

Use of Lexical and Affective Prosodic Cues to Emotion by Younger and Older Adults

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Abstract

Older adults often report that, although they are able to hear conversations, they have difficulty attending to or understanding what is being said. Interactions between cognitive and perceptual processing are necessary for comprehension. It is possible that older adults have difficulty determining what type of emotional information is represented by the affective tone in which speech is spoken. Two studies were conducted using sentences to examine the use of lexical and affective prosodic cues to emotion by younger and older adults. The present studies are the first steps in a research programme concerning the effect of age on perceptual and cognitive interactions during comprehension of affective prosody.

Index Terms: Aging, affective prosody, emotion comprehension

1. Introduction

Everyday communication, whether its aim is information exchange or inter-personal interaction, occurs within a specific context that shapes what and how information is transmitted. Two types of information are conveyed in any given speech utterance: semantic information, in which words are used to express beliefs and ideas (i.e., *what* is said), and paralinguistic or social-emotional information, in which the listener is provided with speaker- and situation-specific cues such as emotional overtones (i.e., *how* the speech is spoken; [1], [2]).

The suprasegmental properties of speech which help to represent situation-specific variations in conversation can be referred to as prosody. Prosodic information, such as variations in pitch, loudness, duration and pausing [3], can carry information about both the linguistic and affective aspects of communication. Linguistically, prosody can alter syntactic or morphological meaning; for example, the placement of a pause between words, such as in “*His boss asked him to call Sue.*” versus “*His boss asked him to call, Sue.*” codes syntactic differences and alters the meaning of a sentence. Alternately, the statement “*My mum served spinach for dinner.*” spoken in a positive or negative tone of voice will convey a different idea about the talker’s enjoyment of this vegetable. In this latter

example, affective prosodic cues are used by the listener to reach a conclusion that is not immediately evident given only the lexical and syntactic information conveyed by the words. Lexical choice may also designate emotion; (e.g., “*delicious spinach*” versus “*disgusting spinach*”). Thus, the processing of affective cues complements and may either reinforce or contradict the linguistic information used to understand speech.

Speech understanding decreases with increasing age, at least when the listening conditions are challenging [4], [5]. Older adults typically report having the greatest difficulty following conversations or understanding spoken language when they are in noisy or busy environments [4]. This reduction in comprehension has been attributed to both perceptual declines associated with an aging auditory system, such as loss of high-frequency hearing and decreased temporal processing [6], [7], and/or to cognitive declines such as reduced attentional control, working memory capacity, or delayed speed of processing [8], [9]. It is most likely that interactions between changes in both perceptual and cognitive functioning account for the reports of older adults’ difficulty in understanding speech [10].

Understanding the prosodic information carried by speech likely also depends on interactions between perceptual and cognitive information processing. For example, perceiving speech as being high pitched (suggesting a happy tone) will interact with top-down processing, such as being able to link the current statement with a previous one to ascertain why the person you are speaking with might be happy. Age-related hearing impairments, characterized by reduced audibility of high frequency sounds, could hinder the comprehension of emotional information insofar as the acoustical properties of emotional speech may be difficult for an older person to perceive. In particular, happy speech differs from angry speech by having higher fundamental frequencies and larger frequency fluctuations [11]. Furthermore, since older adults have more difficulty than younger adults in detecting differences in voice fundamental frequency [12], their perception of certain emotions could be reduced. It may be that the auditory declines of older adults result in a disruption of the processing of affective information in

addition to disruptions in linguistic information comprehension. It is also possible that older adults could have difficulty with processing affective information due to declines in cognitive processing, especially when the cues do not converge.

1.1. Comprehension of prosody changes with age

Older adults seem to be able to make good use of the linguistic prosodic cues available in speech. Benefit from these cues has been shown to improve their memory for and comprehension of spoken information [13], [14], [15]. Conversely, when linguistic prosodic cues involving variations in pitch, loudness, duration and pause [15] are systematically removed from the speech signal, older adults are more penalized than younger adults (as measured by decreased recall), implying that they rely on these cues to aid comprehension more heavily than do younger adults [15]. Thus, the use of linguistic prosody to comprehend linguistic information remains available to older adults, but it may be deployed in an age-related compensatory fashion.

It has been suggested that the regulation of emotions increases with age, as does mood stability [16]. Nevertheless, understanding of affective prosodic cues does not seem to be as well-maintained with age as does use of linguistic prosody. A common test of affective processing used by both clinical neuropsychologists and researchers is the Aprosodia Battery [17], in which participants are asked to discriminate between emotional stimuli (e.g. anger, surprise), or to make judgments concerning the affective valence of particular stimuli. Older adults are commonly found to have impaired understanding of auditory emotional information when tested in quiet using this battery, regardless of whether the stimuli are speech segments or simply syllabic information [18], [19]. Importantly, the degree of comprehension decreases as the amount of verbal information present in the stimulus decreases from words to monosyllables (e.g., *ba ba ba*) and then to asyllabic noises (e.g., *ahhhh*). Few researchers have examined age-related differences in the comprehension of affective prosody when participants are required to listen to entire sentences rather than just words or sounds. In one study [20], older adults made more than twice as many errors as their younger counterparts in distinguishing between emotional tones of voice in sentences. Thus, there is evidence of age-related differences in judging affect across a range of utterances ranging from syllables to sentences.

In everyday communication, linguistic and affective information is processed simultaneously and linguistic content and affective prosody may converge to support the comprehension of emotion. A number of effects may be observed when presenting older and younger participants with discourse-type stimuli in the form of

spoken sentences. One possibility is that, because the perception of the acoustic cues specific to happy or sad stimuli is compromised, older adults may rely more than younger adults on the linguistic content of the stimulus than on affective prosodic cues. When linguistic information about emotion is eliminated or degraded, reducing the ability of older adults to use it in a compensatory fashion, larger age-related reductions in the ability to identify an emotion as happy or to discriminate between emotions should be observed. Further investigations on this topic are needed.

1.2 Goals of the current study

The primary goal of the study was to examine whether older and younger adults use the emotional information present in the affective paralinguistic properties of speech in a similar way. If the results are consistent with findings of age-related reductions in affective prosody processing, analysis of the production of emotional speech might shed light on whether these changes can be ascribed to cognitive or perceptual factors underpinning the comprehension of emotion in speech.

2. Experiments

Two experiments were conducted to examine 1) whether older adults have greater difficulty than younger adults when assigning labels of happy or sad affect to spoken sentences and 2) what differences, if any, older and younger adults exhibit in the acoustical properties of the speech they produce, such as differences in duration and fundamental frequency, when asked to repeat sentences spoken with an emotional valence.

2.1. Experiment 1

2.1.1 Method

Twelve younger (M age = 20.5 years, SD = 2.7) and twelve older (M age = 68.5 years, SD = 3.1) adults with good health, clinically normal hearing thresholds in the speech range, and English as a first language were tested. A group of forty sentences containing emotional information both in terms of the lexical content (what was said) and the affective prosody (spoken in a happy or sad tone of voice) were used as experimental stimuli. An example of a sentence with sad lexical content is "All the kids at camp tease me." An example of a sentence with happy lexical content is "My soccer team just won the championship." These sentences were the same as those used in a previous investigation of affective prosody understanding in children [21], and were divided equally into two conditions. In one condition, there were twenty sentences with congruent lexical and affective prosodic information (e.g. happy content and happy tone). In the second condition, there were twenty

sentences containing incongruent information (e.g. happy content and sad tone). Participants were instructed to listen carefully to each sentence and indicate whether they felt the speaker of each sentence was feeling happy or sad. A two-alternative forced-choice procedure was used. Participants were not told what level of information to attend to in order to make their happy/sad decisions. It was expected that accuracy would be higher for sentences from the congruent compared to the incongruent condition, and that in the incongruent condition the older participants would be more influenced than the younger participants by the lexical than the affective prosodic cues.

2.1.2 Results

For both age groups, emotion was judged very reliably when the lexical and affective prosodic cues were congruent. Compared to congruent trials, when the cues were incongruent, younger adults judged emotion primarily based on the affective prosodic cue whereas older adults were less consistent. As shown in Figure 1, older adults are less consistent than younger adults in judging emotion for the incongruent trials, but age-related differences are less pronounced for the congruent trials where both groups make more consistent judgments. This description was confirmed by an Analysis of Variance with age (young, old) as a between-subjects factor and trial type (congruent, incongruent) as a within-subjects factor. There were significant main effects of age, $F(1,24) = 6.71$, $p = .016$, and trial type, $F(3,22) = 9.37$, $p = .001$, as well as a significant interaction of age and trial type, $F(3,22) = 3.77$, $p = .041$.

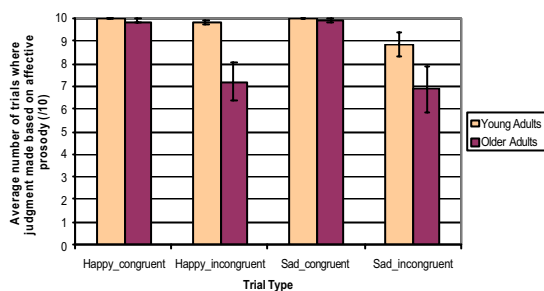


Figure 1. Number of trials in Experiment 1 where emotion was identified based on affective prosody for each age group for congruent and incongruent trials.

2.1.3 Discussion

The results from this preliminary investigation suggest that when congruent emotional information is available from both lexical and affective prosodic cues, older adults are just as capable at discriminating emotions as younger adults. However, when cues are incongruent,

age-related differences in the influence of the cues become apparent.

One possibility is that the difficulties experienced by the older adults in interpreting incongruent cues can be attributed to cognitive factors, such as problems in using attentional control to tease apart the two levels of information. Alternatively, the perception of affective prosodic cues may be reduced with age and as a result older participants may have been more influenced by the lexical cues than by affective prosody. Future steps must be taken to determine the relative contribution of cognitive and perceptual processes to affective prosody understanding.

2.2. Experiment 2

In order to investigate the question of whether reduced consistency in the judgment of emotion in the incongruent sentence condition in Experiment 1 was mediated by cognitive or auditory factors, a follow-up experiment was conducted in which participants were asked to imitate the sentences as well as judge emotion. If older adults can accurately imitate these sentences, this would suggest that their perception of the specific perceptual cues which are characteristic of different emotions is intact. This finding could aid in ruling out differences in perception as a cause for age-related declines in affective prosody processing.

Experiment 1 was repeated using the same method as before except that participants were asked to repeat each sentence exactly as they heard it before making their “happy/sad” decision. We examined the specific acoustical attributes of their imitations, namely fundamental frequency, duration, and amplitude (as per [3], [11]), to determine whether older and younger adults reproduced the sentences differently.

Preliminary qualitative assessment of vocal repetitions suggests that there are age-related differences in the imitation of emotion for both the congruent and incongruent conditions. In both conditions, younger listeners fluctuated from a neutral tone of voice to a tone similar to that of the target. In contrast, in the congruent condition older listeners did not imitate sad affective prosody as closely as they imitated happy affective prosody. In the incongruent condition, older adults were more uncertain and hesitant when imitating the sentences. The sensitivity of the older adults to the different target emotions and the differences observed in their imitations in the congruent and incongruent conditions suggests that their difficulties may be due to a combination of perceptual and cognitive factors. Quantitative analysis of prosodic characteristics will be discussed further at the conference.

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