bias (Malatesta et al., 1987). Moreover, as described above, due to age-related increases in the experience of a co-occurrence of emotions, older adults may be bringing something extra to the emotion recognition task. Older adults may be imposing their own experience with mixed emotions on the emotion recognition task. By adding context, the task may no longer be ambiguous for older adults.

In order to best illustrate how context added to an emotion recognition task might facilitate performance for older adults, we must first understand the nature of the emotion recognition tasks used in the literature. Thus, what follows is a detailed description of an emotion recognition task in which older adults were less accurate than young adults. In a recent study, young, middle-aged, and older adults were tested on their abilities to recognize emotion in a lexical task and a facial task (Isaacowitz et al., 2007). Stimuli for this study were the lexical and facial tests of the *Perception of Affect Test* (PAT; Rau, 1992) borrowed from an unpublished dissertation. For the lexical task, participants were asked to read a sentence that described an emotional situation (e.g., *An <u>older man</u> looks at the picture of his recently departed wife.*). Participants were asked to indicate the emotion

that the underlined subject of the sentence was feeling. The correct answer to the example sentence is sadness. The facial task was similar to those described above. Results for the lexical task indicated that older adults were less accurate at identifying the emotion in six of the seven emotion categories: anger, disgust, happiness, surprise, neutral, and sadness. The only emotion that older adults identified with the same accuracy as young adults in the lexical task was fear. For the facial task, older adults were less accurate than young adults at recognizing anger and happiness.

Returning to the dissociation introduced at the outset of this paper, if older adults are unable to recognize several emotions in both lexical and facial modalities, how are they able to regulate and control their emotional experience and maintain relationships? One possible explanation for this apparent discrepancy is that in daily life, older adults are able to draw upon additional information from contextual cues to help interpret the emotions they encounter. Thus, older adults may fare no worse than young adults at perceiving the emotional states of their social partners in daily life due to the increased contextual information present in daily life (compared to typical laboratory tests).

It is important to note that I am not arguing that there is no decline in the ability to recognize emotions in single modalities (such as pattern recognition); rather, I am suggesting that older adults are able to compensate for these deficits in everyday life by drawing upon contextual cues as well as their own knowledge about emotions. In addition, in a single modality situation, older adults might be at further disadvantage due to changes in the number of emotions perceived in the stimuli. Thus, age-related decline in typical emotion recognition tasks is likely due to both 1) age-related changes in the perception of mixed emotions, and 2) age-related declines in the ability to recognize

emotions. Adding contextual information can help older adults with both of these issues by disambiguating which of the several emotions is intended and by allowing the contextual cues to compensate for loss in emotion recognition abilities. Compensation is considered a process that is engaged in throughout development (Baltes, 1997). Older adults may have adapted strategies in order to compensate for an age-related loss in the ability to recognize emotions from facial expressions. Thus, older adults may rely on integrating information from several channels in order to interpret the emotion of their social partner.

It is important to recognize the possibility that integrating information across channels may pose a problem for older adults, given the well-documented age-related reduction in cognitive resources (Salthouse, 2004). This is especially a concern given the possibility of a general emotion processor that shares many resources across channels (Borod et al., 2000). Importantly, there is evidence from research with college students that integrating visual and audio emotional information is relatively automatic (Vroomen, Driver, & de Gelder, 2001). If this is the case, older adults may not be differentially taxed than young adults at integrating information across channels, as automatic processes are generally preserved with age (Hedden & Gabrieli, 2004). In addition, there is also evidence of an age-related improvement in the ability to integrate information from multiple sensory modalities (Laurienti, Burdette, Maldjian, & Wallace, 2006), although these age effects are yet to be tested with information of an emotional nature.

As mentioned above, a second possibility for the benefit of increased contextual information comes from evidence that older adults have been shown to experience a greater co-occurrence of emotion (Charles, 2005; Kennedy, Fung, & Carstensen, 2001).

If older adults are experiencing more than one emotion in their daily lives, they may also perceive more than one emotion in a single piece of emotional information. This possibility is slightly different from the compensation hypothesis above. Here I am suggesting that older adults are at a disadvantage in typical emotion recognition studies because they are approaching the task differently than young adults. That is, because of their increased experience with the co-occurrence of emotions, the task is actually more ambiguous for older adults. In addition, older adults may be more likely to impose prior experience on the task than young adults. In sum, older adults may need more information in order to make a judgment about the emotion being expressed. For example, in the sample lexical task given above, is the older man looking at a picture of his recently departed wife that was taken during a happy moment? Perhaps the man is feeling bittersweet or nostalgic, as he is reminded of a happy moment with his wife. Older adults may be more likely to interpret this sentence as being both happy and sad, than young adults, which may render the responses of older adults in a forced-choice decision task more often "wrong" than young adults. These possibilities were explored in the following studies.

2.4 Research Questions

The studies were designed to answer two main research questions. First, do older adults approach the emotion recognition task differently than young adults? Specifically, do older adults perceive a co-occurrence of emotions in the typical impoverished emotion recognition task? Second, does adding contextual information attenuate the age differences in emotion recognition by allowing older adults to integrate information from

several channels simultaneously? The specific hypotheses will be addressed in each study.

CHAPTER 3

METHODOLOGY

3.1 Overview of Research

One pilot study and two larger studies were conducted in order to investigate 1) whether older adults approach emotion recognition tasks in a qualitatively different manner from young adults (First Aim; Pilot Study and Study One) and 2) whether contextual information differentially facilitates emotion recognition accuracy in young and older adults (Second Aim; Study Two). In order to address the first aim, we conducted a pilot study in which we compared young and older adults' emotion recognition accuracy as a function of two response format conditions (i.e., free response and forced choice), and two response number conditions (i.e., single and multiple). In further service of the first aim, in Study One we compared a larger sample of young and older adults' emotion recognition accuracy as a function of the number of responses permitted for each emotion. The goal of the first study was to investigate whether older adults were more likely than young adults to identify multiple emotions in a single modality. In Study Two we compared performance on two modalities of emotion stimuli presented alone (i.e., lexical and facial) to performance when the two modalities were presented in synchrony (i.e., lexical and facial combined). Findings from Study One may indicate why age differences are attenuated in the combined condition of Study Two. Because these are the first studies in a program of research investigating the roles of mixed emotions and contextual information in explaining age-related differences in emotion recognition, we are using an extreme-groups design. The effects need to be

established first using an extreme-groups design but future studies should explore the phenomenon across the adult lifespan.

3.1.1 Materials across Studies

The materials and procedures used across the pilot study and the two main studies were similar. Adaptations to these procedures are described in the Method section for each study.

3.1.1.1 Emotion Recognition

Two sections from the *Perception of Affect Task* (PAT; Rau, 1992) were administered to assess emotion recognition: the lexical task and the facial task. Each task consists of 35 items, with five items in each of the seven emotion categories: anger, fear, disgust, happiness, sadness, surprise, or neutral. The lexical task consists of sentences in which the subject of the sentence is intended to be experiencing one of seven emotions. The subjects of the sentences ranged in age from childhood (e.g., boy) to late adulthood (e.g., grandfather). The facial task consists of still black and white photographs of posed facial expressions from the *Pictures of Facial Affect* set (POFA; Ekman & Friesen, 1976). Each face is intended to express one of the seven emotions. The people who posed the facial expressions were men and women of European descent who ranged in age from young adulthood to late middle age. Posers were instructed on which muscles to contract for each emotional expression. The photographs included in this set of facial expressions were consistently judged as the intended emotion by at least 70 percent of observers, with most of the photographs correctly judged by 80 percent of the observers (Ekman & Friesen, 1976). All of the emotion recognition tasks were administered on the computer using the E-Prime program. The tasks were presented in blocks, and the items within

each block were presented in a different random order both between and within participants.

3.1.1.2 Cognitive Abilities

The *Advanced Vocabulary Test* (Ekstrom, French, Harman, & Dermen, 1976) was used to assess verbal ability. For each of the 36 items, participants were asked to circle the word from a list of four words that was closest in meaning to a target vocabulary word. Fluid intelligence was measured using the *Letter Sets Test – I-1 Revised* (Ekstrom et al., 1976). Participants were presented with 30 items, each composed of five letter sets; participants had to deduce the rule that had been followed by four of the five letters sets in each item.

3.1.1.3 Perceptual Functioning

Participants were screened for vision using two tests. We first measured visual acuity with the *Snellen* chart (Snellen, 1868). We administered a second test to determine whether participants could correctly discriminate between human faces because we thought this perceptual ability would be more closely related to the ability to decode facial expressions of emotion. The *Benton Facial Discrimination Test – Short Form* (Levin, Hamsher, & Benton, 1975) assesses the ability to identify and discriminate photographs of unfamiliar human faces. The internal consistency of the test is adequate (Cronbach's $\alpha = .69$). Participants were presented with a target face on the first page. On the facing page, they had to identify the identical target face in an array of six faces. There were 27 targets to match and participants' scores were the number of target faces identified correctly.

3.1.1.4 Demographics Form

Participants also filled out a demographics form as required by the National Institute on Aging. This form included information about age, gender, ethnic background, and health. For health, participants were asked to rate their overall health on a 5-point Likert-type scale (*1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent*).

3.2 Pilot Study

3.2.1 Overview and Design

The purpose of the pilot study was two-fold. First, we wanted to determine whether a multiple response format would differentially facilitate older adults' emotion recognition accuracy, compared to that of young adults. If a multiple response format facilitates older adults' emotion recognition accuracy more than young adults', then this methodology could be expanded upon in Study One. Second, we wanted to rule out the possibility that age differences in emotion recognition accuracy are due to differences in the degree to which the emotion labels provided in a multiple choice list (i.e., afraid, angry, disgusted, happy, sad, surprised) match the emotion labels that young versus older adults endorse. If there are age differences in the emotion labels spontaneously generated by young and older adults, then age differences in the typical emotion recognition tasks which employ multiple choice lists may be due to age differences in semantics for emotions. By eliminating this possibility, the two larger studies that follow the pilot could utilize multiple-choice lists without the danger of hindering one of the age groups due to semantic differences in emotion labels.

In order to address the two goals of the pilot study, we used an extreme age groups design with age as a between subjects factor and all other variables as within-

subjects factors: 2 (age group: young vs. old) X 2 (modality: lexical vs. facial) X 2 (response format: free response vs. forced choice) X 2 (number of responses: traditional scoring vs. liberal scoring) X 7 (emotion: afraid, angry, disgusted, happy, sad, surprised, and neutral).

3.2.2 Method

3.2.2.1 Participants

Young adult participants (n = 21; 52% female)[1], ranged in age from 18 to 24 years and were recruited from a pool of undergraduate psychology students who received credit hours toward a psychology course for their participation. Older adult participants (n = 19; 79% female)[1] ranged in age from 61 to 81 years and were recruited from our participant pool. They received $25 for participation. All participants were community dwelling and spoke English fluently. On average, participants had more than 12 years of formal education, with older adults (M_{years} = 15.16, SE = .39) reporting significantly more years of education than young adults (M_{years} = 13.71, SE = .37), $F(1, 38) = 7.26$, $p < .05$, $\eta_p^2 = .16$. The majority of participants were White (68%) or Black (20%).

The participants in this sample exhibited the typical pattern of age differences in perceptual and cognitive abilities (See Table 1 for full descriptives). There were no age differences in self-reported health in this sample, $p > .20$.

3.2.2.2 Procedure

Participants were tested in groups of one to four for approximately two and a half hours. The order of tasks was as follows: Snellen eye chart, Benton Facial Discrimination

[1] The original sample was composed of 26 young adult participants and 23 older adult participants (N = 49). Five young adults and four older adults had extensive missing data in the free response condition (more than five first choice responses missing in the lexical condition) and were excluded from the present analyses.

Test, Vocabulary Test, Letter Sets Test, emotion recognition task (lexical free response, lexical forced choice, facial free response, facial forced choice), and the demographics form, followed by debriefing and compensation.

Table 1 Descriptives and Analyses of Variance (ANOVAs) for Perceptual and Cognitive Variables

		Young Adults			Older Adults			ANOVA	
Study	Variable	*n*	*Mean*	*SE*	*n*	*Mean*	*SE*	*F*	η_p^2
Pilot Study	Visual Acuity[a]	21	19.14	1.41	17[e]	31.24	1.56	33.16**	.48
	Facial Discrimination[b]	21	22.67	.55	15[e]	21.67	.65	1.37	.04
	Letter Sets Test[c]	21	23.29	.87	18[e]	16.44	.94	28.70**	.44
	Vocabulary Test[d]	21	16.19	1.40	18[e]	23.06	1.51	11.15**	.23
Study One	Visual Acuity	62	21.87	1.04	61	27.90	1.05	16.64**	.12
	Facial Discrimination	62	22.79	.25	61	21.84	.25	7.36**	.06
	Letter Sets Test	62	23.60	.48	61	18.20	.48	62.84**	.34
	Vocabulary Test	62	18.32	.73	61	23.79	.73	28.03**	.19
Study Two	Visual Acuity	76	21.36	1.00	66	30.96	1.08	42.21**	.23
	Facial Discrimination	76	22.12	.28	66	21.80	.30	.61	.00
	Letter Sets Test	76	23.75	.50	66	16.65	.53	95.21**	.41
	Vocabulary Test	76	18.17	.69	66	23.23	.74	25.20**	.15

* $p < .05$. ** $p < .01$. [a] Higher scores = worse visual acuity. [b] Maximum score = 27. [c] Maximum score = 30. [d] Maximum score = 36. [e] Two older adults were missing the visual acuity data. Four older adults were missing the facial discrimination data. One older adult was missing the letter sets and vocabulary data.

3.2.2.2.1 Free Response

For each item, participants listed the emotion(s) they thought the target was feeling. Participants were permitted up to five responses for each item. After generating up to five responses for an item, participants were then asked to rate the intensity for each of the emotions they listed on a Likert-type rating scale (*1* = not at all intense; *7* = extremely intense).

3.2.2.2.2 Forced Choice

For each item, participants made between two and four responses: 1) first emotion choice, 2) intensity rating, 3) optional second emotion choice, and 4) intensity rating.

3.2.2.2.3 Qualitative Coding of Free Responses

A theory and data-driven qualitative coding scheme was developed for the free response data. The coding scheme categorized the emotions listed into the following categories: angry, afraid, disgusted, happy, sad, surprised, neutral, or not codable. Every emotion response received at least one code, but could be coded into more than one category. For example, the word "upset" was categorized as both angry and sad. For a complete description and examples of each category in this coding scheme refer to Table 2. Every emotion response was also coded for whether the response was a match for the intended emotion label[2]. Two coders independently coded 42 percent of the 4,632 responses generated as presence or absence for each category. Coders discussed discrepancies to reach an agreement. Interrater reliability reached 95 percent agreement.

[2] "Anger" and "angry" were considered matches for the angry label, whereas "frustrated" was not a match. "Afraid", "fear", and "fearful" were considered matches for afraid, whereas "apprehensive" was not a match. "Disgust" and "disgusted" were matches for disgusted, whereas "sick" was not a match. "Happy" and "happiness" were matches for happy, "ecstatic" was not. "Sad" and "sadness" were matches for sad, whereas "lonely" was not. "Surprise" and "surprised" were matches for surprised, whereas "shocked" was not.

A single coder coded the remainder of responses. The frequencies of each emotion category endorsed by young and older adults, across all five response-opportunities for each item, are reported as percentages of total responses in Table 3. There were no age differences in either task for total number of responses provided, *ps* > .20.

Table 2 Qualitative Coding Scheme for Free Response Data

Category	Description	Examples
Afraid	Denoting fear or apprehension.	frightened, scared, nervous
Angry	Showing strong resentment or belligerence.	mad, furious, irritated
Disgusted	Exhibiting aversion or repugnance.	nauseated, grossed out, sick
Happy	Delighted, pleased, or glad.	excited, joyful
Sad	Affected by grief or sorrow.	mournful, disappointed
Surprised	Feeling sudden wonder or astonishment.	shocked, amazed, astounded
Neutral	Lacking emotion completely.	no emotion, nothing
Not Codable	Any response that does not fit within any other category.	hungry, confused, empathy, questioning

Table 3
Frequency of Categories Endorsed by Each Age Group Across All Five Responses

Task	Category	Young Adults ($n = 21$)		Older Adults ($n = 19$)		ANOVA	
		Mean	*SE*	*Mean*	*SE*	*F(1, 38)*	η_p^2
Lexical	Afraid	15%	.01	12%	.01	3.05†	.07
	Angry	11%	.01	12%	.01	.14	.00
	Disgusted	6%	.01	7%	.01	3.93†	.09
	Happy	16%	.01	20%	.02	4.13*	.10
	Sad	15%	.01	14%	.01	.04	.00
	Surprised	7%	.00	4%	.00	23.93**	.39
	Neutral	3%	.00	2%	.00	7.01*	.16
	Not Codable	28%	.02	29%	.03	.21	.01
Total Response Count		78.24	4.27	77.16	4.49	.03	.00
Facial	Afraid	12%[a]	.01	13%[b]	.01	.23[c]	.01
	Angry	19%	.01	13%	.02	6.36*	.18
	Disgusted	8%	.01	5%	.02	2.47	.08
	Happy	15%	.01	15%	.01	.00	.00
	Sad	14%	.01	10%	.02	4.59*	.14
	Surprised	17%	.01	16%	.02	.25	.01
	Neutral	12%	.02	14%	.03	.36	.01
	Not Codable	3%	.01	14%	.05	8.07**	.22
Total Response Count		48.20	3.69	51.55	4.97	.29	.01

[a] One young adult was missing data in the facial free response task, decreasing the young adult sample to $n = 20$ for the facial task.

[b] Eight older adults were missing data in the facial free response task, decreasing the older adults sample to $n = 11$ for the facial task.

[c] The degrees of freedom for the ANOVAs on the facial task are $df = 1, 29$.

† $p < .10$, * $p < .05$, ** $p < .01$.

3.2.3 Results and Summary

Across tasks, all individuals were more accurate at recognizing emotions (except for neutral) in the liberal scoring condition than the traditional scoring condition. The gain in performance from liberal scoring compared to traditional scoring was not greater for older adults than young adults. In the lexical task, there was, however, a nonsignificant trend toward a Number of Responses X Age Group interaction, $F(1, 36) = 2.56$, $p = .12$, $\eta_p^2 = .07$. Because we had a relatively small sample size in this pilot study, we may not have had enough power to detect small differences between the age groups. In addition, young adults' performance was at ceiling for several of the emotions, even in the traditional scoring condition. These ceiling effects may decrease the likelihood of detecting an interaction in the degree to which the liberal scoring benefits young and older adults by restricting the range of young adult performance improvement.

Overall, there were not age differences in the degree to which participants' responses matched our emotion labels. There were also no age differences in the number of emotions reported in any of the conditions, $ps > .10$. Young adults had larger average intensity difference scores than the older adults, however, which suggested that young adults rated their first two emotion responses as less similar in intensity than older adults.

Theses age differences in intensity difference scores provide some support for the hypothesis that older adults are construing more emotions in the emotion stimuli than young adults. Although there are not age differences in the number of emotion responses provided for each item, there are age differences in the average difference between the intensity ratings for the first two emotion responses reported (in all conditions except the facial free response condition), with young adults exhibiting a larger difference than older

adults between the intensity ratings of their first and second emotion response for an item.

3.3 Study One

3.3.1 Overview and Design

Study One further examined whether older adults interpret the emotion recognition task in a qualitatively different manner from young adults. Although for some emotions, young adults tended to spontaneously produce an exact match to our intended emotion labels more frequently than older adults in the pilot study, we did not find a differential gain in emotion recognition accuracy for older adults, compared to young adults, in the free response conditions. This suggested that age-related differences in typical emotion recognition tasks are not solely due to age differences in semantics for emotion words. Thus, in Study One, we focused on the forced choice condition only. In Study One, young and older adults were presented with the lexical and facial tasks and permitted up to six emotion responses for each item from a multiple choice list of seven emotions (i.e., afraid, angry, disgusted, happy, sad, surprised, and neutral).

Study One employed a 2 (age group: young vs. old) X 2 (modality: lexical vs. facial) X 2 (number of responses: traditional scoring vs. liberal scoring) X 7 (emotion: afraid, angry, disgusted, happy, sad, surprised, and neutral) design with age group as the only between-subjects factor and all other factors within-subjects.

3.3.2 Hypotheses

3.3.2.1 Hypothesis 1: Emotion Recognition Accuracy Improves When More Responses Are Permitted

3.3.2.1.1 Hypothesis 1a

As in the pilot study, for Study One, we predicted that all individuals would be more accurate at identifying emotions when permitted more than one response, relative to a single response. That is, for all individuals, emotion recognition accuracy will be greater when participants' first and second choice emotion responses are included in the accuracy score (liberal scoring); relative to an accuracy score based solely on participants' first emotion response (traditional scoring).

3.3.2.1.2 Hypothesis 1b

The gain in emotion recognition accuracy from a single response format to a multiple response format will be greater for older adults than young adults. That is, older adults will benefit more than young adults from the liberal scoring. Because older adults may be more likely to interpret a target as expressing multiple emotions than young adults, their first emotion response may not be the intended emotion. By allowing a second emotion response, older adults may be more likely to endorse the intended emotion. Whereas young adults will also benefit from the liberal scoring, they will not benefit to the same degree as older adults because they may be less likely to interpret the targets as expressing more than one emotion. As a result, young adults may be less likely to endorse more than one emotion, when compared with older adults, and thus less likely to benefit from a multiple response format (i.e., liberal scoring).

3.3.2.2 Hypothesis 2: Older Adults Construe More Emotions in the Stimuli than Young Adults

Older adults will report more emotion responses for each item, compared to young adults. Again, older adults may be more likely than young to interpret the targets in the stimuli as expressing multiple emotions, and this will be exhibited as an age difference in the number of emotion responses reported for each item.

3.3.2.3 Hypothesis 3: Lexical Task Elicits More Emotions than Facial Task

Both young and older adults will list more emotions for the lexical task than the facial task. The lexical task appears to lend itself to multiple emotions more so than the facial task because the sentences describe situations in which people may react in different ways. There appears to be more room for interpretation in the lexical task than the facial task.

3.3.2.4 Hypothesis 4: Exploratory Mediating Hypothesis

Individual differences on the multiplicity of emotions task will account for age differences in the traditional scoring of emotion recognition accuracy (i.e., only scoring the first emotion chosen). This hypothesis examines the possibility that age differences in the typical emotion recognition task are a consequence of an age-related increase in the experience of multiple spontaneous emotions. That is, because older adults are more likely than young adults to have experienced several different emotions at the same time, they may also be more likely than young adults to interpret emotional stimuli as containing more than one emotion.

3.3.3 Method

3.3.3.1 Participants

Young adult participants (n = 62; 66% female)[3] ranged in age from 18 to 23 years and were recruited from a pool of undergraduate psychology students who received credit hours toward a psychology course for their participation. Older adult participants (n = 61; 52% female)[9] ranged in age from 60 to 81 years and were recruited from our participant pool. They received $20 for participation. All participants were community dwelling and spoke English fluently. On average, participants had more than 12 years of formal education, with older adults (M_{years} = 15.25, SE = .24) reporting significantly more years of education than young adults (M_{years} = 13.47, SE = .24), $F(1, 121) = 27.96$, $p < .001$, $\eta_p^2 = .19$. The majority of participants were White (72%).

Participants in this sample exhibited the typical pattern of age differences in perceptual and cognitive abilities. Specifically, young adults exhibited better visual acuity and facial discrimination than older adults and outperformed older adults on our measure of fluid intelligence, $ps < .01$. Older adults, however, scored significantly higher than young adults on the Vocabulary Test $p < .01$ (See Table 1 for full descriptives). On average, participants rated themselves as being in fairly good health (M = 3.71, SD = .92) on a 5-point Likert-type scale (*1 = poor*; *5 = excellent*). Young adults (M = 3.97, SE = .11) reported significantly better health than older adults (M = 3.44, SE = .11), $F(1, 121) = 10.80$, $p < .01$, $\eta_p^2 = .08$.

[3] The original sample was composed of 63 young adult participants and 64 older adult participants (N = 127). One young adult scored below our cut-off (i.e., less than 17 correct) on the Facial Discrimination Test. Three older adults had extensive missing data in the emotion recognition task (more than five first choice responses missing) and were excluded from the present analyses.

3.3.3.2 Materials

The materials for Study One were identical to those in the pilot study (i.e., lexical and facial sections of the Perception of Affect Task, Vocabulary Test, Letter Sets Test, Snellen Acuity Chart, Benton Facial Discrimination Test, and demographics form) except that we added a Multiplicity of Emotional Experience measure.

3.3.3.2.1 Multiplicity of Emotional Experience

Participants responded to two short problem vignettes to assess the degree to which participants experience multiple emotions at the same time (See the Appendix for vignettes). One of the vignettes has been shown to elicit anger and the other has been shown to elicit sadness (Coats & Blanchard-Fields, 2008). Participants read each problem vignette and then listed the emotions they would feel if they were in the situation. Participants could list up to five emotions. After listing the emotions they thought they would feel in the situation, participants indicated the degree (from 1 to 100%) to which they would feel each emotion.

3.3.3.3 Procedure

Participants were tested in groups of one to four for approximately two hours. The order of tasks was as follows: Snellen eye chart, Benton Facial Discrimination Test, Vocabulary Test, Letter Sets Test, demographics form, Multiplicity of Emotional Experience, emotion recognition tasks (order of lexical and facial blocks counterbalanced between participants), followed by debriefing and compensation. For emotion recognition accuracy, there was no effect of presentation order, $ps > .10$, so this variable was not included in further analyses.

The procedure for the emotion recognition task was the same as the procedure for the forced choice conditions in the pilot study except that 1) participants were permitted up to six emotion responses, instead of only two, and 2) within one trial, participants first chose all of the emotions they thought a target was feeling, then rank-ordered those emotions from most prevalent to least prevalent, and then rated the intensity of each of those emotions from 1 to 100 percent. The emotion recognition tasks were administered on the computer using the E-Prime program. The tasks were presented in blocks, and the items within each block were presented in a different random order between participants.

CHAPTER 4

STUDY ONE RESULTS

All analyses are reported with two-tailed tests of significance. Effect sizes for each *F* value are reported as partial eta squared (η_p^2). Missing items were treated as incorrect. To control for violations of the sphericity assumption we used the Greenhouse-Geisser correction. The alpha level of multiple comparisons was adjusted using Bonferroni corrections.

4.1 Emotion Recognition Accuracy

To address whether emotion recognition accuracy differs as a function of gender, we conducted a two-way between subjects analysis of variance (ANOVA) with Age, Gender, and the Age X Gender interaction term. This analysis was performed with each of the two total emotion recognition accuracy scores (i.e., summed across emotion) using the traditional scoring: lexical total first choice correct and facial total first choice correct. For the lexical task, neither the main effect of Gender nor the Age X Gender interaction term reached significance, *p*s > .50. For the facial task, there was a main effect of Gender $F(1, 119) = 4.07$, $p < .05$, $\eta_p^2 = .03$, with women ($M = 29.50$, $SE = .44$) performing significantly better than men ($M = 28.11$, $SE = .53$). Because gender was not of primary interest to our analyses and did not interact with age, gender was excluded from further analyses.

Because the majority of our hypotheses were focused on condition differences within task type (i.e., within lexical or within facial), rather than between task types, we analyzed the two tasks separately. For each task (i.e., lexical and facial), we performed a

mixed-effects analysis of variance (ANOVA) with three factors: age-group (between subjects), number of responses (within-subjects), and emotion (within-subjects). The dependent variable was the number of correct responses for each emotion.

4.1.1 Lexical Task

Replicating past work (Isaacowitz et al., 2007), in the lexical task there was a main effect of Age Group with young adults ($M = 4.65$, $SE = .04$) performing better than older adults ($M = 4.44$, $SE = .04$), $F(1, 121) = 16.99$, $p < .001$, $\eta_p^2 = .12$, suggesting that across both types of scoring and all emotions, young adults were better able to recognize emotions in the lexical task than older adults. As expected, there was a significant main effect for Number of Responses, with emotion recognition accuracy being greater in the liberal scoring ($M = 4.74$, $SE = .02$) compared to the traditional scoring ($M = 3.35$, $SE = .03$), $F(1, 121) = 261.48$, $p < .001$, $\eta_p^2 = .68$. There was also a main effect of Emotion, $F(3.84, 465.06) = 14.98$, $p < .001$, $\eta_p^2 = .11$. Follow-up paired samples t-tests suggested that participants were more accurate at identifying fear[4] ($M = 4.76$, $SE = .04$) than anger ($M = 4.38$, $SE = .07$), disgust ($M = 4.36$, $SE = .06$), surprise ($M = 4.47$, $SE = .06$), or neutral ($M = 4.29$, $SE = .10$). Participants were also better at identifying happiness ($M = 4.84$, $SE = .03$) than anger or disgust, and better at identifying sadness ($M = 4.73$, $SE = .04$) compared to surprise, disgust, anger, or neutral.

These main effects, however, were qualified by two significant interactions. There was a significant Number of Responses X Emotion interaction, $F(4.02, 486.26) = 15.35$, $p < .001$, $\eta_p^2 = .11$. Follow up paired samples t-tests revealed that accuracy for all emotions was greater in the liberal scoring condition than the traditional scoring

[4] Without the Bonferroni correction, participants were also more accurate at identifying fear than happiness, $p < .05$.

condition except for neutral[5]. There was also a significant Number of Responses X Age Group interaction, $F(1, 121) = 19.08$, $p < .001$, $\eta_p^2 = .14$, which suggested that the gain in accuracy from the liberal scoring compared to the traditional scoring was greater for older adults ($M_{traditional} = 4.19$, $SE = .05$; $M_{liberal} = 4.69$, SE = .03) than young adults ($M_{traditional} = 4.51$, $SE = .05$; $M_{liberal} = 4.80$, $SE = .03$; see Figure 1).

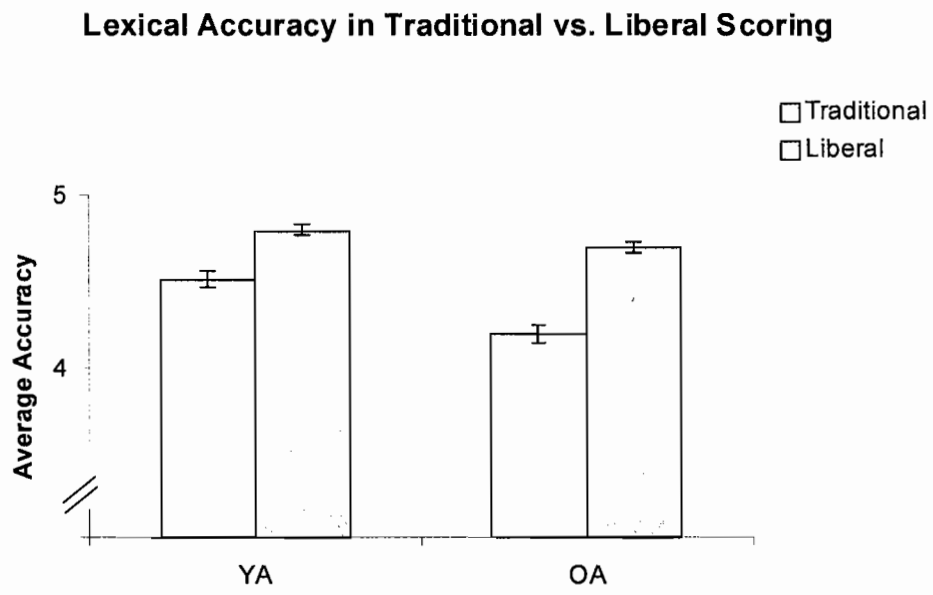

Figure 1. Study One Average Lexical Task Accuracy as a Function of Number of Responses (i.e., traditional scoring or liberal scoring).

[5] Although without the Bonferroni correction, participants were more accurate at identifying neutral in the liberal scoring condition than the traditional scoring condition, $p < .05$.

4.1.1.1 Hypothesis 1

Thus, consistent with Hypothesis 1a, for the lexical task, all individuals were more accurate at recognizing emotions (except for neutral) in the liberal scoring condition than the traditional scoring condition as supported by the main effect for Number of Responses and the interaction for Number of Responses X Emotion. In support of Hypothesis 1b, we also found a significant Number of Responses X Age interaction. The gain in performance from liberal scoring compared to traditional scoring was greater for older adults than young adults in the lexical task.

4.1.2 Facial Task

For the facial task, there was a significant main effect of Number of Responses $F(1, 121) = 129.57$, $p < .001$, $\eta_p^2 = .52$, with participants performing better in the liberal scoring condition ($M = 4.44$, $SE = .04$) than the traditional scoring condition ($M = 4.14$, $SE = .05$). There was also a main effect of Emotion, $F(4.28, 518.08) = 34.80$, $p < .001$, $\eta_p^2 = 22$. Follow-up comparisons suggested that participants were more accurate at recognizing facial expressions of anger ($M = 4.62$, $SE = .06$) than those of disgust ($M = 4.07$, $SE = .10$), sadness ($M = 4.20$, $SE = .10$), or neutral ($M = 3.89$, $SE = .11$). Participants were better at recognizing happiness ($M = 4.81$, $SE = .05$) than anger, disgust, sadness, or neutral and better at recognizing surprise ($M = 4.80$, $SE = .05$) than neutral. Accuracy was greater for recognizing all emotions, other than neutral, when compared with afraid ($M = 3.67$, $SE = .10$), which had the lowest accuracy of all the emotions[6].

[6] If Bonferroni corrections were not made, recognition for surprise was greater than anger and recognition for sadness was greater than neutral, $p < .05$.

These main effects were qualified by three significant interactions. The Number of Responses X Emotion interaction was significant, $F(3.93, 475.43) = 20.83$, $p < .001$, $\eta_p^2 = .15$. Follow-up paired samples *t*-tests revealed that accuracy for recognizing all of the facial expressions of emotion except neutral[7] was greater in the liberal scoring condition than the traditional scoring condition. The Emotion X Age Group interaction was significant, $F(4.28, 518.08) = 5.80$, $p < .001$, $\eta_p^2 = .05$. To investigate this interaction in more detail, we performed a multivariate analysis of variance (MANOVA) with Age Group as the independent variable and the average accuracy collapsed across Number of Responses for each emotion as the dependent variables. This analysis revealed significant age differences in the recognition of anger, disgust, happiness, sadness, and surprise, $ps < .05$. Young adults were more accurate than older adults for all of the emotions with significant age differences except for disgust, $ps < .05$. Older adults ($M = 4.35$, $SE = .13$) were more accurate at recognizing disgust than young adults ($M = 3.79$, $SE = .13$).

These interactions were further qualified by a three way interaction. The Number of Responses X Emotion X Age Group interaction was significant, $F(3.93, 475.43) = 5.30$, $p < .001$, $\eta_p^2 = .05$. (See Table 4 for means and ANOVA results for emotion recognition accuracy with traditional and liberal scoring). To better understand this three-way interaction, we computed a difference score to represent the difference between the traditional and liberal scoring for each emotion, yielding seven difference scores. Next, we performed a MANOVA with Age Group as the independent variable and the seven difference scores as the independent variables. For anger, the gain in accuracy from liberal scoring, compared to traditional scoring, was greater for older adults than young

[7] If Bonferroni corrections were not made, the difference between traditional and liberal scoring was also significant for neutral, $p < .05$.

adults. For disgust, the gain in accuracy from liberal scoring, compared to traditional scoring, was greater for young adults (See Figure 2).

Table 4 Emotion Recognition Accuracy in Study One

	Traditional Scoring						Liberal Scoring					
	Young[a]		Old[b]		ANOVA		Young		Old		ANOVA	
	M	*SE*	*M*	*SE*	*F*[c]	η_p^2	*M*	*SE*	*M*	*SE*	*F*	η_p^2
Lexical Task												
Afraid	4.73	.08	4.51	.08	3.87†	.03	4.94	.05	4.85	.05	1.66	.01
Angry	4.44	.12	3.79	.12	15.13**	.11	4.77	.08	4.53	.08	4.63*	.04
Disgust	4.29	.12	3.87	.13	5.71*	.05	4.69	.08	4.57	.08	1.27	.01
Happy	4.86	.06	4.62	.06	7.14**	.06	4.97	.03	4.92	.03	1.41	.01
Sad	4.66	.08	4.49	.08	2.27	.02	4.92	.05	4.85	.05	1.02	.01
Surp.	4.24	.14	3.92	.14	2.60	.02	4.87	.05	4.85	.05	.07	.00
Neutral	4.36	.15	4.13	.15	1.17	.01	4.42	.13	4.26	.13	.70	.00
Facial Task												
Afraid	3.36	.17	3.26	.17	.15	.00	4.13	.14	3.92	.14	1.19	.01
Angry	4.79	.10	4.25	.10	14.21**	.11	4.84	.07	4.61	.07	5.15*	.04
Disgust	3.39	.16	4.18	.16	13.03**	.10	4.19	.13	4.53	.13	3.37†	.03
Happy	4.87	.07	4.62	.08	5.54*	.04	4.94	.06	4.80	.06	2.78†	.02
Sad	4.40	.15	3.74	.16	9.33**	.07	4.58	.12	4.08	.12	8.28**	.06
Surp.	4.84	.08	4.61	.08	4.10*	.03	4.97	.06	4.77	.07	4.71*	.04
Neutral	3.79	.16	3.90	.16	.24	.00	3.86	.16	4.00	.16	.40	.00

[a] Young adults $n = 62$. [b] Older adults $n = 61$. [c] F statistic $df = (1, 121)$.
Note. $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$.

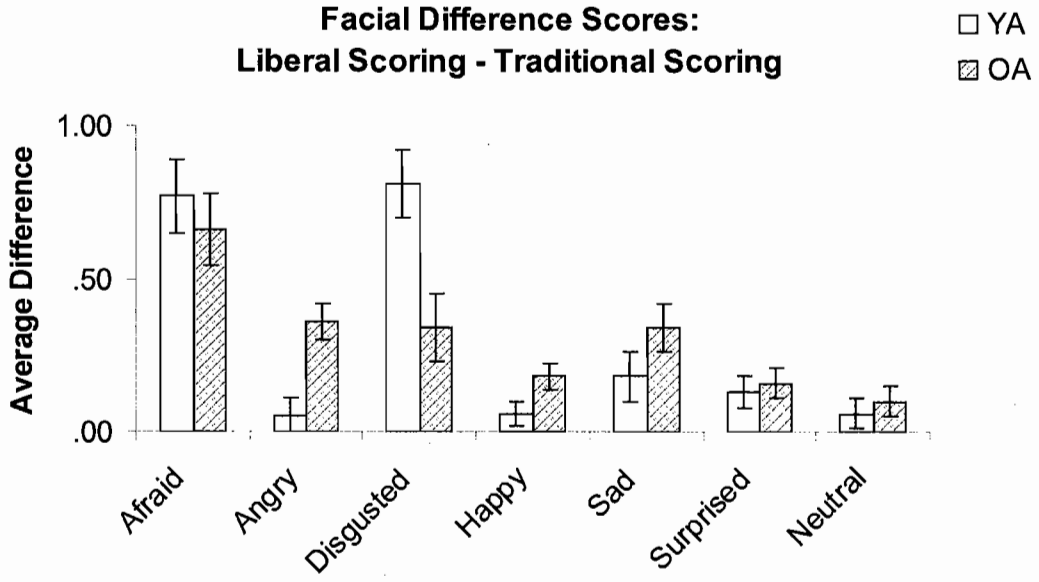

Figure 2. Study One Traditional Minus Liberal Scoring Difference Scores for the Facial Task by Emotion.

4.1.2.1 Hypothesis 1

Consistent with Hypothesis 1a, all individuals were more accurate in the liberal scoring condition compared to the traditional scoring condition overall and for all facial expressions of emotion except neutral. We also found partial support for Hypothesis 1b, however, which predicted that older adults would benefit more than young adults from the liberal scoring condition. For anger recognition, older adults benefited to a greater extent than young adults from the liberal scoring. For disgust recognition, however, young adults benefited to a greater extent than older adults from the liberal scoring.

4.2 Number of Emotions

In order to address Hypothesis 2, which predicted that older adults would report more different discrete emotions for each item than young adults, we computed the total number of responses reported separately for the lexical and facial tasks. Next, we conducted a one-way between subjects MANOVA with Age Group as the independent variable and two dependent variables: lexical total number of responses and facial total number of responses. There were no age differences in the total number of emotions reported in either task, $ps > .10$.

We also investigated whether there were age differences in the number of second emotions chosen. We performed a MANOVA with Age Group as the independent variable and two dependent variables: lexical total second emotions chosen and facial total second emotions chosen. Age Group only reached marginal significance in the lexical task, $F(1, 121) = 3.29$, $p = .07$, $\eta_p^2 = .03$, which suggested a trend for older adults ($M = 16.75$, $SE = .79$) to endorse a second emotion in the lexical task more often than young adults ($M = 14.74$, $SE = .78$).

In order to determine whether there were age differences in the degree to which people endorsed a second emotion for the different discrete emotions, we followed up this analysis with a MANOVA with age group as the independent variable and total number of second choice responses for each emotion (i.e., seven dependent variables, one for each emotion's second choice emotion count). Only anger and disgust showed significant differences, $ps < .05$. For both of these emotions, older adults ($M_{anger} = .74$, $SE = .09$; $M_{disgust} = 3.16$, $SE = .21$) were more likely than young adults ($M_{anger} = .34$, $SE = .09$; $M_{disgust} = 2.44$, $SE = .21$) to report a second emotion response. Next, separately for

anger and disgust in the lexical task, we tested whether age differences in the tendency to report a second emotion account for age differences in first choice accuracy. For the first model, the second emotion count did not account for age differences in anger emotion recognition. In the second model, disgust traditional scoring accuracy was used as the dependent variable in the mediation analysis. Using the Baron and Kenny (1986) steps for mediation, support was found for a fully mediated model. Age was negatively associated with disgust emotion recognition accuracy using the traditional scoring, $r = -.22$, $p < .05$, and age was positively associated with number of second emotions reported for disgust items, $r = .22$, $p < .05$. When age and second emotion count were added to a linear regression model as predictors of disgust recognition accuracy, second emotion count was negatively associated with disgust recognition, $\beta = -.22$, $p < .05$. Also, in this same regression analysis, age was no longer a significant predictor of disgust recognition, $p > .05$.

We also examined the facial task second choice emotion count by discrete emotion. Older adults ($M = .97$, $SE = .13$) were more likely than young adults ($M = .58$, $SE = .13$) to choose a second emotion for happy items, $F(1, 121) = 4.45$, $p < .05$, $\eta_p^2 = .04$. There was also a trend for older adults ($M = 1.64$, $SE = .19$) to choose a second emotion more often than young adults ($M = 1.11$, $SE = .19$) for anger items, $F(1, 121) = 3.84$, $p = .05$, $\eta_p^2 = .03$. Next, we tested whether age differences in the tendency to report a second emotion account for age differences in first choice accuracy. For happy items in the facial task, second emotion count was negatively associated with happy recognition $\beta = -.22$, $p < .05$, and age was no longer a significant predictor of happy recognition, $p >$

.05. Age remained significant, $p < .05$, in predicting anger recognition when the second emotion count for anger was tested as a mediator.

We also investigated whether there were age differences in the similarity of intensity ratings for the first two emotion choices reported for each item. Although age differences in the number of different emotions reported for each item were not reliable, this null finding may be due to a demand characteristic of the study. That is, although young adults may primarily construe each stimulus item as expressing one emotion, when asked for a second emotion response they provided a second emotion. Thus, to further investigate the possibility that older adults are more likely than young adults to construe multiple emotions in the stimuli, we computed a difference score that represented the difference in intensity rating between the first and second emotion choice for each item. We conducted a one-way MANOVA for each task (i.e., one for the lexical task and one for facial task) with age group as the independent variable and two dependent variables: 1) total average intensity difference score for first choice correct, and 2) total average intensity difference score for second choice correct. There were no age differences in the intensity difference scores, *p*s > .10[8].

4.3 Lexical Task versus Facial Task

In order to address Hypothesis 3, which predicted that all individuals would provide more emotion responses in the lexical task than the facial task, we performed a paired samples *t* test to compare the total number of responses in the lexical condition to the total number of responses in the facial condition. Consistent with our hypothesis,

[8] There were also no age differences in intensity difference scores when these analyses were done separately by discrete emotion, *p*s > .10.

participants provided significantly more responses in the lexical task (M = 55.10, SE = .95) than the facial task (M = 46.92, SE = .85), $t(122) = 9.04$, $p < .001$, $d = .82$.

4.4 Multiplicity of Emotional Experience

Hypothesis 4 predicted that individual differences on the number of emotions reported for the multiplicity of emotions measure would account for age differences in the traditional scoring of emotion recognition accuracy. To address this hypothesis, we computed Pearson's correlation coefficients for the relationships between age group, number of emotions experienced, and emotion recognition accuracy. The only significant correlation was for the relationship between age group and the number of the emotions experienced in Story 1 (Anger), $r = -.27$, $p < .01$, which suggested that older adults reported fewer emotions experienced than young adults for Story 1. We did not find support for a relationship between number of emotions experienced and emotion recognition accuracy[9].

4.5 Summary of Results

Overall, participants were more accurate in the liberal scoring condition than the traditional scoring condition. For the lexical task, young adults were better able to recognize emotions overall than older adults. Also in the lexical task, older adults benefited more than young adults from the liberal scoring. In the facial task, older adults benefited more than young adults from the liberal scoring for anger recognition while young adults benefited more than older adults from the liberal scoring for disgust recognition. In the lexical task, older adults endorsed a second emotion more often than young adults for angry and disgusted items. In the facial task, older adults reported a

[9] We also computed the percentage difference scores for the first two emotions experienced (for Story 1 and Story 2). Relationships between the percentage difference scores and age or emotion recognition accuracy were not significant, $ps > .05$.

second emotion more often than young adults for happy items, and marginally for angry items. Participants provided more responses in the lexical task than the facial task. We did not find a relationship between the experience of multiple emotions and emotion recognition accuracy.

CHAPTER 5

STUDY TWO METHODOLOGY

5.1 The Effect of Contextual Information on Age-Related Differences in Emotion Recognition Accuracy

5.1.1 Overview and Design

In Study Two we compared accuracy on single modalities of emotion recognition tasks to accuracy when the two modalities of emotion tasks were combined in synchrony. The lexical and facial tasks of the *PAT* were used. There were three conditions presented within subjects. Participants made judgments about the emotion expressed in 1) the lexical task alone, 2) the facial task alone, and 3) the lexical and facial tasks combined.

Study Two employed a 2 (age group: young vs. old) X 3 (condition: lexical, facial, combined) X 7 (emotion: afraid, angry, disgusted, happy, sad, surprised, and neutral) design with age group as the only between-subjects factor and all other factors within-subjects.

5.1.2 Hypotheses

There were two main hypotheses for Study Two.

5.1.2.1 Hypothesis 1

Young adults will outperform older adults in the two conditions with single modalities (i.e., the lexical alone condition and the facial alone condition).

5.1.2.2 Hypothesis 2

5.1.2.2.1 Hypothesis 2a

All individuals will be more accurate in the combined condition, when compared to either the lexical or the facial tasks alone. That is, accuracy in the combined condition will be greater than accuracy in both the lexical task alone condition and the facial task alone condition.

5.1.2.2.2 Hypothesis 2b

Older adults will exhibit a larger gain than young adults in emotion recognition accuracy when the combined condition is compared to each of the other two conditions.

5.1.3 Method

5.1.3.1 Participants

Young adult participants (n = 76; 54% female) ranged in age from 19 to 28 years and were recruited from a pool of undergraduate psychology students who received credit hours toward a psychology course for their participation. Older adult participants (n = 66; 64% female)[10] ranged in age from 61 to 80 years and were recruited from our participant pool. They received $15 for participation. All participants were community dwelling and spoke English fluently. On average, participants had more than 12 years of formal education, with older adults (M_{years} =15.11, SE = .23) reporting significantly more years of education than young adults (M_{years} = 13.70, SE = .22), $F(1, 136) = 19.42$, $p < .001$, η_p^2 = .13. The majority of participants were White (76%).

Participants in this sample exhibited the typical pattern of age differences in perceptual and cognitive abilities. Specifically, young adults exhibited better visual acuity

[10] The original sample was composed of 76 young adults and 67 older adults (N = 143). One older adult participant scored below our cutoff criterion (< 6 correct) on the vocabulary measure, and was excluded from analyses.

than older adults and outperformed older adults on our measure of fluid intelligence, *p*s < .01. Older adults, however, scored significantly higher than young adults on the Vocabulary Test $p < .01$ (See Table 1 for full descriptives). In this sample, there were no age differences on the facial discrimination measure, $p > .05$. On average, participants rated themselves as being in fairly good health ($M = 3.80$, $SD = .84$) on a 5-point Likert-type scale (*1 = poor*; *5 = excellent*). Young adults ($M = 4.12$, $SE = .09$) reported being in significantly better health than older adults ($M = 3.44$, $SE = .10$), $F(1, 136) = 27.42$, $p < .001$, $\eta_p^2 = .17$.

5.1.3.2 Materials

The materials for Study Two were identical to those in the pilot study (i.e., lexical and facial sections of the Perception of Affect Task, Vocabulary Test, Letter Sets Test, Snellen Acuity Chart, Benton Facial Discrimination Test, and demographics form) except for some modifications to the Perception of Affect Task described below.

5.1.3.2.1 Modifications to Perception of Affect Task

In order to create the combined condition stimuli, emotionally congruent items from the lexical and facial task were matched. Because some of the sentences in the lexical task included targets who were outside the age range of our facial expressions (e.g., a boy, a young girl), we modified the sentences such that the age and gender of the target character was matched to the age range and gender of our facial targets.

In addition, we presented the lexical task orally via headphones rather than having participants read the sentence on the screen. Each revised sentence was recorded by a male speaker who read the sentences in a neutral tone of voice. We made this change because in the combined condition we wanted the lexical information and facial

information to be presented in synchrony, rather than sequentially. We thought the simultaneous presentation of facial information and lexical information would be closer to what occurs in daily life, rather than a serial processing of the sentence and the face (or vice versa). Because we wanted to compare performance on each of the tasks alone to performance when the two tasks were combined, we presented the oral version of the revised sentences to participants in the lexical alone condition as well.

5.1.3.3. Procedure

Participants were tested in groups of one to five for approximately 90 minutes. The order of tasks was as follows: Snellen eye chart, Vocabulary Test, Letter Sets Test, single modality emotion recognition tasks (order of lexical and facial blocks counterbalanced between participants), Benton Facial Discrimination Test, demographics form, combined emotion recognition task, followed by debriefing and compensation. For single modality emotion recognition accuracy, there was no effect of presentation order, $ps > .10$, so this variable was not included in further analyses.

The procedure for the emotion recognition tasks (lexical, facial, and combined) was the same as the procedure in Study One except that 1) participants were only permitted one emotion choice for each item, and 2) participants did not make intensity ratings. The emotion recognition tasks were administered on the computer using the E-Prime program. The tasks were presented in blocks, and the items within each block were presented in a different random order between participants.

All participants completed the combined condition as the third emotion recognition task because we wanted to investigate whether the lexical information or the facial information was more influential in improving accuracy in the combined

condition[11]. In order to reduce the possibility of practice effects, we had participants complete approximately 15 minutes of tasks in the interim between the combined condition and the single modality conditions.

[11] In order to determine whether practice effects influenced performance in the combined condition because it was always presented last (although no condition received feedback on accuracy), we tested 12 additional young adults on only the combined condition and compared performance on the combined condition between young adults in Study Two and these 12 young adults. On total accuracy, combined performance by the 12 participants did not differ significantly from young or older adults in Study Two. Comparing just the young adults from the two samples on combined performance by emotions, we found that accuracy was greater in Study Two than the follow-up study for neutral and fear items. This suggests that increased performance in the combined condition of Study Two is not due to practice effects.

CHAPTER 6

STUDY TWO RESULTS

6.1 Emotion Recognition Accuracy

To address whether emotion recognition accuracy differs as a function of gender, we conducted a two-way between subjects multivariate analysis of variance (MANOVA) with Age, Gender, and the Age X Gender interaction term as independent variables and three total emotion recognition accuracy scores (i.e., summed across emotion) as the dependent variables: lexical alone accuracy, facial alone accuracy, combined accuracy. For all three conditions, there was a significant main effect of Gender, $ps < .01$, with women performing significantly better than men. None of the Age X Gender interaction terms reached significance, $ps > .05$. Because gender was not of primary interest to our hypotheses and did not interact with age, gender was excluded from further analyses.

There was a main effect of Condition, $F(1.87, 261.31) = 167.46$, $p < .001$, $\eta_p^2 = .55$. Follow up paired samples t tests revealed that accuracy in each condition was significantly different than all other conditions, $ps < .001$, with accuracy in the combined condition ($M = 34.23$, $SE = .13$) greater than both the lexical alone ($M = 31.67$, $SE = .26$) and facial alone ($M = 29.90$, $SE = .28$) conditions, and accuracy in the lexical alone condition was greater than accuracy in the facial alone condition.

There was also a main effect of Emotion, $F(5.33, 745.99) = 23.54$, $p < .001$, $\eta_p^2 = .14$. Follow up paired samples t tests revealed that participants were more accurate at recognizing happy items ($M = 4.85$, $SE = .02$) than all other emotions (i.e., fear ($M = 4.45$, $SE = .04$), anger ($M = 4.47$, $SE = .06$), disgust ($M = 4.38$, $SE = .05$), sadness ($M =$

4.50, SE = .04), surprise (M = 4.57, SE = .04), and neutral (M = 4.72, SE = .04)). Participants were better at recognizing neutral items than all others, except for happy, and better at recognizing surprise than fear or disgust. Participants were also better at recognizing sadness than disgust[12].

The main effect of Age was marginally significant, $F(1, 140) = 3.75$, $p = .055$, $\eta_p^2 = .03$, with a trend for young adults (M = 4.61, SE = .04) to be more accurate than older adults (M = 4.51, SE = .04) across all three conditions for all emotions.

These main effects, however, were qualified by four significant interactions. First, the Condition X Age Group interaction was significant, $F(1.87, 261.31) = 5.17$, $p < .01$, $\eta_p^2 = .04$. To examine this interaction in more detail, we conducted three one-way repeated measures ANOVAs with age group as the between subjects variable and the seven emotion accuracy scores for two of the three conditions as the repeated measures. When the lexical alone condition and the facial alone condition were included in the analysis, there was a significant Condition X Age Group interaction, $F(1, 140) = 8.18$, $p < .01$, $\eta_p^2 = .06$, which suggested that the difference between the lexical alone and facial alone conditions was greater for young adults ($M_{lexical}$ = 4.62, SE = .05; M_{facial} = 4.27, SE = .06) than older adults ($M_{lexical}$ = 4.41, SE = .05; M_{facial} = 4.27, SE = .06). When the lexical condition alone and the combined condition were included in the analysis, there was also a significant Condition X Age Group interaction, $F(1, 140) = 4.21$, $p < .05$, $\eta_p^2 = .03$, which suggested that the effect of condition was greater for the older adults ($M_{lexical}$ = 4.41, SE = .05; $M_{combined}$ = 4.84, SE = .03) than the young adults ($M_{lexical}$ = 4.62, SE = .05; $M_{combined}$ = 4.93, SE = .03). That is, older adults exhibited a greater boost in performance

[12] Without the Bonferroni corrections for multiple comparisons, participants were also better at recognizing surprise than afraid and better at recognizing sadness than disgust, $ps < .05$.

than young adults in the combined condition, compared to the lexical condition. When the facial alone condition and the combined condition were included in the analysis, the Condition X Age Group interaction was not significant, $p > .10$.

The Emotion X Age Group interaction also reached significance, $F(5.33, 745.99) = 7.26$, $p < .001$, $\eta_p^2 = .05$. A follow up MANOVA was conducted to examine age differences in each of the seven emotions collapsed across all three conditions. Age-related differences were present for recognizing anger ($p < .001$) and neutral ($p < .01$) and marginally for disgust ($p = .06$). For anger and neutral, young adults were more accurate than older adults. For disgust, however, there was a trend for older adults to be more accurate than young adults.

The Condition X Emotion interaction was also significant, $F(7.91, 1107.69) = 39.34$, $p < .001$, $\eta_p^2 = .22$ (See Table 5 for accuracy scores by condition). This suggested that the emotions that were least and most accurate differed according to condition. For example, participants were least accurate at identifying surprise in the lexical alone condition, whereas accuracy was lowest for disgust in the facial alone and combined conditions.

Table 5 *Study Two Emotion Recognition Accuracy*

	Condition											
	Lexical Alone				Facial Alone				Combined			
Emotion	Young Adults[a]		Older Adults[b]		Young		Old		Young		Old	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Afraid	4.70	.08	4.76	.08	3.79	.13	3.53	.18	4.95	.03	4.95	.03
Angry	4.37	.09	3.71	.14	4.70	.08	4.36	.12	4.95	.03	4.64	.11
Disgust	4.57	.09	4.32	.10	3.42	.14	4.29	.11	4.91	.04	4.82	.06
Happy	4.86	.04	4.80	.06	4.80	.06	4.80	.06	4.92	.03	4.94	.04
Sad	4.83	.05	4.67	.07	3.91	.12	3.71	.16	4.95	.05	4.88	.04
Surprise	4.25	.10	4.17	.11	4.61	.08	4.65	.08	4.91	.04	4.80	.07
Neutral	4.70	.07	4.44	.10	4.67	.09	4.56	.10	4.95	.03	4.86	.05
Total	32.37	.33	30.86	.38	29.89	.36	29.91	.44	34.53	.13	33.89	.23

[a] Young adults, $n = 76$.
[b] Older adults, $n = 66$.

These interactions were further qualified by a significant Condition X Emotion X Age Group interaction, $F(7.91, 1107.69) = 5.39$, $p < .001$, $\eta_p^2 = .04$. To disentangle this interaction, we conducted a MANOVA for each condition with age group as the independent variable and accuracy for each emotion as the dependent variables. There were significant age differences for anger recognition in all three conditions, but age differences for neutral recognition in the lexical alone condition only and age differences for disgust recognition in the facial alone condition only (See Table 6 for results by emotion). In all three conditions, young adults were more accurate than older adults at recognizing anger. In the lexical alone condition, young adults were better than older adults at recognizing neutral items. In the facial alone condition, older adults were more accurate than young adults at recognizing disgusted facial expressions.

Table 6 *Age Differences in Emotion Recognition Accuracy by Condition*

	Condition								
	Lexical			Facial			Combined		
Emotion	$F(1,140)$	p	η_p^2	$F(1,140)$	p	η_p^2	$F(1,140)$	p	η_p^2
Afraid	.29	.59	.00	1.45	.23	.01	.04	.85	.00
Anger	16.23**	.00	.10	5.66*	.02	.04	8.10*	.01	.05
Disgust	3.19	.08	.02	22.38**	.00	.14	1.52	.22	.01
Happy	.57	.45	.00	.00	1.00	.00	0.15	.70	.00
Sad	3.48	.06	.02	1.03	.31	.01	1.02	.31	.01
Surprise	.30	.59	.00	.17	.68	.00	1.89	.17	.01
Neutral	9.28**	.00	.06	.68	.41	.00	1.97	.16	.01

6.1.1 Hypothesis 1

We found partial support for Hypothesis 1 which predicted that young adults would outperform older adults in the lexical and facial conditions. Young adults were more accurate at recognizing emotions in the lexical alone condition, but there were no age differences in the facial alone condition.

6.1.2 Hypothesis 2

Consistent with Hypothesis 2a, all individuals were more accurate in the combined condition than either of the other two conditions (lexical alone or facial alone). We also found partial support for Hypothesis 2b, which predicted a greater gain for older adults in the combined condition when compared to the other two conditions. This was borne out when the lexical alone condition was compared to the combined condition; older adults showed greater improvement in the combined condition than young adults.

6.2 Conditional Probabilities

Because we were interested in whether the lexical information or the facial information was responsible for the boost in performance in the combined condition (or neither), we computed conditional probabilities: P(Combined Correct | Lexical Incorrect) and P(Combined Correct | Facial Incorrect). To compare these two conditional probabilities, we conducted a paired samples *t* test. The probability of getting the combined correct given the facial item was incorrect ($M = .97$, $SE = .01$) was greater than the probability of getting the combined correct given the lexical was incorrect ($M = .89$, $SE = .02$), $t(122) = -4.50$, $p < .001$, which suggested that the lexical information was more helpful than facial information in disambiguating the intended emotion of the stimuli in the combined condition. Next, we conducted this same analysis separately by age group. Whereas the two conditional probabilities did not differ for the young adults, $p > .10$, older adults were more likely to get the combined correct given they got the facial incorrect ($M = .96$, $SE = .01$) than to get the combined correct given they got the lexical incorrect ($M = .85$, $SE = .03$), $t(60) = -4.99$, $p < .001$ (See Figure 3). Thus, only older adults exhibited a difference between the two conditional probabilities, which suggested that the lexical information was more helpful than the facial information in disambiguating the intended emotion in the combined condition, for older adults only.

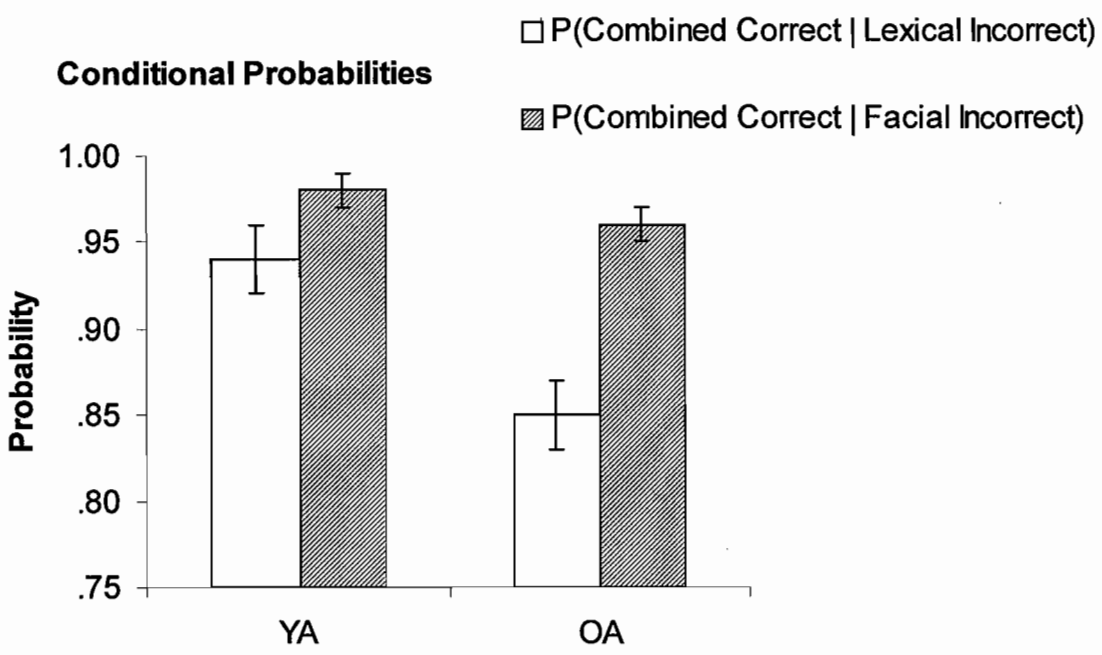

Figure 3. Study Two Conditional Probabilities for Each Age Group.

We then performed two one-way ANOVAs with Age Group as the independent variable and the conditional probabilities as the dependent variables. There were age differences in the probability of a participant getting the combined condition correct given that they got the lexical condition incorrect, $F(1, 124) = 5.81$, $p < .05$, $\eta_p^2 = .05$, with young adults ($M = .94$, $SE = .02$) being more likely than older adults ($M = .86$, $SE = .02$) to get the combined item correct if they got the lexical item incorrect. This suggests that young adults were more likely than older adults to successfully rely on the facial information to identify the emotion in the combined condition. There were no age differences for the probability of getting an item correct in the combined condition given that the facial alone item was incorrect, $p > .20$.

6.3 Summary of Results

Overall, accuracy was better in the combined condition than either of the single modality conditions. The difference between the lexical alone condition and the combined condition was greater for older adults than young adults. Participants were more accurate in the lexical alone condition than the facial alone condition. There was a trend for young adults to be more accurate than older adults, but this differed according to discrete emotion. For anger and neutral items, young adults were more accurate than older adults. For disgust items, there was a trend for older adults to be more accurate than young adults. Conditional probabilities revealed that the lexical information was more helpful than the facial information in determining the intended emotion in the combined condition, but only for older adults. In addition, young adults seemed to benefit more than older adults from the facial information when combined with a lexical item they previously got wrong. That is, if a young adult got a lexical item incorrect, they were more likely than older adults to get the item correct when it was paired with a facial expression (in the combined condition).

CHAPTER 7

DISCUSSION

Overall, we found partial support for age-related increases in the perception of mixed emotions as a possible explanation for age-related differences in emotion recognition. Consistent with this hypothesis, 1) in the lexical task older adults exhibited a greater gain in emotion recognition accuracy than young adults when permitted two responses rather than one, 2) older adults endorsed a second emotion more often than young adults for anger and disgust items in the lexical task and this tendency accounted for age differences in disgust recognition, 3) older adults endorsed a second emotion more often than young adults for happy items, and marginally for angry items, in the facial task and this tendency accounted for age differences in happy recognition, and 4) older adults showed more improvement in emotion recognition accuracy than young adults when the two modalities of information were combined. Taken together, these findings are consistent with the hypothesis that age-related differences in the perception of multiple emotions account for some of the age differences in emotion recognition.

In Study One, the interaction of age with number of responses in the lexical task indicated that older adults benefited to a greater degree than young adults from the opportunity to provide two emotion responses. That is, older adults benefited more from the liberal scoring (compared to the traditional scoring) than young adults. This makes sense if older adults see a mix of two emotions in the stimuli. If both emotions are perceived as equally likely, older adults might sometimes respond with the "incorrect" response in a task that only permits a single response. If the task permits two responses,

older adults are more likely to respond with the correct emotion in one of their responses. Because older adults' first response is less likely to be the intended emotion than young adults' first response, older adults gain more in accuracy when permitted two responses.

An alternative explanation of the same finding is simply that when given more opportunities to provide the correct answer, all participants improved their scores. Older adults were less accurate to begin with, so they exhibited a greater gain from the opportunity to provide more than one response. In order to determine which explanation is more appropriate (i.e., age differences in perceived multiplicity of emotion versus increased odds of getting the response correct), the intensity rating difference scores are important. We found some support for qualitative age differences in the task approach when the intensity difference scores were examined. In the pilot study, young adults rated their two emotion responses as less similar in intensity than older adults. In Study One, we found a trend for this same age difference in the lexical task.

Consistent with this possibility, we also found that older adults were significantly more likely than young adults to endorse a second emotion for angry and disgust items in the lexical task and for happy items (and marginally for angry items) in the facial task. This supports the mixed emotion view because there were age differences in the accuracy of identifying anger and disgust items in the first response of the lexical task, with young adults achieving greater accuracy than older adults. Similarly, young adults were more accurate at identifying happy and angry facial expressions.

If young adults are more likely than older adults to perceive the emotion stimuli as expressing a single emotion, then this may explain why young adults are more likely to respond with the intended emotion in single-response formats. Thus, the age differences

in typical emotion recognition tasks may be due to a mismatch between the number of emotions perceived in the stimuli and the number of emotion responses permitted. We found partial support for this explanation, depending on which discrete emotion was examined. Emphasizing the importance of a discrete emotions perspective, we found that for the lexical task the tendency to choose to report a second emotion accounted for age differences in first response accuracy for disgust items, but not angry items. Similarly, in the facial task, frequency of second emotion responses accounted for age difference in happy recognition accuracy, but not for angry recognition.

In Study Two, older adults benefited more from the combined condition than young adults. That is, older adults showed a greater improvement in accuracy in the combined condition, when compared to the lexical alone condition. This differential gain for older adults may be because the additional information helps to disambiguate which of the perceived emotions in one modality is the intended emotion. Interestingly, we also found that for older adults, the lexical information was more helpful than the facial information when they were presented together in the combined condition. We did not find this difference for young adults. This makes sense because overall accuracy on the lexical items was greater than the facial items. In addition, the lexical information is inherently richer in contextual elements than the facial information.

7.1 Mixed Emotions

Why might there be age differences in the perception of mixed emotions? We posit that evidence for age-related increases in the *experience* of mixed emotions may translate into age-related increases in the *perception* of mixed emotions. Then the question becomes, why are there developmental differences in the experience of mixed

emotions? There are several possible explanations for this change. First, it has been suggested that this increase in the experience of mixed emotions is due to a more limited future time perspective (Carstensen et al., 2000). That is, as people become more aware of their impending death, situations that are positive are also tinged with some negative feelings because it may the last event of its kind. This renders positive events bittersweet, or poignant. This explanation is consistent with an increase in the co-experience of positive and negative emotions, but does not account for an increase in the co-occurrence of negative emotions, or heterogeneity of emotional experience (Charles, 2005). It is not clear why older adults experience more of a co-occurrence of negative emotions than young adults. It may that the types of life events that occur in later adulthood are more apt to be interpreted as a mix of several emotions, or it may be due to a change in the ways in which emotional events are experienced. More research is needed in this area to determine the underlying mechanism in the shift toward experiencing greater poignancy and emotional heterogeneity in later adulthood.

Returning to the perception of mixed emotions, we suggest that increased experience with mixed emotions may translate into increased perception of mixed emotions. Although we did not find support for this relationship with our Multiplicity of Emotional Experience measure, there may not have been enough variability between age groups in this measure to detect a relationship with perceived mix of emotions. We argue that because older adults themselves are more complex in the emotions they experience, they project this onto the targets in the stimuli when asked to identify the emotion they are feeling. For the lexical task, this strategy of identifying the emotion a target is feeling seems intuitive. Participants may "put themselves into the shoes of the target" in order to

determine what emotion the target is feeling. The facial task, on the other hand, seems less likely to lend itself to this type of strategy. Participants may be more likely in the facial task to simply "read" the emotional expression presented rather than try to imagine themselves producing the same expression and then interpolating the emotion from that imagined experience. This inherent difference in the processes likely employed when identifying an emotion in the lexical task compared to the facial task are consistent with the broad differences we found between the two tasks in the present research. Thus, in the next section we discuss the differential task effects.

Before turning to the differential task effects, however, there is another plausible explanation for age differences in the perception of mixed emotions, which may or may not be related to the experience of mixed emotions. Changes in the perception of emotions may be adaptive for emotion regulation and for interpersonal relationships. In the lexical task we found that older adults were more likely than young adults to see two emotions for disgust and angry items. Past research shows that the toxicity of anger is less tolerated with increasing age and so avoiding anger may be more salient for older adults than young adults (Blanchard-Fields, 2007; Labouvie-Vief, 2003). Thus, a person who to a young adult may appear to be angry, might instead be interpreted by an older adult as expressing a mix of disgust and anger, which is less alarming to the system. We found some support for this possibility in Study One. When we examined the frequency of reporting angry and disgust for the same item, we found that older adults were more likely than young adults to report these two emotions in combination, $p < .01$.

We also know that there are developmental differences in the degree to which adults prioritize interpersonal relationships (Carstensen, 1995). Perhaps perceiving a

social partner as disgusted, rather than angry, is less damaging to the social relationship. Because of an age-related increase in the importance of maintaining close relationships, it may be adaptive for older adults to avoid interpreting a friend as angry. For example, if older adults are more concerned with preserving the relationship than being accurate, they may construe a social partner as being disgusted with a situation or person rather than being angry. Future research should investigate whether age-related changes in the experience of mixed emotions, emotion regulation strategies, or interpersonal relationship maintenance contribute to age-related changes in the perception of mixed emotions. We may find that age differences in the perception of mixed emotions are influenced by a confluence of all three factors, perhaps differentially by discrete emotion.

7.2 Differential Task Effects

A number of our findings differed as a function of task. For example, in Study Two, we found that the lexical information was more helpful than the facial information in disambiguating the intended emotion in the combined condition for older adults. In Study One, older adults benefited more than young adults from the liberal scoring condition in the lexical task, but we did not find this interaction in the facial task. This lack of an interaction may in part be due to differential age effects as a function of discrete emotion (i.e., young better than old at anger recognition, old better than young at disgust recognition), yet it is clear that the underlying mechanism for age differences in emotion recognition operates differently in the lexical task than the facial task.

Although we found evidence for age differences in the perception of mixed emotions in both tasks, the cause of these differences in perception likely differs for the two tasks. That is, items in the lexical task may be perceived as a mix of emotions

because of changes in the experience of mixed emotions, emotion regulation strategies, or different goals in interpersonal relationships. Items in the facial task may also be influenced by a more basic visual pattern recognition factor. The other motivational mechanisms may apply to the facial task as well, but the added pattern recognition factor may at times "trump" the other factors. We did try to control for differences in perceptual ability by including the Facial Discrimination Test, but this test is not specifically a test of pattern recognition. Future research should control for age differences in pattern recognition to better understand age differences in recognizing facial expressions of emotion.

Turning back to the motivational explanations for perceiving a mix of emotions, the underlying mechanisms at work may be manifested differently, according to the task. For example, in the facial task these motivational and experiential differences between young and older adults may be manifested as different eye gazing strategies during the emotion identification task. Two studies have suggested online age-related strategy differences between young and older adults during an emotion recognition task are responsible for age differences in emotion recognition accuracy for facial expressions. Using eye-tracking methodology, these studies were able to record eye movements during the emotion judgments. By examining number of fixations and dwell time to the upper and lower halves of the face, these studies both found that older adults look less at the eyes of the target face than young adults (Sullivan et al., 2007) (Wong et al., 2005). Moreover, poor performance in the older adult group for fearful, angry, and sad face recognition was significantly correlated with fewer fixations to the top halves of faces (Wong et al., 2005). In contrast, within young adults, eye looking is positively related to

recognizing angry, sad, and fearful emotional expressions (Sullivan et al., 2007). These strategy differences suggest age-related changes in visual attentional biases during an emotion recognition task. It is unclear, however, why these differences in attentional biases occur.

7.3 The Special Case of Anger

Across studies and tasks, we found that age differences remained for anger recognition. Although the liberal scoring in Study One and the combined condition in Study Two resulted in improved anger recognition for older adults, they were still impaired, relative to young adults, at recognizing anger. As discussed above, there are physiological differences in the toxicity of anger with older adults being less able to tolerate the toxicity than young adults (Blanchard-Fields, 2007; Labouvie-Vief, 2003). This difference may render angry expressions and situations as best avoided by older adults. Older adults may "down-grade" frustration from describing it as angry situation to instead describing it as a disgust-provoking situation. This may result in young adults interpreting disgust as only "gross" situations; whereas older adults might include frustrating situations in the disgust category. This possibility would be interesting to explore in future research.

Furthermore, with age-related increases in the importance of interpersonal relationships, older adults have been shown to avoid anger in their daily lives (Birditt & Fingerman, 2003). Of course, in order to avoid anger, one must first be able to recognize it. It may be that older adults initially detect anger during pre-attentive or early processes, but then avoid anger as soon as it is detected. Older adults have been shown to be as good

as young adults at detecting an angry face in an array of neutral faces (Mather & Knight, 2006).

Another possible explanation is that there are cohort differences in the degree to which anger is a "taboo" emotion. Some of the older adults in this sample could be considered part of the World War II generation. Historically, the baby-boomer generation may have brought about a change in how willing people were to talk about certain emotions, such as anger. Baby-boomers may be more likely than the WWII cohort to believe in the catharsis of talking about and acknowledging anger. Because this research employed a cross-sectional design we cannot disentangle possible cohort effects from developmental differences. We did however, divide our older adults into young-old (60 to 69 years) and old-old (70 to 80 years) to investigate whether there were differences in anger recognition between the young-old and old-old groups. For anger recognition in both the lexical and facial task, both the young-old and old-old groups were significantly less accurate than the young adults, $ps < .05$. The young-old group, however, was significantly more accurate than the old-old group. These findings are consistent with both a developmental change in emotion recognition and a cohort effect. Future research should employ a longitudinal design to elucidate which of these descriptions is more appropriate. If a developmental shift is occurring, it would also be interesting to understand when this shift occurs (i.e., middle-age, young-old, or old-old).

7.4 Limitations and Future Directions

In addition to the issues mentioned throughout the discussion above, this study had several other limitations. First, a common problem in the emotion recognition literature is ceiling effects and the present research was not immune to these effects.

Ceiling effects may have obscured some of the interactions in Study One and Study Two by limiting the amount of improvement possible with the liberal scoring and combined condition manipulations. Future research might present the stimuli either very quickly, as with microexpressions of emotion which are presented at a rate of 40 milliseconds (Ekman; Frank & Ekman, 1997) or masked, to get performance off the ceiling.

We found age differences in the intensity difference scores in the pilot study, but only a trend ($p < .10$) in Study One. If older adults perceive more of a mix of emotions than young adults, then we would expect that they would rate their emotion responses for an item as more similar in intensity than young adults. We found support for this in the lexical task of the pilot study where participants only responded with two emotions and rated them on intensity on a Likert-type scale from 1 to 7. We did not find significant age differences in the intensity difference scores for either task in Study One, despite a trend in the lexical task. In Study One participants could choose up to six emotions and rated each for intensity on a scale of 1 to 100 percent. In the future, Study One might be replicated using a Likert-type rating scale for intensity to see if the difference in scaling might be more sensitive to differences in intensity ratings. Examining the intensity difference scores is still a promising approach and perhaps a necessary one for the mixed emotions/qualitatively different approach argument. Future research should look into the intensity difference scores and perhaps other ways to gauge age differences in perceived multiplicity of emotions, such as asking participants what "blends" of emotions they perceive in the stimuli.

Because we used a cross-sectional design, it cannot be determined whether age-related differences in the present research are due to developmental differences or cohort

effects. Future research should look at the relationship between the perception of mixed emotions and emotion recognition longitudinally. Future work should also move toward even more ecologically valid tasks, which are closer approximations to emotion recognition tasks of daily life. For example, participants could be asked to recognize emotions in a social partner during an online communication task.

7.5 Conclusions

It is important to determine the extent to which current patterns of data on age-related differences in emotion recognition generalize to situations that are more typical of daily life. If older adults are impaired at recognizing emotions in daily life, this has important consequences for their well being (Carton et al., 1999). In the present research, we applied a lifespan contextual approach to the study of emotion recognition. We found that older adults are better able to recognize emotions when congruent emotional information is presented in more than one modality. This suggests that the redundancy of information in everyday life may help older adults disambiguate the intended emotion of their social partners. Thus, whereas older adults may be impaired at recognition emotions of impoverished stimuli, these age differences may not carryover to emotion recognition in daily life.

The present research suggests that age differences in typical emotion recognition tasks arise from a confluence of factors. First, it may be that recognizing certain facial expressions becomes more difficult with age due to age differences in pattern recognition. This possibility remains to be tested but may explain the lack of an Age X Number of Responses interaction for the facial task in Study One. In conjunction with this increased difficulty, older adults might also approach both the facial and the lexical

task in a qualitatively different manner, such that they perceive more than one emotion in the stimuli. Thus, adding context may compensate for losses in pattern recognition *and* help disambiguate the intended emotion. Past emotion recognition research may have underestimated older adults' emotion recognition capacity to the extent that older adults approach the task in a qualitatively different manner.

The exception to the above findings was that older adults are still impaired at recognizing anger even when two modalities of emotional information were combined. Older adults may be especially motivated to avoid anger due to a decreased tolerance for the toxicity of anger and/or an increased focus on maintaining interpersonal relationships. Thus, older adults may detect angry emotional information in the environment as well as young adults, but are then motivated to avoid such information, which may be adaptive for older adults.

APPENDIX

Multiplicity of Emotional Experience

Anger: Family Vignette

Imagine that you invite one of your closest friends to spend some time with your family. After spending the day with them, your friend makes an offensive comment about your family members.

Sadness: New Approach

Imagine that one of your closest friends has a new approach to life. You feel like your friend's new approach is very different from yours, and the two of you are drifting apart. You understand where your friend is coming from, but you will miss your friend dearly.

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