Appropriate Accommodations:
Speech Technologies and the Needs of Older Adults

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Abstract

Older adults interacting with speech technologies may benefit from a range of communicative accommodations. Potential accommodations include volume, intonation, and sentence structure, to name a few. This paper reviews the literature on human communication with the elderly in search of recommendations for speech interface design. We conclude that spontaneous human behavior cannot easily be taken as a guide in designing communicative interactions for older adults. Due to substantial variability in the population, successful accommodations are largely dependent on the specifics of speaker and situation. Regrettably, humans are frequently not attuned to these specifics, and inappropriate accommodation is often perceived as patronizing. Speech technologies present an opportunity to offer accommodations appropriate to the specific communication needs and social values of individual users. Acknowledging the limitations of using research between human communicators to inform the design of speech interfaces, we offer considerations for further research on appropriate communication technologies for older adults.

Assistive Technologies for Seniors

To a large extent, work on assistive technologies for seniors focuses on monitoring the state of the older adult in the home. Projects using various sensor technologies seek to inform family caregivers about aspects of the older adult's health, if the adult is not eating regular meals, for example, or spending a great deal of time in bed (Mynatt et al. 2001; Haigh et al. 2003). Other interfaces give the feedback directly to the older adult in situations where the stove has been left on or a daily medication has not been taken (Pollack et al. 2002). Monitoring technologies may ultimately be able to provide cognitive assistance for a wide range of activities. In the future, an aware home may recognize that a common sequence of events has been only partially completed and begin prompting the user to complete the remaining steps. The overarching goal of this work is to support "aging in place," allowing seniors to retain their autonomy by remaining in their own homes.

Supposing that speech interfaces will become more prevalent in applications that provide cognitive assistance, it is wise to consider how they should be designed. Among humans, communication is facilitated by an exchange of linguistic and prosodic adjustments between speakers. Some adjustments take place as a subconscious reaction to features of the conversational partner's speech, but other adjustments seem to be based on an estimate of the partner's communication needs. When considering the design of speech technologies, there are a range of features that could potentially accommodate the specific communication requirements of the elderly population. This paper reviews the literature on human communication with the elderly in search of recommendations for speech interface design. We conclude that spontaneous human behavior cannot easily be taken as a guide in designing for older adults. Due to substantial variability in the population, successful accommodations are largely dependent on the specifics of speaker and situation. Regrettably, humans are frequently not attuned to these specifics, and inappropriate accommodation is often perceived as patronizing. Speech technologies are an opportunity to offer accommodations appropriate to the specific communication needs and social values of individual users. Acknowledging the limitations of using research between human communicators to inform the design of speech interfaces, we offer considerations for further research on appropriate communication technologies for older adults.

Human-Human Communication

One of the most robust findings from the literature on communication with the elderly is that adults do not speak to the elderly the way they speak to adults their own age. In reviewing the literature on this phenomenon, we will look first at what constitutes this difference in communication behavior. We will then consider several functions of this behavior from the perspective of both the speaker and the listener. Finally, we will review a general model of this phenomenon.

Elderspeak

Early interest in a special speech register directed toward the elderly was labeled "baby talk" because of its similarity to communication between mothers and their infants. Indeed, certain features of the baby talk register are present in speech among intimate adults and to animals as well. There are many unique features of elderspeak communication (see Figure 1), and the defining elements vary from study to study. As the research in this area progressed, speech directed toward the elderly was termed "secondary baby talk," "elderspeak," "dependency-supportive communication" and "patronizing speech." In this paper, communication directed toward older adults will be referred to as "elderspeak." The term "elderspeak" is preferable because it is a neutral term, unlike "patronizing communication." It is also distinguishable from the baby talk that occurs to infants. As we shall see, elderspeak functions differently for its speakers and is interpreted differently by its listeners than baby talk to infants.

Verbal Elements	Nonverbal Elements
Vocabulary	**Voice**
Simple	High pitch
Few multisyllabic words	Exaggerated
Childish terms	intonation
Minimizing words (e.g.	Loud
just, little, short)	Slow
Pronoun modifications	Exaggerated
(e.g. over inclusive we,	pronunciation
exclusive we,	**Gaze**
avoidance of me/you in	Low eye contact
favor of name substitutions)	Staring
Grammar	Roll eyes
Simple clauses and	Wink
sentences	**Proxemics**
Repetitions	Stand too close
Tag questions	Stand over a person
Imperatives	seated or in bed
Fillers	Stand too far off
Fragments	**Facial expression**
Forms of address	Frown
First names and	Exaggerated smile
nicknames	Raised eyebrows
Terms of endearment (e.g.	**Gestures**
sweetie, dearie, honey)	Shake head
Childlike terms (e.g. good	Shrug shoulders
girl, cute little man)	Hands on hips
Third-person reference	Cross arms
Topic management	Abrupt movements
Limited topic selection	**Touch**
Interruptions	Pat on head
Dismissive of other-	Pat on hand, arm,
generated topics	shoulder
Exaggerated praise for	
accomplishments	

Figure 1. Elements of Elderspeak (Ryan, Hummert and Boich 1995)

Functions of Elderspeak

Researchers interested in the features of speech addressed to children hypothesized that baby talk to children had two primary components, a communication-clarification component and an expressive-affective component (Brown 1977). When data began to be collected on baby talk addressed to the elderly, the focus on comprehension and affective goals prevailed. Later research presented the idea of control as an additional function of elderspeak (Lanceley 1985). We will discuss the nurturance function, the comprehension function, and the control function of elderspeak with respect to both speakers and listeners.

Nurturance Function

In a landmark study on baby talk in institutional settings, nurses' aides in a health care facility were audiotaped while working in the dining room during the lunch hour (Caporael 1981). These samples were content-filtered and categorized on the basis of paralinguistic features alone. Roughly twenty percent of the speech gathered during this field study was reliably categorized as baby talk. In this work, baby talk is distinguished from normal adult speech on the basis of prosodic features such as exaggerated intonation and high pitch. When these samples of baby talk in the institution were compared to similarly processed samples of teachers' aides in a nursery school class, college students were unable to differentiate between them. However, normal adult speech was clearly distinguished from either of the two forms of baby talk. In this study, participants rated the baby talk register as more comforting than the adult speech register. This finding was the impetus for a line of research which investigated the nurturance component of elderspeak.

Motivation of Speakers

Caregivers may see an institutionalized elderly adult in a dependent position and believe he or she needs caring attention. If this rationale for using elderspeak to convey nurturing information is accurate, one would expect that the more dependent an individual is, the more elderspeak the individual would receive. This motivation was explored in some of Caporael's earliest work but has not been supported. Caregivers' ratings of individual care receivers did not predict the amount of baby talk they received from those same caregivers (Caporael 1981). Instead, caregivers' composite ratings of several elderly listeners predict caregivers' beliefs about the appropriateness of elderspeak. Ratings of elderly behavior, particularly behavior in the social sphere (e.g. motivation, friendships), predicted caregivers' choice of the baby talk register as an appropriate strategy (Caporael, Lukaszewski and Culbertson 1983). The motivation of speakers to convey nurturing information is not specific to individual needs; it is dependent on general perceptions of the elderly population.

Impact on Listeners

The first study that suggested baby talk was comforting did not make the participants aware of the target of the communication, so a follow-up study asked for judgments from institutionalized elderly adults themselves. These participants listened to the samples in pairs and were asked which voice they liked the best. As elderly adults' functional ability went down, their preference for the baby talk register went up (Caporael et al. 1983). In an institutional setting, low functional ability would be highly related to the amount of help received by the nurses' aides; it is these more dependent adults who prefer the sound of the baby talk register.

Further investigations along these lines provide conflicting evidence that elders find elderspeak to be nurturing. Another judgment study using paired samples did not find the expected relationship between elderspeak and ratings of warmth (O'Connor and Rigby 1996). This study asked participants for ratings of two related written scenarios. The elderspeak condition included terms of endearment and childlike terms, but the neutral-talk scenario was rated higher on the warmth dimension by both nursing home residents and community-dwelling elderly adults. The self-reported functional health of the participants was not associated with perceptions of warmth, except among female nursing home residents.

Asking participants to rate two comparable scenarios may exaggerate the differences between them. Further research, using a between-subjects design, demonstrated that elderspeak does not convey nurturing affective information. Instead, it is related to more negative outcome measures (Ryan, Hamilton and Kwong See 1994). College students and elderly adults heard an audiotaped sample of either elderspeak or a neutral style. This elderspeak condition included a term of endearment, simpler expressions, more short imperatives and tag questions, and presumption about the resident's inability to remember to go to the dining room. Both college students and elderly adults rated users of elderspeak as less respectful and less competent; they did not rate elderspeak as more nurturing.

Conclusion

There is evidence that elderspeak carries an affective component, but there is no evidence that it unequivocally conveys nurturance. In limited circumstances, particularly where the elderly are in a highly dependent situation, it can be appealing and comforting. These adults need care; therefore, a caring tone is appropriate. Outside of this situation, particularly among community-dwelling elderly adults, this kind of tone is considered highly disrespectful. Regrettably, speakers do not appear to make this distinction. They do not seem to use the nurturing component of elderspeak in ways that differentiate the speech target on an individual basis. Instead, the use of elderspeak appears to be associated with general beliefs about the elderly.

Comprehension Function

The second function of a modified register to the elderly population is language comprehension. The aging process introduces several variables which may influence the ability of seniors to communicate. First, the mechanics of speaking and listening can decline. The voices of older adults lose strength, and hearing deteriorates. From a processing perspective, reaction times decrease and memory problems increase, specifically those associated with divided attention (Ryan et al. 1986). In light of these communication difficulties, we now consider whether elderspeak functions as a comprehension modification for speakers and for listeners.

Motivation of Speakers

While elderspeak may very well improve the comprehension of older adults, there is little evidence that speakers intend to use it in this way. If elderspeak was intended to increase comprehension, one would expect that restricting the availability of feedback from the listener would increase the amount of elderspeak produced. Instead, young adults use elderspeak to partners who are permitted to interrupt (Kemper et al. 1995) and to partners who are not permitted to interrupt (Kemper et al. 1996).

An early study in an institutional setting asked nursing staff and volunteer participants to speak to one senior they perceived to be alert and another they perceived to be non-alert (Ashburn and Gordon 1981). Only verbal dimensions of elderspeak were analyzed. The volunteer participants did not speak differently to alert and non-alert seniors, and the only distinction made by the nursing staff was an increase in the number of interrogative statements to the non-alert seniors.

There is some evidence, however, that speakers will adjust their language to compensate for a serious communicative deficiency (Kemper et al. 1998). Participants were told that the target of their communication was cognitively impaired and suffered from memory lapses, disorientation, and failed to recognize family members. Both young and older adults reduced sentence length and the propositional density of their communication when they targeted their messages to the cognitively impaired. The young adults compensated even more and produced more checks, expansions, and repetitions in their messages.

Impact on Listeners

Older adults were paired with young adults and peers on a referential communication task. A referential communication task separates two people and gives them different but overlapping information about a problem. Older adults working with young adults using elderspeak performed better than when paired with a peer. However, these same older adults report more problems with their own communicative competence (Kemper et al. 1995; Kemper et al. 1996). Interestingly, the self-reported

communication problems of the older partner are not reported by the younger partner. Subsequent work on the comprehension function of elderspeak explores which aspects of elderspeak may assist comprehension and seeks to discover which aspects predict a decline in the listener's self-confidence.

Improving Comprehension
An experiment using a map task created instruction in two conditions. One condition used directions that were simplified by shortening sentence length; the other condition used directions that eliminated embedded clauses. Shortening sentence length did not improve comprehension but did increase participants' self-reported communication problems. Eliminating embedded clauses, which simplifies syntactic complexity, improved comprehension and decreased communication problems (Kemper and Harden 1999). In a separate experiment, repetitions or elaborations of roughly half the instruction steps helped older adults perform as well as their young adult counterparts (Kemper and Harden 1999).

A widely acknowledged element of baby talk is exaggerated intonation. In order to investigate whether this feature serves a function in comprehension, young adults and older adults listened to an audiotape of a newspaper story being read aloud. The audiotape was manipulated to feature significant stress on the relevant nouns and verbs or in the alternate condition, stress on irrelevant aspects of the sentence (such as prepositions). Relevant stress improves comprehension for older adults; misplaced stress decreases comprehension for older adults. But the comprehension of the young is unaffected (Cohen and Faulkner 1986). A similar result was described in (Wingfield, Lahar and Stine 1989). Wingfield contrasted normal prosody with a "list" prosody that placed equal stress, pitch, and amplitude on every word. The recall of young listeners declines, but the recall of older listeners is severely impaired. Word stress and other prosodic elements are crucial for the comprehension of older listeners.

Undermining Confidence
The previously described results showed a benefit for older adults given speech with appropriately placed stress, but the use of intonation in elderspeak is often considered exaggerated, not merely appropriate. One experiment manipulated the prosodic register of elderspeak independently of its verbal features. The exaggerated prosody condition included stress on key words, a slow rate of speaking, pauses, and clear enunciation. The effect of this manipulation was a slight decrease in performance as well as a significant increase in self-reported communication problems (Kemper and Harden 1999). Recipients may believe that their own communication shortcomings are responsible for their partner's use of elderspeak accommodations.

Conclusion

There is evidence that certain features of elderspeak improve comprehension, specifically syntactic simplification and semantic elaboration. But these beneficial features of elderspeak are often accompanied by elements which do not appear to improve performance. It is these unnecessary features of elderspeak which seem to imply that the listener is incompetent. Listeners respond to this by believing that they are less communicatively competent than they actually are. Unfortunately, speakers do not appear to regulate their speech by modifying only what is required by their listeners. Consequently, the use of elderspeak as a general register may be doing as much harm as good.

Control Function

Certain features of the elderspeak register do not clearly serve a caring or a comprehension function. It has been argued that the inclusive we (e.g., "up we go"), tag questions (e.g., "you know?"), third person references, and other features of elderspeak signal a demonstration of the power dynamic between nurses and the institutionalized elderly (Lanceley 1985). Negative evaluations of elderspeak are consistently produced, but there is no evidence that the detrimental effects of elderspeak are deliberate. Considering the balance (shown in Figure 2) between managing relationship goals (associated with the care dimension) and managing task goals (associated with the control dimension), may shed some light on how elderspeak is produced and evaluated (Hummert and Ryan 1996).
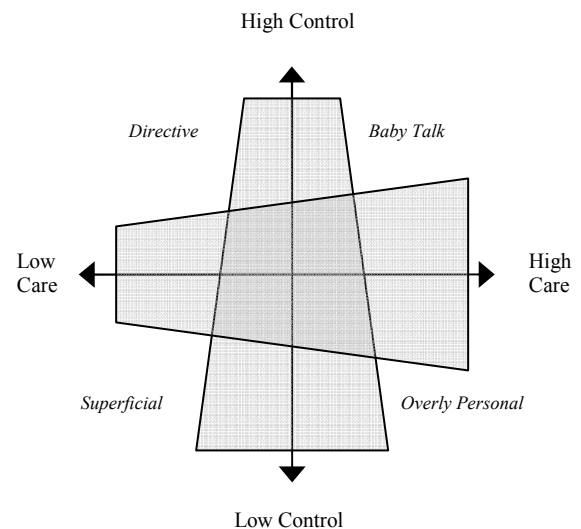

Figure 2. Model of Patronizing Talk, Shaded areas of the model represent polite talk (Hummert and Ryan 1996) .

Motivation of Speakers
Speakers manage concerns related to relationships and tasks with all manner of different listeners. Decades of work on politeness theory have described the balance between maintaining positive face (protecting individual

worth) and maintaining negative face (protecting autonomy) when conversing with anyone (Brown and Levinson 1987). But the situation becomes more complicated with an older adult who may require the maintenance of an additional security dimension (Parmelee and Lawton 1990). One possibility is that the interaction between these three goals is challenging and impolite conversation is the result.

For example, caregivers who visit the homes of older adults will cite autonomy goals for their clients more frequently than caregivers in institutions. Caregivers in institutions will cite security goals more frequently. Although caregivers understand that community-dwelling seniors value their autonomy, the verbal and physical behavior of these two groups of caregivers is nearly identical in practice (Wahl 1991). While engaging with older adults as "helpers," it appears to be difficult for speakers to optimize for autonomy as well.

Impact on Listeners

In order to explore possible differences in the value and experience of independence among older adults, several observational studies were conducted among nursing home residents and older adults who received assistance with self-care from their home. Verbal as well as behavioral data was coded for either control by the older adult, control by the staff, or cooperation. The results show that dependent behaviors result in immediate, positive reactions, while independent behaviors are ignored or, often, receive dependence-supportive responses (Baltes and Wahl 1996). One example of a dependence-supportive responsive might be "I told you not to do that; you always get it wrong." In fact, in one study, independent behaviors are followed twice as often by dependence-supportive responses as independence-supportive responses (Baltes and Wahl 1992).

A byproduct of dependence-support scripts is the nonuse of competence by older adults. This occurs when an older adult has the ability to do something but receives help anyway. These studies also investigated the causal explanations for this surrender of responsibility. Perhaps not surprisingly, the elderly see their inactivity as the result of staff's behavior, while the staff see the elderly person's inactivity as the result of the elderly person's characteristics (Wahl 1991).

Conclusion

Of course, few would acknowledge that they were seeking to undermine an individual's autonomy with their speech. It may simply be, however, that seeking to simultaneously provide care, to provide security, and to facilitate autonomy is a tall order in any given conversation. Further, paid caregivers may see themselves as helpers; that is what they are paid to do. While it is unnecessary for caregivers to assume that a limited need for help implies that older adults can do nothing for themselves, there is not enough incentive for professional caregivers to attend to the varied skill levels of their different clients in order to ensure that each senior maintains as much personal control as possible.

The Communicative Predicament of Aging Model

The impact of the three functions of elderspeak—nurturance, comprehension, and control—varies depending on how appropriate that accommodation is to the target individual. But for each of the three functions, speakers do not appear to be moderating their use of elderspeak in ways that benefit older adults. Instead, speakers seem to be accommodating their use of elderspeak to nurture, to aid comprehension, and to control for an entire population. The idea that speakers are accommodating to a stereotype of aging, as opposed to the needs of a specific listener is termed the "communicative predicament of aging" (Ryan et al. 1986). This model claims that the motivation of the speaker is an aging stereotype, and the impact on the listener is the acceptance of that stereotype as a self-stereotype.
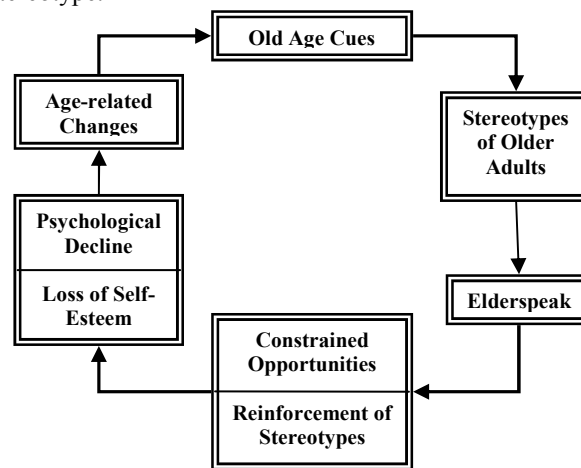

Figure 3. The Communicative Predicament of Aging (Ryan et al. 1986)

Motivation of Speakers

Stereotypes can be exposed by a variety of different techniques—trait sorting, implicit association tests, matched-guise technique, etc. (Hummert et al. 2004). In a matched-guise study, an actor taped the same passage using a "young" and an "old" voice. Participants who heard the "old" voice estimated the speaker to be around sixty-two years old. The presumed age of the speaker led participants to interpret the passage in different ways. The "old" voice was assumed to be confused when saying "I don't know what to think" while the "young" voice was assumed to be withholding judgment (Giles et al. 1992). When participants were asked to question the writer of the passage, they included more questions about health, physical condition, quickness of reaction, and mental competence to the older target (Giles et al. 1992).

In a study specifically designed to measure beliefs about communication with older adults, participants rated themselves and another adult aged either 25 or 75 years on the Language in Adulthood Questionnaire (Ryan et al. 1992). Respondents expected fewer communication problems from 25-year-olds on every item, except for telling enjoyable stories and sincerity while talking.

Impact on Listeners

When elderspeak cues a negative aging stereotype, older adults are vulnerable to accepting this stereotype. For example, when older adults are addressed with elderspeak by young adults, they give lower assessments of their own communication abilities even when these communication problems do not exist (Kemper and Harden 1999). Even more distressingly, stereotypes can have an expectation effect. Even subliminal priming of negative age stereotypes (words like "senile" or "decrepit") can produce surprising effects. Levy and colleagues have reported the detrimental effects of self-stereotyping for memory, handwriting, even walking (Levy 2003). Negative age stereotypes have no effect on young people because it is thought that these stereotypes are not yet salient, but older adults have internalized and are fearful of these negative aging stereotypes. For example, older participants evaluate a forgetful older target more negatively than younger and middle-aged participants (Rodin and Langer 1980). These internalized stereotypes make older adults susceptible to self-stereotyping.

Conclusion

There are a few positive stereotypes about aging, but there are also many negative stereotypes. The Communicative Predicament of Aging explains that cultural stereotypes influence communication behavior toward older adults even when the older adult does not conform to the stereotype. The judgments inherent in the communication then trigger aging self-stereotypes in the older adult listeners, which can lead to negative outcomes. Inappropriate accommodation can have serious consequences for older adult listeners.

General Discussion

Looking across the reviewed research, human accommodation to older listeners has potentially negative consequences. The perception of insult in elderspeak is frequently related to unnecessary accommodation or overaccommodation by the speaker. Elderspeak may be nurturing to those in a serious state of decline, but it is offensive to those in good health. It aids comprehension when it includes useful elaborations but becomes insulting when it includes features that are not useful for performance, such as pauses and short sentences. And although, in some cases, seniors need to relinquish a limited amount of control over their lives to their caregivers, elderspeak may become damaging when control

is asserted uniformly. This review suggests that speech technologies should not model communication on spontaneous human behavior. Humans are not always successful at differentiating between necessary and unnecessary accommodation.

Application to Speech Technologies

We acknowledge the limitations of applying human-human communication research to human-computer communication within the domain of technologies for the elderly. Further research will clarify the extent to which this application is warranted. The research does give us guidance in creating speech technologies that adapt to older adults as individuals. Looking at the functions of elderspeak as potential goals for human-computer communication, we discuss considerations for research of speech technologies for older adults.

Nurturing Goals

While it is true that nursing home residents in poor health found elderspeak to be nurturing, pursuing the goal of nurturing communication using prosodic cues is an uncertain proposition. Based on research with older adults, perceptions of elderspeak as nurturing would be predicted only for adults in highly dependent positions. Other listeners may find the communication demeaning. There are other reasons to be wary about implementing a system which could use an elderspeak register to convey nurturance. A nurturing tone demonstrates a level of responsibility for the listener that may be inadvisable from a machine, especially when interacting with an adult in poor health.

Instead of nurturance, a more reasonable goal for speech technologies may be a type of social cohesion based on prosodic convergence. Prosodic convergence is a gradual adjustment in nonverbal features that mirrors particular features of a user's speech. It has been suggested by researchers of accommodation that this type of convergence is a desire for social approval (Giles, Coupland and Coupland 1991). Further research should examine if convergence on user's speech characteristics translates into user liking of the system.

Comprehension Goals

The research reviewed in this paper would advise that in order to facilitate comprehension among older users, speech synthesis should maintain natural distinctions in prosody, including word stress. On the verbal dimension, the research suggests that using simple sentence structure and providing semantic elaboration will benefit older adults as well. The concept of semantic elaboration can include repetition, expansion, and comprehension checks (Kemper 2001). Although its usefulness has been empirically demonstrated, it is still quite difficult to predict the appropriate amount of semantic elaboration. In an experiment with university students and staff, participants

interacting with a robot that used semantic expansions that were inappropriate to level of expertise had difficulties with information exchange and experienced weakened social relations with the robot (Torrey et al. in review). These experiments provide preliminary evidence that features associated with semantic elaboration need to be tailored to the specific knowledge requirements of the listener. Further research is necessary to investigate the responses of older adults to semantic elaboration which is too extensive or too limited.

Control Goals

The issue of user control in speech technologies for older adults can be described as a problem of adjustable autonomy. The goal is to let the user do as much of the task as he or she is capable. When the user is unable, the dialogue system should then provide assistance. This is a fundamentally different metric for optimization than task efficiency. Autonomy goals keep the responsibility for a task squarely in the hands of the user, avoiding reliance on the system and the deterioration of human skills through nonuse. The research in this area reviewed does not lay out specific communication features that are responsible for conveying conversational control, but it seems likely that patterns of turn-taking are influential in determining who is dominating the conversation. Further research on dialogue systems should compare the effects of mixed-initiative dialogue to current system-driven dialogues and user-instigated assistance to system-instigated assistance.

Conclusion

We have considered the adjustment of a range of verbal and nonverbal features that could potentially accommodate the specific communication requirements of the aging population. We have concluded that opportunities for successful accommodation rely on sensitivity to both the speaker and the situation. Based on our review of the communication literature, we have considered three speculative ideas for further research. First, prosodic accommodations are likely to be effective for social cohesion when they mimic the user's speech. Second, comprehension can be enhanced by a degree of semantic elaboration that is well matched to the user's expertise. Third, the value of personal autonomy may outweigh the benefits of task efficiency, and older adults may benefit from dialogue systems which defer to user initiative. While speech technologies cannot be modeled directly from the literature on communication to older adults, previous work does provide several promising directions for future research.

Acknowledgements

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