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Is Younger Really Better? Age Differences in Emotion Perception

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IS YOUNGER REALLY BETTER?
AGE DIFFERENCES IN EMOTION PERCEPTION

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By

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ABSTRACT

Previous research suggests that younger adults outperform older adults on emotion-matching tasks because emotion recognition ability declines with age. These studies involved tasks in which participants identified a target emotion by selecting from multiple verbal labels. The use of multiple verbal labels placed great cognitive demand on participants, influencing the results that were found in such studies. In the present study, a computer emotion-matching task was used to determine differences between younger and older adults when presented with a target stimulus expressing one of five emotions (anger, fear, disgust, happiness, and sadness) and asked to match the target emotion to one of two comparison faces presented simultaneously. One comparison face displayed no emotion, while the other displayed the same emotion as the target, but at varied intensity (20%, 40%, 60%, and 80%). In general, the results indicated that younger and older adults only minimally differed from one another in emotion-matching performance. Older adults were only outperformed on those trials involving lower intensity fear and disgust, and actually outperformed younger adults on expressions of anger, happiness, and sadness. These findings suggest that emotion recognition ability does not exhibit general age-related decline, but may be challenged by specific emotions expressed at low intensities.

Keywords: emotion recognition, age differences, intensity, emotion matching, aging

Dedicated to

My Lord and Savior, for bringing me through these past four years
My parents, for always supporting and challenging me
My grandparents, for inspiring me and loving me unconditionally
Dylan, for loving and encouraging me through many late nights of studying
Ericka, for surviving senior year and this thesis process with me
WKU, for making me the successful college graduate I am today

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CHAPTER 1

INTRODUCTION

Emotion recognition is a complex process that occurs when someone encounters a stimulus and must evaluate the displayed facial expression to determine the emotion being portrayed. It occurs automatically, although some amount of control can and must be used in the process. Emotion recognition is an ability utilized daily in nearly every social encounter. Great care must be taken in evaluating, labeling, and responding to the emotions of others, and mistakes at any of these levels could have negative social consequences. Therefore, emotion recognition ability is a topic of great interest to researchers of cognitive and social development across the lifespan. A topic of such relevance to social interactions for all people provides numerous opportunities for research and investigation.

One such area of research growing in popularity seeks to illuminate how emotion recognition ability develops and changes with age. There is an abundance of literature to support the thesis that age differences in emotion recognition ability exist. Researchers have used a variety of methods to validate this conclusion and investigate the reasons behind it. Initially it was thought that because older adults possess more social experience, they should be better at assessing emotions. Experience would have taught them to avoid negative emotions so as to avoid negative interactions and maintain

positive well-being (Orgeta & Phillips, 2008). Differences in age and experience would therefore result in differences of emotion recognition ability.

However, researchers found that older adults actually performed worse than younger individuals on many emotion recognition tasks. To understand these unexpected findings, researchers looked for additional reasons for age differences in emotion recognition. One suggested cause of age differences is that older adults have more trouble detecting negative facial emotions. Mather and Carstensen (2003) even went so far as to suggest that older adults do not just prefer to focus on positive emotions but may actually be biased against negative emotions. Perhaps because of this bias, or for other yet undiscovered reasons, it has been proposed that older adults spend less time inspecting parts of the face relevant to detecting negative emotions. Another possible explanation for age-related deficits in emotion recognition is that older adults may possess general problems with processing all facial stimuli, such as not knowing where to focus attention when attempting to determine others' emotion. Should they focus on the mouth, or eyes? What features are most salient to emotion detection?

Other researchers have attempted to focus on the physiological differences between younger and older adults that could lead to differences in emotion recognition ability. It is well known that changes in brain regions occur as a function of age. For example, the frontal regions associated with making complex decisions are known to endure age-related change (Ruffman, Henry, Livingstone, & Phillips, 2008). It logically follows that if a region were used to detect a certain emotion, then emotion recognition would be affected over time as well if that brain region were to undergo age-related change. Additionally, the levels of neurotransmitters in emotion recognition areas of the

brain have been studied. Kaasinen found that neurotransmitter levels in these areas do decline with age (as cited in Ruffman et al., 2008). Differences in neurotransmitter levels could be a reason why age differences in emotion recognition exist.

The task methodology for studying age differences in emotion recognition could also be a causal factor in why differences are seen. For one thing, task difficulty can affect the emergence of age differences. As more difficult tasks increasingly rely on fluid abilities and the speedy application of knowledge, disparities in performance can begin to be seen (Ruffman et al., 2008). Reasoning behind this finding can be drawn from aging effects on crystallized vs. fluid abilities. Although crystallized abilities increase with age as one stores more general knowledge, fluid abilities, or knowing how to respond quickly to novel situations, appear to decline with age. The type of ability that a task is testing could, then, affect age differences seen in the results. And finally, the intensity of emotional expression may be a factor in the emergence of age differences. Older adults may need more intense expression of the emotion to be able to distinguish and accurately identify it. If an emotion is expressed at very low intensity, older adults may perform worse than younger adults on the emotion recognition task.

In reviewing the research, it is important to identify consistent differences found across the literature. It appears that older adults are worse at detecting emotions overall, but some particular emotions appear to be more susceptible to age-related decline in accurate perception than are others (Issacowitz et al., 2007). Ruffman et al. (2008) suggest that older adults are generally better at identifying positive emotions than negative emotions, and are the worst when detecting anger, sadness, and fear expressions. For expressions of happiness, surprise, and disgust, it appears that there are no age

differences in emotion recognition ability (Orgeta & Phillips, 2008). Surprisingly, it has been found that older adults are actually better than younger adults at detecting one type of emotion: disgust (Ruffman et al., 2008). When emotion intensity is considered, it appears that at lower intensities everyone will do poorly and no age differences are seen. But at 50% intensity and above, age differences begin to be seen. Of course, these findings are also contradicted by more recent work, which demonstrates that age differences in emotion recognition only emerge when expressive intensity of the stimuli is low (Mienaltowski et al., 2013).

The study of emotion recognition accuracy is actually quite important to society and the development of social cognition across the lifespan. The ability to detect emotions helps in social interactions and elicits social adaptation. Emotion expression and recognition are critical aspects of nonverbal communication. As Isaacowitz et al. (2007) explained, "Our ability to quickly interpret the emotionally salient aspects of our environment allows us to anticipate events and respond appropriately to avoid negative outcomes" (p.147). Interpersonal relationships and emotion regulation become even more valued as one ages, due to heightened awareness of one's own mortality and increased exposure to negative experiences. If older adults cannot recognize and assess others' emotions accurately in social situations, this may cause incorrect reactions and behavior that could be detrimental to relationships. Older adults are particularly vulnerable to the repercussions of such a mistake. Social problems can affect one's health and well-being, particularly later in life, when social isolation is prevalent and linked to many unwanted outcomes.

Aging Theories in Relation to Older Adults' Emotion Recognition Deficits

It follows logically that the reasons underlying these differences in emotion recognition accuracy between younger and older adults should be investigated. A few theories have thus emerged for the causes of the observed differences; namely visual scanning, theory of mind, and the social and emotional consequences of aging. Each theory must be evaluated and addressed in order to determine how future research should be structured.

Emotion recognition requires that an observer appropriately scan a social target's face to read critical details of his or her expression that can then be interpreted as emotion. Perhaps the target's eyebrows are furled and his or her lips are pressed tightly together. In order to detect the target's anger, the observer will have to notice the combination of features that are the telltale signs of irritation. One's failure to pick up on these details links deficits in visual scanning to perceptual and/or cognitive deficits that might account for age difference in emotion recognition. As Wong, Cronin-Golomb, and Neargarder (2005) posited, visual scanning needs to be studied in an attempt to find whether emotional information is being perceived accurately enough for proper processing. If not, poor visual scanning patterns could affect emotional recognition and one's reactivity to emotions. Wong et al. (2005) focused on characterizing where older versus younger adults were looking when they analyze emotion. As alluded to above, it seems that where participants fixate depends on the emotion expressed by the social target. For example, most people tend to fixate on the top half of the face when identifying anger, fear, or sadness, but fixate on the bottom half of the face when viewing disgust and happiness (Calder et al., 2000, as cited in Wong et al., 2005). This highlights

a potential problem, as emotions that require fixation on specific portions of the face could be misinterpreted if the observer fails to attend to the optimal location for perceiving emotion cues. Wong and colleagues' work suggests that younger and older adults may differ on their performance in emotion recognition tasks because older adults and younger adults tend to fixate on different regions of the face. More specifically, Wong et al. (2005) found that younger adults tend to fixate more on the upper half of the face, whereas older adults fixate more on the lower half of the face. However, older adults are more accurate when they fixate on features of the top half of the face, such as the eyes. This introduces a predicament because older adults tend to fixate on the area of the face that leads to the lowest accuracy in emotion recognition for their cohort, but can do well for any given emotion if they fixate on the appropriate region.

Compounding this issue are the findings by Sullivan, Ruffman, and Hutton (2007) that indicate focusing on the eyes (top half of the face), not the mouths (bottom half of face), is better for emotion recognition. This seems to be because eyes are particularly important for determining emotional information, as the eyes provide a variety of intention-related information and social cues. By not spending enough time scanning the eye-region of a face, older adults might not be able to integrate emotional cues found in the upper half of the face with the same efficiency as younger adults. Thus, aside from the findings of Wong et al., which begin to attribute age differences to fixation location, Sullivan and colleagues also claim that the deficiency in time allocated to the top half of the face might place older adults at risk for failing to develop a completely integrated interpretation of the emotion on the targets' faces.

In line with the perceptual and cognitive deficits proposed by the visual scanning theory, it has been suggested that to make sense of emotional information coming from the eyes, perhaps older adults need to take longer to fixate on the eyes and process the information. This interpretation is consistent with Salthouse's seminal work on general slowing (1992; as cited in Sullivan et al., 2007) in which he proposed that a decline in processing speed with age leads to a need to consider stimuli for a longer period of time before fully integrating the most relevant details into an interpretation that lends itself to a response (Rousselet et al., 2009). In emotion recognition studies that examine visual scanning, stimuli are presented for only a short period of time (e.g., 200 – 8000 msec). If aging slows the integration of facial cues into a meaningful interpretation, perhaps presenting the stimuli for a longer period of time would allow older adults to have the time that they need to engage in more elaborate visual scanning and invest more time into processing the eye-region of the social target's face. When self-paced tasks are not used, older adults likely have difficulty prioritizing where to look from one trial to the next, as for some emotions looking at the mouth (sadness and disgust) is more important than looking at the eyes (anger and fear). If it were true that the location of fixation and the time needed to integrate information changes with age, these steps within the detection process would surely give older adults a disadvantage in emotion recognition tasks.

An additional explanation for age differences in emotion recognition is a regression, on average, of older adults' theory of mind. Introduced by Phillips, MacLean, and Allen (2002), theory of mind focuses on empathy and the ability to incorporate understanding of others' emotions, as well as motivations and reflections, with understanding of their behavior. It is believed that people use theory of mind constantly

to decipher the mental states of those around them. For instance, most theory of mind tasks evaluate how well one can infer the thoughts and knowledge of someone else when given different cues, such as pictures of someone's eyes or passages of text. But theory of mind tasks differ from average emotion recognition tasks because they seek to identify more complex emotions and mental states, which are often related to social interactions. From a sociocognitive perspective, it is believed that emotion recognition improves with age. Proponents of this perspective reason that the ability to understand and recognize emotional cues increases with age, particularly because older adults have more experience interpreting and expressing emotion over the lifespan. But from a neuropsychological perspective, it is thought that there is an age-related decline in the understanding of emotion. Neuropsychological research highlights that the two brain regions most strongly linked to emotion processing (the frontal lobes and medial temporal lobes) are also the regions most altered by the aging process. As one ages and the physiological makeup of these lobes changes, it seems that emotion-processing difficulties would arise. This discrepancy between theories draws our attention to the emotion recognition task itself, which actually evaluates how well one perceives emotions in others and relates to the social and environmental conditions that might trigger these emotions. Perhaps this attribute of the test is what leads to the age differences.

Another proposed reason for observed age differences in emotion recognition comes from the understanding that proper identification of emotion from facial stimuli is affected by emotional intelligence. Studies on theory of mind have lent credibility to this idea by showing that task performance may be related to an individual's ability to

determine emotion from facial expressions. Many of the research measures used to study emotion recognition thus rely on tasks that fundamentally test emotional intelligence, as well. What we do not know is how these emotion recognition tasks test other types of intelligence. It is known that fluid intelligence is activated in the presence of novel stimuli, whereas crystallized intelligence uses emotion understanding more from acquired knowledge and skills. Fluid intelligence is shown to decrease with age whereas crystallized intelligence generally increases. So it is possible that the effects of aging on these types of intelligence influence emotion recognition measures, as well.

However, despite the body of knowledge surrounding theory of mind, Phillips et al. (2002) found more age related differences in identifying specific aspects of emotion in faces (e.g., cues given by the eyes) than in general emotion understanding and empathy (which seemingly should improve over time with increased experience with emotional cues). The findings suggested that older adults are actually choosing not to look in the right portion of the face for the most salient features to emotion recognition. In particular, older adults are choosing to not invest as much attention on negative emotions.

The final explanation behind the age related differences in emotion recognition focuses on the social and emotional consequences of aging. This theory, proposed by Charles and Carstensen (2009), uses previous literature on the topic to analyze the choices and motivation that may lead to differences between younger and older adults. It has been established that age affects what emotions a person dwells on and how that person spends his or her time. This may result in older adults not focusing on the negative emotions as much as they do on the positive because they have already learned their lessons from negative experiences and want to, instead, focus on positive ones. It may

also be that older adults, because they perceive that their time is limited relative to younger adults, are more selective about how they spend their time and with whom. Older adults may also avoid negative experiences and prefer positive emotions simply because they want to decrease tension and avoid negative outcomes.

Although the sociocognitive perspective mentioned in Phillips et al. (2002) supports the notion that older adults should be better at emotion detection than younger adults because of the accumulation of life experiences and knowledge, this is not actually reflected in the studies evaluated by Charles and Carstensen (2009). It seems, therefore, that although older adults may be better at regulating their own emotions because of experience, this does not mean that they will be better at detecting emotion in others. The literature suggests that life experiences affect future responses to emotional information, making older adults more sensitive to emotional cues and more skilled in emotion regulation, although not emotion recognition (Blanchard-Fields, 2007).

One final social and emotional outcome of aging seems to be changes in motivation. Motivation appears to play a role in the level of arousal preferred by younger versus older adults, and in the effects of arousal on emotion recognition abilities. Past research suggests that people come to prefer low-level arousal emotions as age increases (Diener et al. 1985; Lawton et al. 1992, as cited in Charles & Carstensen, 2009). This may have an effect on the emotions preferred and more closely attended to across the lifespan. Older adults also tend to use more contextual information in making determinations about emotion. Compared to younger adults, they show a decreased ability to bar irrelevant information (particularly the emotional aspects of such information) during processing. The added facets of emotional information taken in by

older adults affect how they process emotions in social situations. Therefore, if tasks and stimuli limit the amount of context available during emotion recognition, older adults may be at a disadvantage relative to younger adults (Noh & Isaacowitz, 2013).

From one perspective, it seems that the ability to perceive emotion may be declining across the lifespan, because it relies on fluid intelligence and the timely integration of emotional cues. On the other hand, researchers have found that the understanding of emotion is maintained or actually improves with age. These seemingly contradictory findings summarize many of the reasons underlying differences in emotion recognition accuracy between older and younger adults. It will be important to minimize the effects of these elements of emotion recognition on test measures, in an attempt to more accurately assess the differences between younger and older adults.

Effects of Experiment Content On Task Outcomes

The experimental design of test measures used to assess emotion recognition has its own effect on task outcomes and can skew results in one way or another. This causes experimenters to approach research design very carefully and attempt to determine the most relevant research task for the constructs they are studying. Concerning the content of experiments that assess emotion recognition ability in particular, Orgeta (2010) explained, "The effects of age on emotion recognition depend on the type of task used to assess recognition accuracy" (p.3). In fact, Orgeta was one of the first researchers to look at how other variables interact *with* age differences to cause the supposed decline in emotion recognition ability. This was no easy mission, due to the many above-mentioned factors that contribute to and affect emotion recognition ability. Emotion recognition is one of the many complex abilities of the human brain, involving both automatic and

controlled processes in combination with perception and decision-making (Mienaltowski et al., 2013). Tasks used to evaluate such a complex ability need to be free from extraneous variables that may hinder proper measurement and influence results.

As researchers have looked more closely at the claim made by Orgeta, it has been concluded that the type of task used to assess emotion recognition ability does in fact affect results. Verbal tasks seem to show larger age differences, and the number of choices or labels offered to participants to consider during the task reflects the cognitive demand of the task, which also affects performance. These effects of task type all seem to depend on the level of task difficulty, determined by the amount of cognitive load placed on the participant by the task at hand. Researchers have found that the difficulty of emotion-labeling tasks affects people differently depending on their age, particularly when evaluating emotions of surprise, fear, and sadness (Orgeta, 2010). So for future studies to provide a better understanding of the differences between older and younger adults, researchers need to control for task difficulty. Otherwise, it is hard to determine whether measured age-related differences reflect true disparities in emotion recognition ability, or if the tasks are instead displaying age differences in cognitive ability or processing speed.

To test this hypothesis, Orgeta (2010) conducted a study to determine task difficulty effects, which were conceptualized as age differences caused by the number of labels available to choose from in an emotion labeling task. Overall, older adults performance was lowest for detecting surprise in a target face when 4 labels were provided, or for detecting sadness and fear when 4 or 6 labels were provided. The older adults did best when only two options were given. Due to these findings, it seems that

changing emotion recognition tasks to only provide two emotion label options for each target stimulus will reduce the age differences normally observed in emotion labeling tasks. It is also important to note the finding that older adults perform worse than younger adults only in specific conditions (at a certain level of difficulty for certain emotions). This suggests there is no general age-related decline in emotion recognition ability. Rather, older adults perform comparably well when the label choices are limited.

Altering the intensity of expression for emotions being tested can also increase task difficulty and cognitive demand. Expressions that are so subtle that they lack the characteristic facial features of their emotion are much more difficult to pinpoint. In fact, it has been found in past research that differences do emerge between younger and older adults when the intensity of emotion expressions is manipulated. Building on the work of Orgeta (2010), Mienaltowski et al. (2013) hypothesized that low intensity expression of emotions combined with multiple labels leads to more cognitive demand, which affects accuracy of emotion recognition. Lowering the complexity of tasks makes them fairer across age groups, because the confusing mix of emotion perception and cognitive demands is decreased. Mienaltowski et al. (2013) tested this by using two labels for the emotion being assessed, but at only two intensities. The study was also self-paced, unlike visual scanning studies, in an attempt to evaluate the effect of different measurement techniques. Results of the study indicated that younger adults still did better than older adults in terms of accuracy, but only for some of the emotions. Therefore, expression intensity does seem to play a large role in emotion recognition. These results are not in line with the findings of Orgeta and Phillips (2008), but logically make sense when one

considers that lowering the salience of available cues increases the difficulty of recognizing an emotion.

One problem with measurement techniques of previous research is that multiple labels for each emotional stimulus confuse the researcher's ability to make a distinction between cognitive deficits and perceptual deficits in participants. It is also interesting that even though older adults spend more time focused on the mouths when determining emotion in stimuli, they still do worse recognizing emotions characterized by the mouth. When participants are only given two labels to choose from they must focus on facial cues most relevant to the compared emotions for that trial; this requires focused attention. Mienaltowski et al. (2013) also proposed that perhaps negative emotions are harder to categorize as we age or more context is needed to make good inferences about the presented stimuli. It is also possible that older adults are less familiar with the emotions that are most difficult for them. As can be seen, there are many possible variables that might work in conjunction with aging to affect emotion recognition ability.

As previously mentioned, context of the stimuli presented in emotion recognition tasks also influences how participants process and categorize emotions. Context can be provided by body posture, the environment a stimulus is placed in, descriptions that are given about stimuli, voices used for instruction or description, or the choice of vocabulary for a task. When emotions are processed, there is a rapid integration of contextual information with the facial expression. Context influences the way information is taken from facial stimuli by changing visual scanning patterns used by participants. Visual scanning patterns affect where people fixate on a face to determine the emotion being expressed. Researchers have suggested that older adults might have

different gaze patterns than younger adults, which they use to sample information from facial expressions. This could lead to the noted differences in emotion recognition ability if older adults' strategies for gathering information are not as effective as young adults'.

Patterns in eye tracking data for emotion recognition tasks suggest that younger adults focus first on the eyes, whereas older adults focus on context. This alone suggests that there is a greater contextual influence on older adults' emotion recognition ability. Despite this finding, however, previous emotion recognition research has primarily used facial expressions isolated from any context. Another reason context is so important for the assessment of emotion recognition ability is it makes the experiment more realistic. People use context in everyday encounters with others, when they must assess and respond to emotion. Body language, voices, and situational awareness all provide clues to others' emotions.

To study the affect of context on emotion recognition accuracy, Noh and Isaacowitz (2013) manipulated experimental context to convey the same emotion being expressed by the target, to be inconsistent with the emotion being expressed, or to be a "nonemotional" context. Basically, they altered whether what the target stimuli was doing with his/her body went along with, or did not make sense for, the emotion being expressed by the target's face. What the researchers found was that participants do best when the context is congruent with the emotion being expressed and worst when the context is incongruent. They perform somewhat better when the context is simply neutral. Older adults performed worse than younger adults when the context was incongruent. The results of this study indicated that the extent to which context has an influence on emotion recognition depends on the similarity between the target face emotion and the

emotion elicited by contextual cues. The more similar the facial emotion and context, the more influence context has on emotion recognition ability. The effects of context appear to be most prominent with older adults, who benefit most from a context that makes sense and agrees with the emotion being expressed by a target.

One hypothesis for the reasoning behind these results is that as one ages, one becomes more sensitive to environmental cues for social situations, perhaps to make up for perceptual or cognitive declines. Because older adults rely on context more than younger adults, taking context away in the experimental design may be the cause of differences in emotion recognition ability seen in past research. In fact, one study has showed that presenting body and facial expressions together decreased age differences in emotion recognition ability (Murphy, Lehrfeld, & Isaacowitz, 2010, as cited in Noh & Isaacowitz, 2013). Fewer age related deficits in ability to recognize emotion are seen when tasks and stimuli incorporate context, which makes the experimental design more true-to-life. Based on this research, it is safe to conclude that future studies need to provide context in the test design so as to make the study more realistic and applicable to real-world uses of emotion recognition.

Another characteristic of emotion recognition tasks that may affect outcomes is the novelty of target stimuli. It is known that the age and novelty of stimuli are processed in the amygdala. The natural orienting response is what causes novel faces to activate the amygdala. However, participants usually pay more attention to target faces of the same age and group membership as themselves. To gauge the influence of the novelty of stimuli on age differences in emotion recognition ability, Wright et al. (2008) studied how the amygdala response to novel stimuli changes with age. These results were

evaluated in light of the fact that the left and right amygdala of older adults has a smaller volume compared to those of younger adults. Despite these differences in amygdala volume, novelty processing appears to function similarly across the lifespan. Even in older adults, the amygdala responses are not that different from those of younger adults.

The Wright et al. (2008) study also revealed that participants, regardless of age, perform better when the presented facial stimuli are familiar to them. All participants were more sensitive to information in the faces of same age cohort targets, which was demonstrated by a significant amygdala response when presented with these particular stimuli. However, older adults were especially sensitive to information in the faces of people their own age. The race of target stimuli also affected the amygdala response, although this is not believed to be the result of participants' preference for members of their own group. In fact, when tested separately, the similarity between participants and target stimuli in terms of group membership caused less of an amygdala response and reduced subsequent emotion processing, possibly because of habituation to stimuli that possess characteristics common to one's group.

In summary, it seems that previous exposure to stimuli and the age of target faces compared to the age of participants in emotion recognition tasks could both affect recognition ability. One possible reason for the results found in the Wright et al. (2008) study is that this was not a self-paced study; meaning participants were constantly processing a rapid influx of stimuli. The high volume and frequency of stimuli to be processed by participants may have affected their perception of novelty in the stimuli, particularly after many trials. When considering the novelty of stimuli in emotion recognition tasks, age effects may also be seen because people in one's potential social

network (those closest in age and with whom the participant might see potential for a relationship) are considered more relevant, drawing more attention and focus from participants.

The established body of research on age differences in emotion recognition ability paints a picture of emotion processing and labeling problems that coincide with perceptual and cognitive deficits caused by aging. These results seem to contradict the logic that with age comes experience, both in expressing emotion and detecting it in others. Older adults should seemingly possess heightened skills for determining emotion from facial expressions, as evolutionary demands place value on the ability to maintain social relationships in old age, as well as to limit negative interactions with others that could be caused by mislabeling of emotions. So perhaps the age differences seen in previous research are the result of other factors aside from, or in addition to, genuine age-related decline in emotion recognition ability. To better understand and assess true age differences in ability, the above-mentioned research on factors that contribute to emotion recognition problems must be used to design a new study that limits the effect of these variables. Only then can pure emotion recognition ability be compared across the lifespan.

The goal of the current study was to examine the trajectory of changes in emotion recognition skills that accompany advancing age. One hypothesis for the study was that emotional matching ability would improve for all participants as the expressive intensity increased. This was hypothesized because of the findings of Mienaltowski et al. (2013), which suggest that with greater intensity the cues used to categorize emotion become more salient, making it easier to choose the stimulus with the same emotion as the target

from the two alternatives. Also, it was believed that older adults' performance would be impaired at low expressive intensity. Meaning, when the alternatives in the matching task were expressed at low intensities, older adults should be less accurate than younger adults at matching the target to the appropriate alternative (Isaacowitz et al., 2007; Ruffman et al., 2008). Finally, this research investigated the hypothesis that there is limited, if any, value in using a greater number of trials, considered the overall number already performed. Past studies have used a wide variety of methods to capture age differences in emotion recognition. Less cognitively demanding tasks, like a matching task, may require fewer trials to reliably detect age differences.

In this study, participants completed an explicit emotion-matching task that required matching the emotion of a target stimulus with one of two emotional comparison faces presented simultaneously. Participants were required to choose the face that corresponded to the emotion being expressed by the target, rather than directly label the observed emotion. This was to minimize participant's reliance on verbal labels. Target stimuli expressed one of five emotions (anger, disgust, fear, happiness, and sadness) at 100% intensity, while one of the comparison faces expressed the same emotion, but at a lower intensity (20%, 40%, 60%, and 80%). Intensity of emotional expression was varied to determine whether the salience of emotional cues in facial expressions impacts the performance of younger and older adults on emotion matching tasks. Participants completed either 320 or 640 trials to determine the value of additional trials.

CHAPTER 2

METHOD

Participants

Fifty-seven younger adults (Age: M = 20.0 years, SD = 2.7 years, 33 female/24 male) and 42 older adults (Age: M = 68.2 years, SD = 3.8 years, 21 female/21 male) took part in this study after providing written informed consent before testing. All older adult participants who were recruited for the study were screened using the Telephone Mini Mental Status Exam (Newkirk et al., 2004) and reported normal functioning. The Human Subjects Review Board of Western Kentucky University approved the procedures of this research study. Younger adult participants were recruited from the Western Kentucky University Study Board participant pool. Non-student volunteers (older adult participants) were recruited using voter registration information obtained from the state of Kentucky. Younger adult participants (M = 0.04, SD = 0.08) had greater visual acuity (log MAR) than did older adults (M = 0.12, SD = 0.13), $t(95) = 3.63$, but controlling for visual acuity did not impact the current study's findings.

Stimuli and emotion matching task

In this study, participants compared photographs of target faces containing one of five emotions (anger, disgust, fear, happiness, and sadness) at four intensities (20%, 40%, 60%, and 80%). Emotion recognition performance was assessed using an explicit

emotion-matching task (Herba et al., 2006). Participants in the study viewed neutral and emotional faces that varied as a function of intensity (20%-100%), ethnic background, and/or gender. On each trial, participants were presented with a target face expressing emotion at 100% intensity on the top half of a computer display. On the bottom half of the display were two comparison faces – one demonstrating a neutral expression and the other expressing the same emotion as the target but at a lower intensity. The two foils on the bottom half of the display were dissimilar in identity to the target. Figures 1a and 1b shows two examples of trial screens. Participants were asked to match the target face at the top of the screen to one of the comparison faces below based on the emotion being expressed. Responses were indicated by pressing one of two keys on a keyboard for each trial.

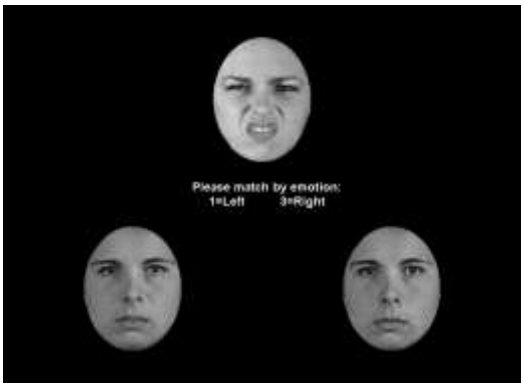

Fig. 1a. Sample trial screen – disgust at 20% intensity

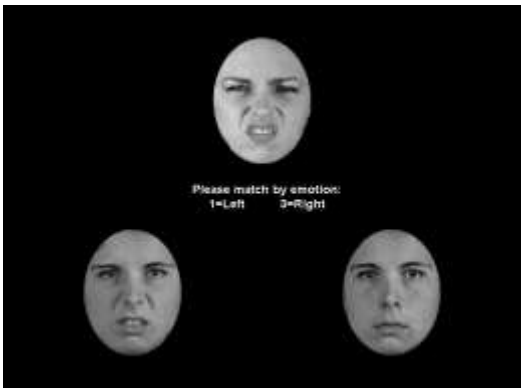

Fig. 1b. Sample trial screen – disgust at 80% intensity

The stimuli used in this experiment were grayscale faces adapted from the Montreal Set of Facial Displays of Emotion (Beaupre & Hess, 2005), and included four targets (two men and two women). Intensity was assigned to the stimuli by Beaupre and Hess, who used face morphing software to combine a target individual's neutral facial expression with his or her most intense and obvious expression of that emotion. This technique was completed at incremental ratios for each emotion (i.e., 80% sadness =

average of four 100% sadness expressions and one neutral expression). The original set of facial stimuli was modified using an oval filter, which highlighted only those facial features deemed necessary to make emotional comparisons; all background information was removed.

Participants completed either 320 or 640 trials separated into blocks consisting of 40 trials each. The short vs. long versions of the experiment were randomly assigned to determine the effect of task length and number of trials on performance. The correct comparison face included each target (four people) expressing each emotion (anger, disgust, fear, happiness, and sadness) at each intensity level (20%-80%), presented on each side of the display randomly on different trials. Each stimulus was repeated four times in the 640-trial condition and twice in the 320-trial condition. The photographs were presented at a viewing distance of 57.3 cm on a 17 in. Dell 1703 FPt LCD monitor (resolution: 1024 x 768 pixels) by a PC with an Intel Pentium 4 2.8 GHZ CPU using E-Prime software (Psychology Software Tools, Inc.; pst-net.com), and stimuli were 13° (height) by 9° (width). Experimental sessions lasted no more than two hours. On average, sessions lasted between 60-90 minutes. Participants were allowed time to take breaks between tasks. Every participant completed the tasks in a single session.

Procedure

Participants provided informed consent in writing and then completed the emotion-matching task after a brief cognitive battery screening. The battery included a vocabulary test (Ekstrom et al., 1976), Finding A's Speed Test (Ekstrom et al., 1976), Colenbrander Visual Acuity Test (www.ski.org), Center for Epidemiological Studies

Depression Scale (Radloff, 1977), View of Self Survey (Rammstedt & John, 2007), and a brief demographics questionnaire. During the emotion recognition task participants chose from one of two possible facial stimuli of varied intensity, selecting the one that most accurately replicated the emotion being expressed at 100% intensity by the target stimulus at the top of the screen. Each trial remained visible to the participant for as long as was necessary to make a selection. From one trial to the next the emotion being expressed by the target stimulus varied, as did the identity and expressed emotion of the two foils below it. Participants were instructed before each block of trials which computer keys to use to indicate their responses, and a reminder was displayed on the screen throughout the experiment. Matching accuracy scores were calculated for each emotion and intensity, and reflect the percent of trials in which a correct match was provided.

Advanced Vocabulary Test

The Advanced Vocabulary test contains 36 items and measures verbal ability from the Kit of Factor Referenced Tests (Ekstrom, French, Harman, & Derman, 1976). On each of the 36 items, participants chose the option that had an identical or similar meaning as a target word. It took about 8 minutes to run the test.

Finding A's Speed Test

The Finding A's Speed Test measures processing speed by means of the ability of the participant to find the letter "A" among six pages of words. Each page contains five columns, with each column containing five words spelled with the letter "A" (Ekstrom et

al., 1976). To indicate recognition, participants cross out as many words containing the letter "A" as possible during a two-minute period.

Visual Acuity Test

For the Colenbrander Visual Acuity Test we had participants stand one meter away from an eye chart containing rows of letters of decreasing size. Participants were judged based on the smallest row of letters they could accurately read. The acuity values were converted to log MAR (minimum angle of resolution). This test took about two minutes for participants to complete.

Center for Epidemiological Studies Depression Scale (CES-D).

The CES-D is a 20-item scale utilized in our experiment to evaluate symptoms of depression in participants (Radloff, 1977). Participants indicated the frequency of experience for certain scenarios on a four-point Likert scale (*a = rarely or none of the time (<1 day), b = some or a little of the time (1-2 days), c = occasionally or moderately (3-4 days), and d = most or all of the time (5-7 days)*). Example scenarios are: *"During the past week, I felt that people dislike me"* or *"During the past week, I did not feel like eating. My appetite was poor"*. For each item, the participant's response was converted to a value of 0 to 3. The total score was calculated by summing the responses for individual items, which created a scale from 0 to 60. Internal consistency for items on the CES-D measure is typically 0.85 (Radloff, 1977).

View of Self Survey (VoS)

The View of Self Survey was utilized in this experiment to evaluate participants in relation to the Big Five personality traits (conscientiousness, openness, agreeableness, extraversion, and neuroticism; Rammstedt & John, 2007). A smaller version of the Big Five Inventory (BFI-44), this measure contains 10 items in which participants rate how well statements apply to their personality. Participants rate each statement on a five-point Likert scale (*1 = disagree strongly, 2 = disagree a little, 3 = neither agree nor disagree, 4 = agree a little, 5 = agree strongly*). Example statements could include: *"I see myself as someone who is outgoing and sociable"* or *"I see myself as someone who tends to be lazy".* This measure has been found to have a test-retest reliability of 0.75 (Rammstedt & John, 2007).

Brief Demographics Questionnaire

In our study participants completed a 30-item questionnaire pertaining to marital status, age, religious affiliation, gender, health, education level, etc. The questionnaire took about five minutes to complete and is helpful for ensuring that we obtained a representative sample of the population demographics for Warren County, Kentucky, and/or the United States.

CHAPTER 3

RESULTS

Sample Characteristics: Comparing the Younger and Older Adult Samples

Independent samples t-tests were performed to compare the younger and older adults who took part in the current study on each of the following individual difference measures: Center for Epidemiological Studies – Depression Scale (CES-D), the Advanced Vocabulary Test, the Finding A's Test, and a brief Big Five personality inventory. Overall, younger adults reported more depressive symptomology than did older adults, $t(97) = 2.96$, $p = .004$. Younger adults outperformed older adults on the Finding A's Test, $t(97) = 4.64$, $p < .001$, but older adults outperformed younger adults on the Advanced Vocabulary Test, $t(97) = 6.13$, $p < .001$. Younger and older adults were not different from one another in their self-reported openness, extroversion, agreeableness, and neuroticism, $t(97) < 1.80$, $p > .07$. However, older adults reported higher levels of conscientiousness than did younger adults, $t(97) = 3.74$, $p < .001$. Please refer to Table 1 for the mean younger and older adult scores for each measure.

Table 1

Mean difference of individual difference measures by age group

Measure	Older Adult		Younger Adult	
	Mean	SD	Mean	SD
View of Self				
Openness	7.19	2.06	7.40	1.91
Conscientiousness*	8.69	1.65	7.42	1.69
Extroversion	7.19	1.95	6.96	1.88
Agreeableness	8.02	1.33	7.81	1.52
Neuroticism	4.90	2.06	5.60	1.76
Vocabulary*	18.90	6.40	12.70	3.58
A's Test *	22.05	7.12	31.04	10.95
Feelings Scale	29.37	7.67	33.88	7.37

**p < .05*

Emotion Matching Task

We conducted a 2 (age: young, old) × 2 (experiment length: short, long) × 5 (emotion: anger, disgust, fear, happiness, and sadness) × 4 (intensity: 20%, 40%, 60%, 80%) mixed model analysis of variance on the emotion recognition accuracy scores. Age and experiment length were the between-subjects factors; emotion and intensity were the within-subjects factors. The analysis yielded main effects of emotion, $F(4, 380) = 147.77$, $p < .001$, $\eta_p^2 = .61$, and intensity, $F(3, 285) = 670.84$, $p < .001$, $\eta_p^2 = .88$, which were qualified by the following interactions: intensity × age group, $F(3, 285) = 9.86$, $p < .09$, $\eta_p^2 = .61$; emotion × intensity, $F(12, 1140) = 60.46$, $p < .001$, $\eta_p^2 = .39$; and emotion × intensity × age group, $F(12, 1140) = 2.93$, $p < .001$, $\eta_p^2 = .03$. It is important to note that

gender itself, when added to the model, produced a significant main effect, $F(1, 91) = 6.67$, $p = .011$, $\eta_p^2 = .068$ (Men $M = 89.1\%$, $SE = 0.9\%$; Women $M = 92.3\%$, $SE = 0.8\%$); however, gender did not interact with any of the other variables. Experiment length had no impact on matching accuracy, $F(1,95) = 0.02$, $p > .89$, $\eta_p^2 = .00$.

We broke down the three-way interaction of emotion × intensity × age group by running five separate 2 (age group: old adult, young adult) × 4 (intensity: 20%, 40%, 60%, 80%) analyses of variance, one per emotion. Within each ANOVA, least significant difference post hoc tests were used to compare the impact of the differing levels of intensity of expression on matching accuracy. After each of these ANOVAs, independent samples post-hoc t-tests were used to compare younger and older adults. Please note that younger and older adults' mean performance can be observed for each emotion and intensity of expression in Figures 2 through 6.

Anger

For anger, the ANOVA yielded no main effect of age, $F(1, 97) = 0.88$, $p = .35$, $\eta_p^2 = .009$, but did reveal a main effect of intensity, $F(3, 291) = 256.64$, $p < .001$, $\eta_p^2 = .724$, and an interaction between age and intensity, $F(3, 291) = 4.83$, $p = .003$, $\eta_p^2 = .047$. Overall, accuracy improved with intensity, but leveled off at 60% (20% < 40% < 60% and 80%). Younger adults were equal to older adults in recognition accuracy, $t(97) < 1.88, p > .05$, for all but 40% intensity, where older adults were more accurate than younger adults, $t(97) = 2.09, p = .04$. Younger and older adults' mean performances are displayed in Figure 2.

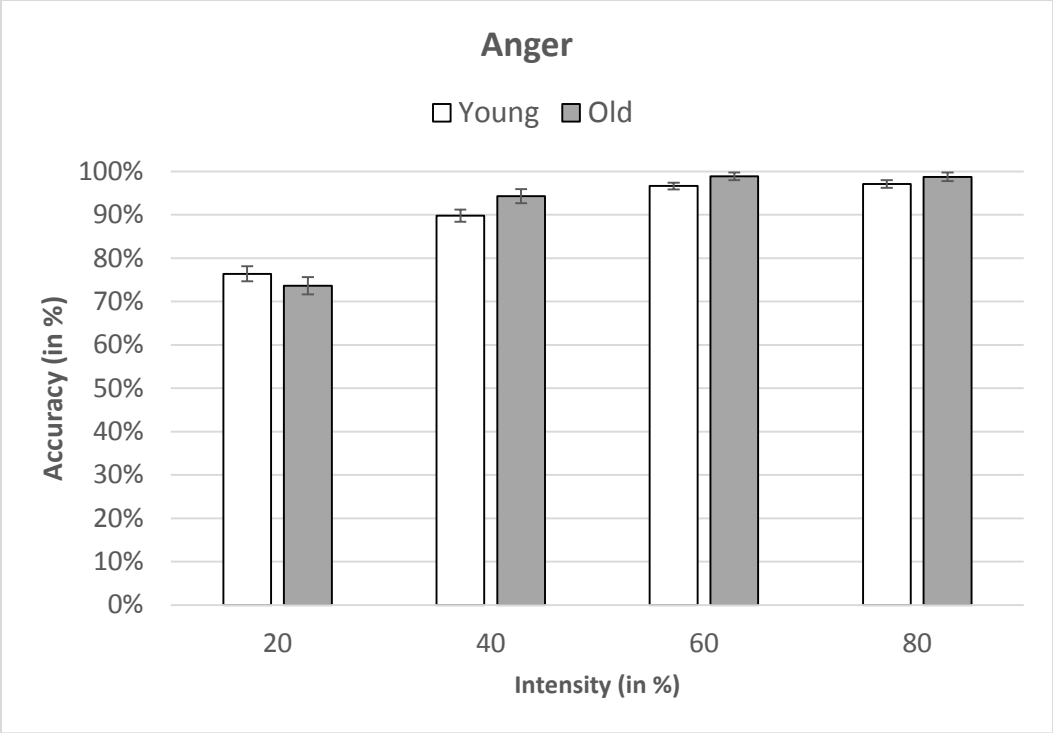

Fig. 2. Mean anger matching performance of younger and older adults at each expressive intensity.

Disgust

Disgust did show a main effect for age, $F(1, 97) = 4.68$, $p = .03$, $\eta_p^2 = .046$, indicating that younger adults performed better than older adults. There was also a main effect of intensity, $F(3, 291) = 192.02$, $p < .001$, $\eta_p^2 = .664$, showing that performance improved as intensity increased, and did not level off at 60% intensity but rather continued to improve (20% < 40% < 60% < 80%). There was an interaction between age and intensity as well, $F(3, 291) = 10.22$, $p < .001$, $\eta_p^2 = .095$. Younger adults were found to perform better than older adults at 20% intensity, $t(97) = 3.18, \mathrm{p} = .002$, but younger adults displayed accuracy equal to that of older adults for the rest of the intensities, $t(97) < 1.10, \mathrm{p} > .27$. Younger and older adults' mean performances are displayed in Figure 3.

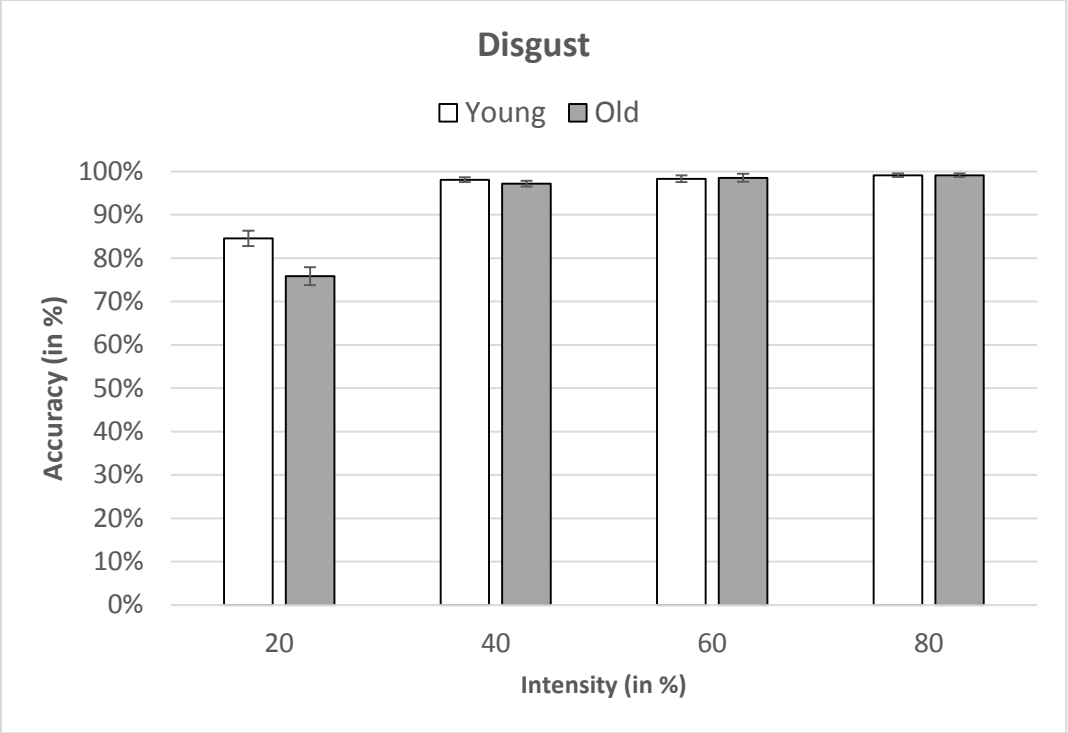

Fig. 3. Mean disgust matching performance of younger and older adults at each expressive intensity.

Fear

For fear there was also a main effect of age, $F(1, 97) = 7.56$, $p = .007$, $\eta_p^2 = .072$, showing that younger adults performed better than older adults. The main effect of intensity, $F(3, 291) = 311.00$, $p < .001$, $\eta_p^2 = .762$, was similar to that of disgust, showing that accuracy improved as intensity increased (20% < 40% < 60% < 80%). The intensity × age group interaction, $F(3, 291) = 3.32$, $p = .02$, $\eta_p^2 = .033$, showed that younger adults were more accurate than older adults at 20%, $t(97) = 2.85, \mathrm{p} = .005$, and 40% intensity, $t(97) = 2.42, \mathrm{p} = .017$, but not at 60% and 80%, $t(97) < 1.55, \mathrm{ps} > .12$. Younger and older adult's mean performances are displayed in Figure 4.

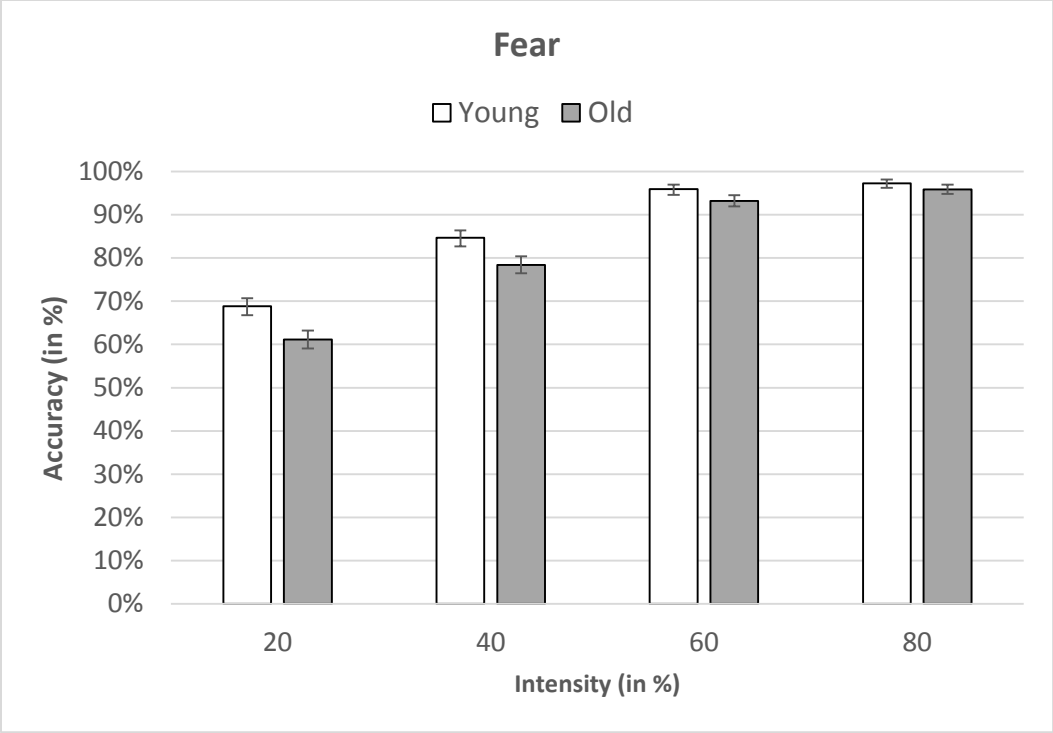

Fig. 4. Mean fear matching performance of younger and older adults at each expressive intensity.

Happiness

Happiness displayed near ceiling effects for both younger adults and older adults. There was no effect of age, $F(1, 97) = 1.22$, $p = .27$, $\eta_p^2 = .012$, nor an intensity × age group interaction, $F(3, 291) = 0.97$, $p = .41$, $\eta_p^2 = .010$. However, there was a main effect of intensity, $F(3, 291) = 42.94$, $p < .001$, $\eta_p^2 = .307$. Accuracy at 20% intensity was lower than that for 40%, 60%, and 80%. Younger and older adults' mean performances are displayed in Figure 5.

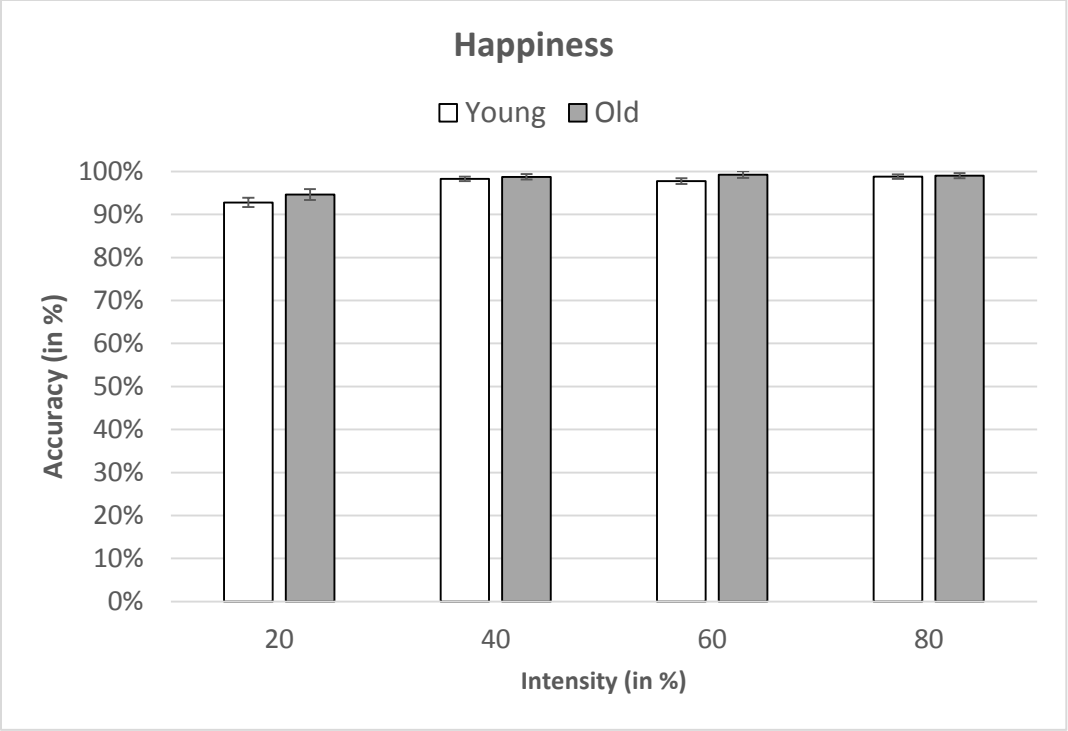

Fig. 5. Mean happiness matching performance of younger and older adults at each expressive intensity.

Sadness

No age effects were seen for sadness, $F(1, 97) = 0.01$, $p = .92$, $\eta_p^2 = .001$. However, a significant intensity × age group interaction was seen, $F(3, 291) = 4.50$, $p < .001$, $\eta_p^2 = .734$, but follow-up analyses revealed that there were no significant differences between younger and older adult performance at any intensity, $t(97) < 1.67, p > .09$. There was a main effect of intensity, $F(3, 291) = 286.09$, $p < .001$, $\eta_p^2 = .734$, such that accuracy at 20% < 40% < 60% and 80%. Younger and older adults' mean performances are displayed in Figure 6.

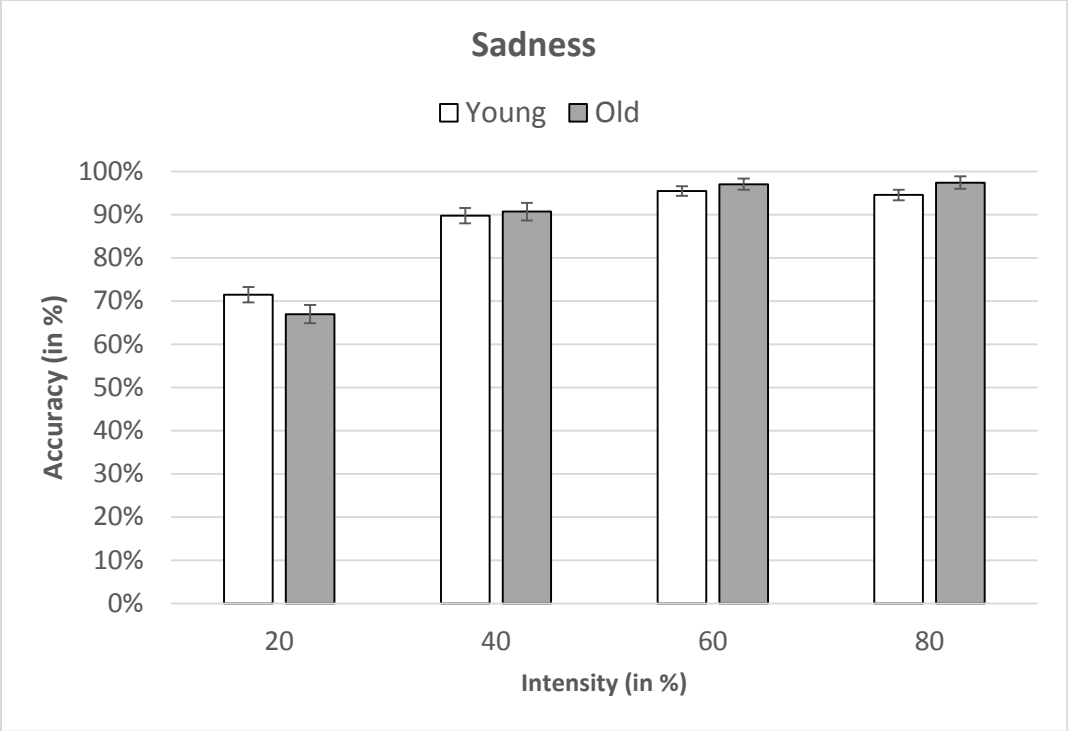

Fig. 6. Mean sadness matching performance of younger and older adults at each expressive intensity.

CHAPTER 4

DISCUSSION

The goal of the current experiment was to examine whether or not age differences in emotion perception found in prior research extended to a stimulus-matching assessment developed to minimize the participants' reliance on categorizing emotion through the use of verbal labels. In prior research, younger adults outperformed older adults on emotion recognition tasks. These age-related deficits were particularly pronounced for some specific emotions (Issacowitz et al., 2007). However, many researchers suggest that these age-related differences were only seen because older adults are worse at identifying negative emotions, and that, for expressions of happiness, surprise, and disgust, there are no differences in ability (Orgeta & Phillips, 2008; Ruffman et al., 2008). Older adults may even perform better than younger adults when detecting the emotion of disgust (Ruffman et al., 2008). A more recent study suggests that the intensity of the emotion being expressed is actually what leads to the published age differences, with age differences in emotion recognition ability only being seen when expressive intensity of the stimulus is low (Mienaltowski et al., 2013). In the current study we found that younger and older adults only minimally differed from one another in emotion matching performance. Older adults were outperformed only on those trials involving lower intensity fear and disgust.

Various theories exist to explain these differences found between younger and older adults in emotion recognition studies. Aging theories, for example, suggest that the differences between older and younger adults in visual scanning, the theory of mind, and the social and emotion consequences of aging could all possibly explain age-related decline in emotion recognition ability. It has also been proposed that experiment content could be affecting task outcomes. The type of task used to test emotion recognition, which relates to task difficulty and the amount of cognitive demand placed on participants, has been found to impact the age differences seen between younger and older participants (Orgeta, 2010). Contextual stimuli, expression intensity, and number of emotion label choices are all facets of experiment content that have been found to influence age differences in emotion recognition ability (Mienaltowski et al., 2013; Noh & Isaacowitz, 2013; Orgeta, 2010;).

Discrete Emotions Matter

Although we did see some age-related differences in emotion recognition ability, the findings of this study did not indicate overall age-related decline in ability, as suggested by previous research. The age differences found in this study were limited to emotions of disgust and fear, and only for lower intensity expressions. Younger adults performed slightly better than older adults on tasks involving these two emotions, but older adults actually performed better overall than younger adults for expressions of anger, happiness, and sadness. It should be noted that although older adults were better at detecting emotions of happiness, the scores for both younger and older adults were nearly perfect. These results were not consistent with previous research that claimed there should be no differences in ability for disgust (Orgeta & Phillips, 2008; Ruffman et al.,

2008), and challenged the idea that older adults may even be better at detecting disgust (Ruffman et al., 2008).

Consistent with our predictions, we found that matching performance improved for both younger and older adults as the expressive intensity of the comparison stimuli increased to more closely resemble the target face. Age differences between younger and older participants were not seen at high-level expressive intensity, which is inconsistent with prior research on emotion labeling ability (Orgeta & Phillips, 2008). On the other hand, the findings of this current study are consistent with aging research, which suggests that when emotional cues are highly salient (as they are in high intensity expressions), younger and older adults do not differ very much in their ability to correctly label emotions (Norman, Bartholomew, & Burton, 2008). However, performance did not improve uniformly across all emotions. For anger, improvement leveled off at 60%, whereas performance for disgust and fear improved as intensity increased, all the way up to 80% intensity. Accurate emotion matching for happiness was not affected by intensity, as all participants displayed near ceiling results for this emotion.

One possible reason for older adults' impaired ability to detect the emotions of disgust and fear at low intensities is that these emotions are observed less often in everyday life than emotions of happiness, sadness, and anger (Birditt & Fingerman, 2003; Chipperfield, Perry, & Weiner, 2003). If older adults, in particular, experience these emotions less frequently, it makes sense that they would have more difficulty identifying them, especially when the emotions are expressed at low intensity and with limited contextual cues.

Task Characteristics Are Important

The current study sought to eliminate all extraneous variables that might confound the results of an emotion recognition ability test. In particular, we sought to minimize cognitive demand on participants so that younger and older adults could approach the task on a level playing field. By the use of this emotion-matching task, we hoped to see whether younger and older adults perceive emotion differently, which would be evident if older adults were less able than younger adults to accurately label emotions presented on target faces. We hoped to simulate natural social encounters in which younger and older adults must recognize, interpret, and respond to emotional cues on the faces of other people.

Unlike past research, we eliminated the use of multiple verbal emotion labels. The use of verbal labels creates an additional step in the response process that may introduce age-related variability that is only indirectly connected to one's ability to detect emotion. We instead asked participants to match a target emotional face to one of two face alternatives, indicating via a computer keyboard which option expressed the same emotion as the target. One of the facial choices displayed the same emotion as the target but at varied intensities, while the other face displayed a neutral expression. We varied the intensity of emotion expression to assess the impact of expression intensity on emotion recognition ability. This would be akin to a participant witnessing a group of several people react to some event and attempting to discern how they felt about it; individuals will display their emotions at various levels of intensity. It was our prediction that emotion matching would improve for all participants as expressive intensity

increased. We also believed that older adults' performance would be lower than that of younger adults at low expressive intensity.

The current study also limited contextual cues, so that participants could only use the emotional content of the facial stimuli to determine emotion. The grayscale faces used in this experiment were adapted from the Montreal Set of Facial Displays of Emotion (Beaupre & Hess, 2005), and were modified using an oval filter that selected only those facial features that were necessary to make emotional comparisons. This allowed us to solely test emotion recognition, rather than knowledge or appropriate use of contextual cues to infer emotion from a stimulus.

Task-Length Had No Impact

This study also examined the impact of task length on younger and older adults' performances. The shorter version of the emotion matching task had half as many trials as the longer version (320 versus 640), but still included more trials than have typically been included in past studies. We predicted that there would be limited, if any, value in a greater number of trials, given the overall number.

Consistent with our predictions, the results of the current study indicated that the length of the task had no impact on younger and older adults' performance. It appears that tasks involving numerous trials are no more accurate in assessing the differences between older and younger adults for emotion matching. It is likely that task length displayed no significant effect on performance because the study already involved a substantial number of trials. Although the number of trials was doubled in the long condition, the 320 trials employed in the short condition were of an adequate number to accurately reflect participant performance. It is also possible that task length did not

influence results because the task itself is quite simple. If the task exerted a very minimal amount of cognitive demand on participants, even increasing the number of trials would not have led to the type of mental strain that could impact performance. Because we did not use verbal cues, but rather visual emotional stimuli, perhaps this aspect of the experimental design led to consistent performance even across the longest trial condition.

CHAPTER 5

CONCLUSIONS

In summary, the present findings support the assertion that younger adults only outperform older adults on emotion matching tasks for certain emotions displayed at low intensity. These results contradict previous research suggesting that younger adults have greater emotion recognition ability than older adults and consistently outperform them on emotion recognition tasks. Younger and older adults in this study only minimally differed from one another in emotion matching performance, and older adults were only outperformed on trials involving lower intensity expressions of fear and disgust. As is to be expected, performance improved for younger and older adults in this study as the expressive intensity of the comparison stimuli increased. The length of the task had no impact on younger and older adults' performance, suggesting that tasks that minimize the cognitive demands on older adults may more reliably assess adult emotion perception ability. The current study is important to the literature related to age differences in emotion recognition ability because it contradicts previous research suggesting that this ability declines with age across all emotions. This study also demonstrates that decreasing the cognitive demands placed on participants by experiment content may allow for more accurate evaluation of ability in adults. Future research in this field could examine how further reducing the number of trials influences reliability, in the hopes of extending the work to an even younger age group (e.g., children and adolescents). This

would allow researchers to examine the development of emotion matching performance across the entire lifespan.

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