

How Readers Spontaneously Interpret *Man*-Suffix Words: Evidence from Eye Movements

Manizeh Khan · Meredyth Daneman

Published online: 18 August 2011
© Springer Science+Business Media, LLC 2011

Abstract This study investigated whether readers are more likely to assign a male referent to *man*-suffix terms (e.g. *chairman*) than to gender-neutral alternatives (e.g., *chairperson*) during reading, and whether this bias differs as a function of age. Younger and older adults' eye movements were monitored while reading passages containing phrases such as “The chairman/chairperson familiarized herself with...” On-line eye fixation data provided strong evidence that *man*-suffix words were more likely to evoke the expectation of a male referent in both age groups. Younger readers demonstrated inflated processing times when first encountering *herself* after *chairman* relative to *chairperson*, and they tended to make more regressive fixations to *chairman*. Older readers did not show the effect when initially encountering *herself*, but they spent disproportionately longer looking back to *chairman* and *herself*. The study provides empirical support for copy-editing policies that mandate the use of explicitly gender-neutral suffix terms in place of *man*-suffix terms.

Keywords *Man*-suffix words · Language comprehension · Eye movements · Reading

Introduction

Consider the following passage:

The armed robbery trial of the young suspect was full of surprises. None of the evidence was conclusive, and none of the witnesses seemed believable. After twelve hours of deliberation, the jury finally reached a unanimous verdict. The foreman reassured

M. Khan
Department of Psychology, Harvard University, 33 Kirkland Street, Cambridge, MA 02138, USA
e-mail: khan@wjh.harvard.edu

M. Daneman (✉)
Department of Psychology, University of Toronto, 3359 Mississauga Rd,
Mississauga, ON L5L 1C6, Canada
e-mail: daneman@psych.utoronto.ca

herself that they had made the correct decision, and announced a verdict of ‘not guilty’. Almost immediately, the family of the suspect began rejoicing, while the victim cried injustice.

Readers may find it difficult to integrate the reflexive pronoun *herself* when reading the phrase “The foreman reassured herself...”. This is likely the result of initially assuming that the foreman of the armed robbery trial jury was male. Even though the suffix *man* in *foreman* can be used in its gender-neutral sense to refer to a person of unspecified gender, it is possible that *man* tends to evoke a male-biased expectation because the gender-specific sense of *man* is used more frequently than its gender-neutral sense (MacKay 1980). According to this account, any surprise experienced upon encountering *herself* would have been a result of the *man* in *foreman* steering the reader to expect a male referent, rather than to entertain the possibility of a male or a female referent in the way that an explicitly gender-neutral alternative such as *foreperson* might have done (Kennedy 1993; Martyna 1980).

In response to the concern that gender-neutral uses of masculine terms might encourage readers “to think male, rather than male and female” (Schneider and Hacker 1973, p. 17), numerous academic and commercial publishing houses instituted copy-editing policies that mandate the use of explicitly gender-neutral alternatives such as *person* in place of the more ambiguously gender-neutral *man* terms (see for example, APA Publication Manual Task Force 1977; Harper & Row Publishers Inc. 1976; Holt, Rinehart & Winston (College Division) 1976; Prentice-Hall Inc. 1975; Random House 1975). But is there any empirical evidence that people are more inclined to ignore or exclude female referents when they encounter *man*-suffix role terms (e.g., *foreman*, *policeman*) than when they encounter explicitly gender-neutral alternatives (e.g., *foreperson*, *police officer*)? In the present study, we used eye-tracking methodology to address that question.

So far, the evidence for male-biased interpretations of generic masculine terms (e.g., *man*, *he*) has relied on tasks that required readers to make some kind of response or judgment after reading (or even repeatedly reflecting upon) the linguistic construction(s) of interest (e.g., MacKay 1980; McConnell and Fazio 1996; Moulton et al. 1978; Schneider and Hacker 1973). For example, Schneider and Hacker (1973) used a picture selection task to investigate readers’ interpretations of chapter titles with or without the generic *man* (e.g., “Economic Man” vs. “Economic Behavior”; “Political Man” vs. “Political Behavior”). They told participants that the authors of a recently completed introductory sociology textbook wanted to use student-created collages as artwork at the beginning of each chapter. Schneider and Hacker found that 64% of the students assigned to construct collages for *man*-titled chapters selected pictures depicting males only, whereas only 50% of the students assigned to construct collages for chapters without *man* in the title did so.

Moulton et al. (1978) used a creative writing task to investigate readers’ interpretations of the pronouns *his*, *their*, and *his or her*. They had students read the following theme: “In a large coeducational institution the average student will feel isolated in _____ introductory course” (Moulton et al., p.1034). For one group, the blank space was replaced by *his*, for another group, by *their*, and for a third group, by *his or her*. The students’ assignment was to make up a story with a fictional character fitting the theme. Moulton et al. determined the gender of the fictionally created characters from pronouns and proper names used in the stories and from a follow-up question that asked participants to name their fictional characters if they had not already done so in their written stories. The researchers found that only 35% of the story characters were female when the pronoun *his* was used in the provided theme, and this was significantly lower than the 46 and 56% female character rates produced in response to the more feminist-friendly *their* and *his or her* alternatives, respectively. Based

on these findings, Moulton et al. concluded that the generic use of masculine terms does not support female interpretations to the same extent as other neutral terms do.

MacKay (1980) demonstrated the biasing effect of the masculine personal pronoun, *he*, by asking college students to read paragraphs containing the pronoun *he* or a neologism (*E*, *tey*, or *e*) that referred to a neutral antecedent (e.g., *writer*). After reading each paragraph, participants had to respond to a multiple-choice question that assessed their comprehension of the antecedent of the pronoun. For example, after one paragraph, the question was “The beginning writer discussed in the paragraph is: (a) male, (b) female, or (c) either male or female” (MacKay 1980, p. 446). MacKay found that readers of *he* paragraphs were much less likely to choose the “either male or female” alternative than were readers of neologism paragraphs.

Although the results of these earlier studies are suggestive, they all relied on off-line measures to make inferences about how readers interpreted the generic masculine terms. Consequently, there is always the concern that these measures (choosing pictorial illustrations, writing stories, answering a post-reading multiple-choice question) do not accurately reflect the way in which readers interpreted the terms when initially processing them. In this study, we used on-line eye fixation data to make inferences about the spontaneous interpretations that readers give to terms such as *foreman* and *foreperson* when encountering them in natural prose passages (such as the “armed robbery trial” passage above). Our paradigm was based on determining the relative disruption to on-line comprehension processes that readers experience when they encounter the reflexive pronoun *himself* or *herself* following a noun phrase such as “The foreman reassured...” or “The foreperson reassured...”.

Before going into the details of our task, we briefly describe the study by Duffy and Keir (2004). Although this study did not examine the influence of generic *man* terms on gender assignment, it is relevant because it used a similar garden-path methodology to ours, and the results highlight the potential usefulness of using eye movement data to investigate the way in which readers treat *man*-suffix versus neutral-suffix role names during regular reading. Of interest here was the fact that Duffy and Keir used “role name-verb-reflexive pronoun” constructions as we did. However, their manipulation was not to contrast *man*-suffix and neutral-suffix role names, but rather to contrast role names that were all linguistically neutral but whose real-world referents were stereotypically male (e.g. *electrician*; *firefighter*) versus stereotypically female (e.g. *babysitter*; *secretary*). The role names were followed by a reflexive pronoun that either matched or mismatched the gender stereotype (e.g., *The electrician taught himself/herself...*; *The babysitter found herself/himself*). Duffy and Keir found that fixation times on the reflexive pronoun were inflated when the pronoun specified a gender that mismatched the gender stereotype of the role name (e.g. *herself* after *electrician*; *himself* after *babysitter*) than when it matched the gender stereotype (e.g. *himself* after *electrician*; *herself* after *babysitter*). The disruption to the reading process was evident when the reflexive pronoun was first processed, and was also reflected in a tendency for readers to make regressive fixations to earlier parts of the sentence. Duffy and Keir took their findings to indicate that gender stereotypes are immediately and automatically activated during reading (see also Kreiner et al. 2008; Osterhout et al. 1997; Sturt 2003).

Duffy and Keir (2004) showed that readers assign gender-specific referents to role names on the basis of cultural stereotypes (electricians tend to be male; babysitters tend to be female) and that violations of these gender assignments interfere with the readers’ processing of a subsequent reflexive pronoun that referred to the role name (e.g., *The electrician taught herself...*; *The babysitter found himself...*). We adapted the Duffy and Keir paradigm to investigate whether readers’ gender assignments to role names are influenced by the linguistic properties of the word itself (e.g., *foreman* vs. *foreperson*; *spokesman* vs. *spokesperson*)

rather than simply the readers' world knowledge about gender stereotypes. We monitored eye movements as participants read one of four "role name-verb-reflexive pronoun" constructions (e.g., *The foreman reassured himself...*; *The foreman reassured herself...*; *The foreperson reassured himself...*; *The foreperson reassured herself...*) embedded in gender-neutral prose contexts. If readers are more inclined to assign a male referent to a *man*-suffix word (*foreman*) than to an explicitly gender-neutral alternative (*foreperson*), then we should expect greater interference in the processing of the female-specific reflexive pronoun, *herself*, after reading *man*-suffix role names (e.g., *foreman*) than gender-neutral role names (e.g., *foreperson*). A finding such as this cannot be attributed to gender assignment being made on the basis of the reader's knowledge of the gender stereotype associated with a particular role or occupation because our role name manipulation (e.g., *foreman/foreperson*) keeps the occupation (e.g., overseer of a jury) constant.

Our design also allowed us to investigate whether explicitly neutral alternatives do indeed act to promote the inclusion of female referents. If a word such as *foreperson* actually invites readers to entertain a male or female referent until the text provides further clarification, then processing time on a subsequent *himself* or *herself* should be equivalent. Of course, it is possible that readers prefer to commit to a single gender initially, regardless of the form that the role name takes. The studies using off-line comprehension measures have produced conflicting evidence on this issue. Merritt and Kok (1995) found a strong male attribution bias for gender-unspecified individuals, whereas McConnell and Fazio (1996) found an increased attribution of feminine personality traits when a gender-unspecified character had been referred to as a *chairperson* rather than *chairman*. Our design allowed us to investigate how readers treat gender-neutral role names as they encounter them during the course of regular reading.

So far, we have ignored possible influences of the age of the reader on the interpretation of generic *man* terms. However, there is reason to hypothesize that current university-aged readers may treat *man* and *person* role names differently than do older (65 years+) adults. This difference would not be a result of age per se, but rather reflect differences in the two generations' exposure to generic *man* terms versus explicitly gender-neutral alternatives. During the 1970s, feminists successfully argued that the generic use of masculine terms reflected and encouraged a view of women as peripheral and excluded from positions of power (Martyna 1980; Kennedy 1993). Sensitive to these concerns, academic and commercial publishing houses published guidelines for non-sexist language that prohibited the use of generic masculine terms and that encouraged the use of neutral terms, such as *chairperson*, that encompass both males and females (see Moulton et al. 1978). Given the extent of the language reforms that have occurred in just a few decades (see also Rubin et al. 1994), current university-aged students (who were born well after the 1970s) have likely had much less exposure to generic masculine terms than have older adults whose formative years will have pre-dated the language reform. Accordingly, one might hypothesize that *man* terms might bias against a female interpretation more strongly for younger adult readers than for older adult readers because today's younger adults are less familiar with the possibility of a *man-herself* pairing. Alternatively, today's young adults may have grown up in an era in which there are constant reminders that sexist language is to be avoided, and so even if they are seduced into automatically thinking male when encountering a *man*-suffix role name, their heightened awareness of *man*'s double function may allow them to register a gender mismatch immediately, and to recover the alternative interpretation of the *man*-suffix word more readily than their older counterparts are able to do. To investigate potential age differences in the processing of *man*-suffix terms, we administered our reading task to two groups of readers in our study: a group of university

students whose average age was 19 years, and a group of older adults whose average age was 71 years.

Method

Participants

The participants were 32 younger adults whose age ranged from 17 to 21 years ($M = 18.69$ years, $SD = 1.06$), and 32 older adults whose age ranged from 65 to 80 years ($M = 71.03$ years, $SD = 3.35$). An equal number of males and females were included in both age groups.

The younger adults were students enrolled in an introductory psychology course at the University of Toronto Mississauga who were not above the age of 21. The older adults were volunteers drawn from the local Mississauga community who had completed at least 12 years of formal schooling ($M = 14.75$ years, $SD = 2.47$) and were at least 65 years of age. A questionnaire was used to screen participants for general health, hearing, vision, and cognitive status. Only participants who reported that they were in good health and that they had no history of serious pathology (e.g., stroke, head injury, neurological disease, seizures, mental pathology) were included in the study. To ensure that our older adults were indeed high functioning (see Schneider et al. 2005; Murphy et al. 2006), we administered the Mill Hill Vocabulary Scale (Raven 1965) to all participants. The mean vocabulary score on the Mill Hill was 15.59 out of 20 ($SD = 2.23$) for the older adults. This score is comparable to the means found for older participants in previous studies (see Schneider et al. 2005; Murphy et al. 2006), and was significantly higher than the mean vocabulary score of 12.28 out of 20 ($SD = 2.19$) for the younger adults, $t(62) = 6.00$, $p < 0.001$ (see also Baltes 1997; Johnson 2003).

All participants were fluent speakers of English and had normal, or corrected-to-normal, vision. Participants were administered (1) the experimental task, (2) the Mill Hill vocabulary test, and (3) the gender stereotype questionnaire. They were tested individually, in a session lasting approximately one hour, and were given course credit or paid \$10 per hour for participation.

The Experimental Task

Participants read 36 passages and responded to a true-false question after each of them. Twelve of the passages were experimental passages: three were in the *man role name/himself* condition, three in the *man role name/herself* condition, three in the *neutral role name/himself* condition, and three in the *neutral role name/herself* condition. The other 24 passages were filler passages that did not contain *man*-suffix words. Participants' eye movements were monitored and recorded while reading the passages.

Materials

The experimental manipulation involved the following 12 generic role names that either appeared in the *man*-suffix form or in an explicitly gender-neutral form: *businessmanbusinessperson*; *chairman-chairperson*; *congressman-congressperson*; *doorman-doorperson*; *foreman-foreperson*; *Frenchman-French person*; *mailman-mail carrier*; *policeman-police*

Table 1 Sample passages with two possible role names and two possible reflexive pronouns*(a) Chairman/chairperson*

The budget committee of Good Money Inc. was caught in a complete deadlock about decreasing holiday spending. Half the members would never consider approving the measure, while the others were determined to see it succeed. Ultimately, the decision would come down to a single vote. The *chairman/chairperson* familiarized *himself/herself* with all the relevant material, and prepared to make the final call. The only certainty was that whatever the decision, it was sure to be unpopular
 Test statement: The committee was discussing holiday spending. True or False?

(b) Spokesman/spokesperson

The image of the Rest Assured insurance company was suffering after a series of blunders made by the CEO. Much of the clientele had left the firm, while those that remained distrusted their executives. It was clear that a new public relations campaign needed to be undertaken. The *spokesman/spokesperson* gave *himself/herself* a deadline of two months to establish a new, positive image for the company. Before long, heart-warming tales of past and present clients filled people's television screens and newspaper pages
 Test statement: The CEO of Rest Assured had made a series of public blunders. True or False?

officer; salesman-salesperson; spokesman-spokesperson; sportsman-sportsperson; statesman-statesperson.

Twelve five-sentence passages were created, one for each generic role. See Table 1 for sample passages. The first three sentences of each passage set up an appropriate and gender-neutral context for the role name. The fourth sentence was the critical target sentence and began with the structure "The-role name-verb-reflexive pronoun". The two role names (man, neutral) crossed with the two reflexive pronouns (*himself, herself*) produced four versions (see Table 1). The fifth and final sentence provided a gender-neutral conclusion to the passage. A simple true/false question was constructed for each passage; the question did not interrogate information to do with the critical sentence containing the role name (see Table 1 for examples).

Each version of a passage was assigned to one of four stimulus files with the constraint that each file contain three passages of each sentence type (man/himself; man/herself; neutral/himself; neutral/herself). In each version, the 12 experimental passages were randomly interspersed with the 24 filler passages. An equal number of younger and older participants were assigned to read each file.

Procedure

Passages were presented in double spaced Arial 36 font on a computer screen. Participants were asked to read the passages silently at their own pace. They were instructed to read for comprehension because they would be presented a true/false question about each passage after reading it. When participants had finished reading a passage, they pressed a key on a button box, prompting the true/false statement to appear on screen. Participants indicated whether the statement was true or false by pressing the "yes" or "no" key on the button box. The experimenter pressed a button to initiate presentation of the next passage.

While reading, participants' eye movements were recorded using an eye-tracker system (EyeLink II, which SR Research Ltd. developed). Each participant wore the EyeLink headband, which contains three small cameras that allow simultaneous tracking of both eyes and head position, making possible the computation of true gaze position with unrestrained head motion. The movements of one eye, chosen based on superior calibration, were recorded and analyzed. The on-line saccade detector of the eye tracker was set to detect saccades with

an amplitude 0.5° or greater, using an acceleration threshold of $9,500^\circ/s^2$ and a velocity threshold of $30^\circ/s$. The EyeLink system uses an Ethernet link between the eye tracker and the display computers so that real-time gaze position data can be displayed. We used two computer monitors for our task. One was used to display the passages to the participant, and the second was used to display real-time feedback about the participant's eye movements to the experimenter; this allowed the experimenter to monitor performance and recalibrate the eye-tracking system as necessary (see Daneman et al. 2007; Shen et al. 2003, for a similar set-up).

Mill Hill Vocabulary Test

Participants were administered the Mill Hill test of vocabulary knowledge (Raven 1965). There were 20 multiple-choice items (e.g., fecund means [a] esulent, [b] profound, [c] sublime, [d] optative, [e] prolific, [f] salic). Participants completed all 20 items.

Gender Stereotype Questionnaire

In order to obtain off-line data concerning how our participants assigned gender to *man*-suffix and neutral role names, we administered a questionnaire to them at the end of the experimental session. Participants were given a list of the 12 *man*-suffix role names (e.g., *foreman*; *spokesman*) and the 12 gender-neutral role names (e.g., *foreperson*; *spokesperson*) in random order. They were told to rate the gender stereotypes of each role and occupation on a seven-point scale, with 1 = extremely male and 7 = extremely female.

Results and Discussion

Gender Stereotype Ratings

Both younger and older participants rated *man* role names (e.g. *foreman*; *chairman*) as being more strongly associated with a male referent than the explicitly gender-neutral alternatives (e.g., *foreperson*; *chairperson*). On the 1–7 scale (with 1 = extremely male), younger adults gave mean ratings of 2.01 (SD = 0.56) and 3.42 (SD = 0.62) for *man* role names and neutral role names, respectively, $t(31) = 10.87$, $p < 0.001$; older adults gave mean ratings of 1.87 (SD = 0.93) and 3.84 (SD = 0.50) for *man* role names and neutral role names, respectively, $t(31) = 16.53$, $p < 0.001$. Note that younger and older adults provided equivalently strong male stereotype ratings for *man* role names, $t(62) = 0.72$, $p = 0.47$; however, the 3.42 rating that younger adults gave to the explicitly gender-neutral role names was significantly “more male” than the 3.84 rating that older adults gave to those terms, $t(62) = 2.94$, $p < 0.01$.

The pattern of results is consistent with previous off-line studies that have shown that *man*-suffix terms are more likely to support a male interpretation than are their explicitly gender-neutral counterparts (Schneider and Hacker 1973). However, we need to turn to our eye fixation data for a more sensitive index of the spontaneous gender assignments that readers give to these linguistic constructions.

The Experimental Task

Participants performed well on the true/false statements about the experimental passages; on average, they responded correctly on 9.88 out of 12 test statements, a finding that suggests that

they were reading the passages for meaning. Younger and older readers performed equally well on the comprehension task; the means were 9.78 (SD = 1.54) and 9.97 (SD = 1.09), respectively, $t(62) = 0.56, p > 0.50$. Furthermore, the eye fixation data showed that older adults were not slower overall than younger adults on any of the dependent measures of interest (there were no significant main effects of age, all $ps > 0.08$). Thus, any age effects to do with our experimental manipulations could not be attributed to age-related differences in the overall ease of comprehension or speed of reading.

We used four dependent measures to investigate whether there were on-line differences in the gender attributions made to *man* words (e.g. *foreman*) versus neutral words (e.g. *foreperson*). These were (a) first-pass time on the reflexive pronoun, (b) look-back time on the role name, (c) look-back time on the verb between the role name and reflexive pronoun, and (d) look-back time on the reflexive pronoun. An example from four readers' eye fixation protocols will illustrate how the dependent measures were computed. Figure 1 shows the four readers' eye fixations while reading the critical region of the *chairman/*

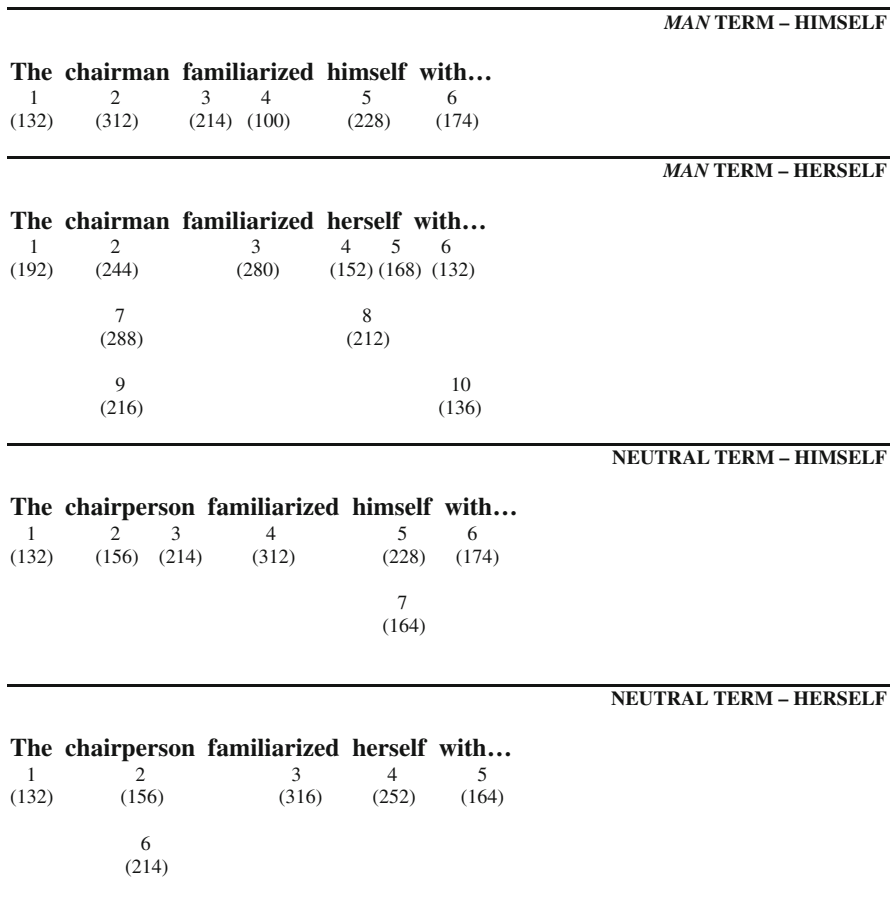


Fig. 1 Four readers' eye fixations while reading different versions of the sentence containing the target role name and reflexive pronoun. For each reader, the sequence of fixations is denoted by the number underneath the word being fixated, and the duration, in milliseconds, is placed in parentheses under the associated fixation

chairperson passage. In each case, the sequence of fixations is denoted by the successive numbers below the word being fixated, with the duration of each fixation (in milliseconds) indicated in parentheses below the associated fixation. The first-pass reading time on the reflexive pronoun was simply the time spent fixating *himself* or *herself* when first encountered (and before the reader moved on to a subsequent or earlier word); for the reader who saw *chairman-himself*, the first-pass time on the reflexive pronoun was 228 ms (fixation 5); for the reader who saw *chairman-herself*, it was 320 ms (the sum of fixations 4 and 5). First-pass times were used to determine whether differences across conditions in the processing of the gender-disambiguating reflexive pronoun, *himself* or *herself*, occurred immediately; that is, whether the processing costs associated with detecting a mismatch between the gender specified by the reflexive pronoun and the gender initially assigned to a role name emerged on the reflexive pronoun itself, rather than later on in the sentence.

Look-back times on the role name, verb, and reflexive pronoun were the sum durations of any fixations spent refixating those regions after the reader had encountered the reflexive pronoun. For the reader who saw *chairman-himself*, the look-back time on the role name, verb, and reflexive pronoun were all 0. For the reader who saw *chairman-herself*, the look-back time on the role name was 504 ms (the sum of fixations 7 and 9). That same reader spent 0 ms refixating the verb and 212 ms (fixation 8) looking back at *herself*. Look-back times were used to provide evidence for delayed detection of a perceived inconsistency between the gender specified by the reflexive pronoun and the gender that had been assigned to the role name, as well as the repair processes initiated following the detection of the inconsistency.

Table 2 presents the eye fixation data for the younger and older participants on these four dependent measures as a function of the type of role name (*man/neutral*) and the type of

Table 2 Mean reading times (in milliseconds) on regions of interest as a function of role name, reflexive pronoun, and age of reader

Measure	<i>Man</i> term				Neutral term			
	Himself		Herself		Himself		Herself	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
<i>First-pass time</i>								
Reflexive pronoun								
Younger	231	13	294	17	238	12	242	14
Older	212	19	240	24	254	23	246	13
<i>Look-back time</i>								
Role name								
Younger	20	08	78	21	43	16	25	09
Older	17	09	120	23	36	14	52	17
Verb								
Younger	81	29	59	14	81	23	75	20
Older	72	21	156	26	64	18	127	33
Reflexive pronoun								
Younger	73	19	95	22	56	13	75	24
Older	48	11	179	29	72	15	94	19

reflexive pronoun (*himself/herself*). The data have been collapsed across male and female readers because preliminary analyses showed that sex of the reader had no significant effects on any of the dependent measures. We first conducted analyses of variance on each of the four dependent measures with age (younger, older) as a between-subjects variable, and reflexive pronoun gender (*himself, herself*) and type of role name (*man, neutral*) as within-subject variables. There were no main effects of age (all $ps > 0.08$). However, the analyses showed a different pattern of results for older and younger readers (e.g., a significant Age \times Role Name interaction on the first pass reading time for the reflexive pronoun, $F(1, 60) = 5.08$, $MSE = 34,720$, $p < 0.03$; a significant Age \times Role Name \times Reflexive Pronoun interaction on the look-back times to the reflexive pronoun, $F(1, 60) = 5.85$, $MSE = 44,415$, $p < 0.02$), and so we present the findings for each age group separately.

Younger Adult Readers

The first-pass fixation data strongly suggested that younger adult readers are inclined to think male when they encounter a *man*-suffix role name (e.g., *foreman, chairman*), and that they are more inclined to favour a male referent for *man*-suffix role names than for the explicitly gender-neutral alternatives (e.g., *foreperson, chairperson*); see Table 2.

An analysis of variance (ANOVA) on younger readers' first-pass times on the reflexive pronoun, with reflexive pronoun gender (*himself, herself*) and type of role name (*man, neutral*) as within-subject variables, yielded a significant Reflexive Pronoun \times Role Name interaction, $F(1, 31) = 4.95$, $MSE = 5,617$, $p < 0.04$. This interaction is depicted in Fig. 2a. As Fig. 2a shows, younger adult readers appeared to have difficulty processing the female-specific reflexive pronoun, *herself*, when the antecedent role name contained *man* as a suffix. On average, they spent 294 ms initially fixating *herself* when it followed a *man*-suffix role name, and this was 63 ms longer than the time they spent processing *himself* when it followed the same *man*-suffix role name, $t(31) = 2.87$, $p < 0.01$. Presumably, the additional 63 ms in processing time on *herself* relative to *himself* suggests that readers initially assigned a male referent to *man* role names such as *chairman* and had to resolve the gender inconsistency. Of course, one could argue that the initial assignment of a male referent to *chairman*, for example, has less to do with its *man*-suffix than with our cultural expectations that the major players in corporations tend to be male rather than female (Duffy and Keir 2004). However, the 294 ms that younger readers spent initially fixating *herself* when it followed a *man*-suffix role name was also significantly longer than the 242 ms spent initially processing *herself* when it followed the non-*man* version of that role name, $t(31) = 2.95$, $p < 0.01$. The additional 52 ms required to process *herself* following *chairman* versus *chairperson* cannot be attributed to role-induced gender stereotypes because *chairman* and *chairperson* refer to the same role.

The first-pass times on the reflexive pronoun suggested that the neutral terms (e.g., *foreperson, chairperson*) could be easily reconciled with either a male or a female interpretation because young adult readers spent equivalent amounts of time processing *herself* and *himself* when the antecedent role was an explicitly gender-neutral role name, $t(31) = 0.26$, $p > 0.79$, and neither time differed from the time spent initially processing *himself* following a *man*-suffix role name, both $ps > 0.52$. This finding suggests that younger readers were allowing for a "male or female" interpretation of the explicitly gender-neutral roles names.

In general, younger readers did not spend much time refixating the target phrase in any of the conditions (see Fig. 3a), and the only significant effect was for regressive fixations to the role name itself. ANOVAs on look-back times to the verb and reflexive pronoun regions showed no effects of Reflexive Pronoun or Role Name (all $ps > 0.18$), and no Reflexive

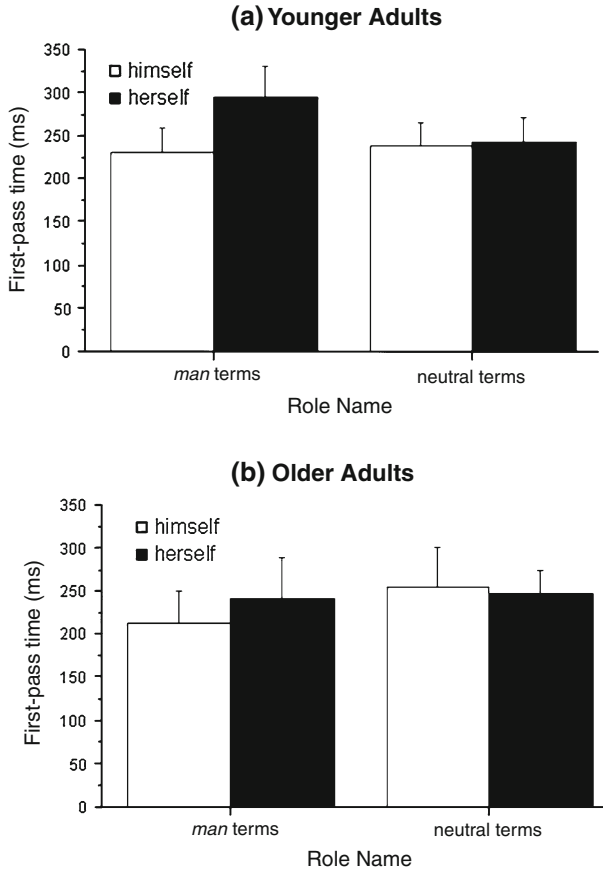


Fig. 2 First-pass times of younger and older readers on the reflexive pronoun (*himself* or *herself*) after encountering one of two types of role names (a *man*-suffix term such as *chairman* or a neutral term such as *chairperson*)

Pronoun × Role Name interaction ($F_s < 1$). In contrast, the ANOVA on look-back time to the role name showed a significant Reflexive Pronoun × Role Name interaction, $F(1, 31) = 9.92$, $MSE = 4,854$, $p < 0.04$. As was the case for the first-pass fixation time data, this interaction could be explained by the finding that the female-specific *herself* caused greater disruption to the reading process when it followed a *man*-suffix role name (e.g., *chairman*) than when it followed an explicitly gender-neutral role name (e.g., *chairperson*). As Fig. 3a shows, after encountering *herself*, younger adult readers spent 78 ms refixating the *man*-suffix role name but only 25 ms refixating an explicitly gender-neutral role name, a 53 ms difference that was statistically significant, $t(31) = 3.28$, $p < 0.01$. The 78 ms spent refixating the *man*-suffix role name after encountering *herself* was also significantly longer than the 20 ms that readers spent refixating the *man*-suffix role name after encountering *himself*, $t(31) = 2.67$, $p < 0.02$. All other pair-wise comparisons were not significant ($ps > 0.10$).

In summary, the on-line eye fixation data provided strong evidence that *man*-suffix role names evoked the expectation of a male referent in young adult readers. The interference effects emerged immediately on the female-specific reflexive pronoun itself, and led to a tendency for readers to spend time making regressive fixations to the *man*-suffix role name. On

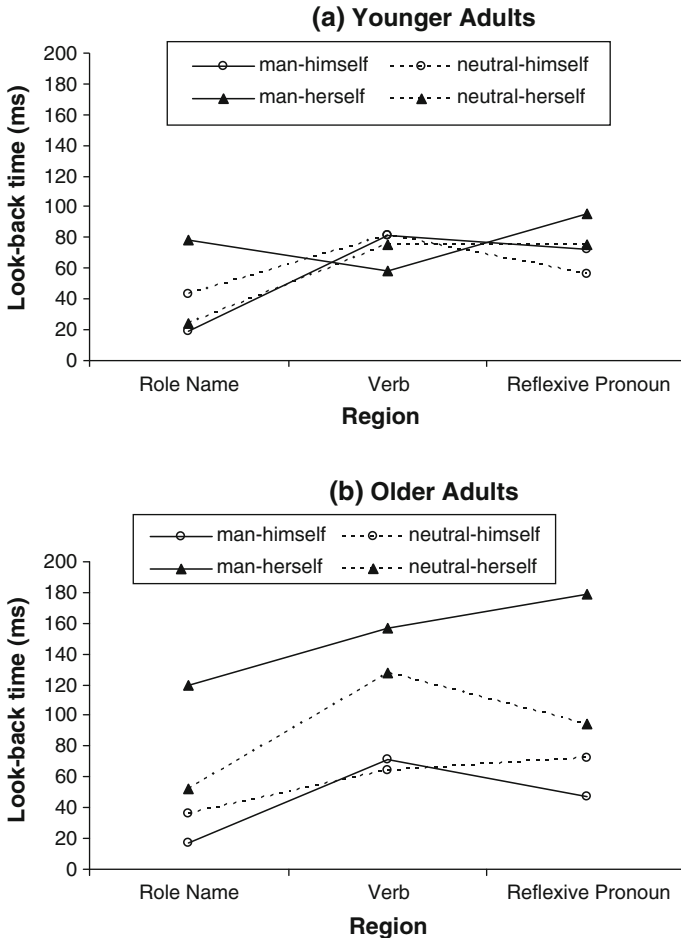


Fig. 3 Look-back times of younger and older readers on the role name, verb, and reflexive pronoun for each of the four conditions (e.g. *chairman-himself*, *chairman-herself*, *chairperson-himself*, *chairperson-herself*)

the other hand, explicitly gender-neutral role names did not appear to evoke a gender-biased expectation because younger readers spent equivalent amounts of time processing *herself* and *himself* when the antecedent role name was in a gender-neutral form.

Older Adult Readers

Older adult readers also demonstrated a male bias in response to *man*-suffix role names. However, unlike their younger counterparts, they did not show evidence of detecting the gender mismatch when first fixating the reflexive pronoun. Older readers also appeared to require more time to recover from a falsified gender expectation because they spent a disproportionately longer time in regressive fixations, not only to the role name, but to the reflexive pronoun region as well.

Whereas the processing cost associated with an incorrect gender assignment to *man*-suffix words emerged when younger adult readers first fixated the reflexive pronoun (Fig. 2a), this

was not the case for the older adult readers (Fig. 2b). Indeed, an ANOVA on the older readers' first-pass times on the reflexive pronoun revealed no significant main effects ($ps > 0.18$), and no hint of a Reflexive Pronoun \times Role Name interaction, $F(1, 31) = 1.18$, $MSE = 8,509$, $p > 0.27$. On their own, these null results could be taken to mean that older readers treated both *man*-suffix role names and explicitly gender-neutral role names as truly neutral, experiencing no difficulty processing the gender-disambiguating reflexive pronoun because they had suspended judgment about the referent's gender until that point (or could easily accommodate either gender). However, two aspects of the data argue against this. Although previous research has shown that readers frequently fixate the reflexive pronoun directly (e.g., Duffy and Keir 2004; Sturt 2003), some studies have shown that processing of a target word can continue after the eyes have moved to the next word (e.g. Duffy and Keir 2004; Duffy and Rayner 1990; Rayner and Duffy 1986). When we allowed for spill-over processing by analyzing the first-pass time on the reflexive pronoun combined with the very next fixation (whether progressive or regressive), there was a marginally significant Reflexive Pronoun \times Role Name interaction, $F(1, 31) = 3.59$, $MSE = 7,649$, $p = 0.068$, suggesting that at least some older adults may have detected a gender mismatch soon after encountering the female-specific, *herself*. The look-back data provided even more compelling evidence against the interpretation that older readers were treating *man*-suffix role names as gender neutral because they appeared to engage in extensive recovery processes, especially in the *chairman-herself* condition.

Figure 3b shows the older adult readers' mean look-back times on the role name, verb, and reflexive pronoun. As Fig. 3b shows, strong Reflexive Pronoun \times Role Name effects were apparent in the older readers' look-back times to the role name, $F(1, 31) = 6.50$, $MSE = 9,256$, $p < 0.02$, and to the reflexive pronoun $F(1, 31) = 13.26$, $MSE = 7,179$, $p < 0.01$, but not to the verb ($F < 1$). When the female-specific *herself* followed a *man*-suffix role name (e.g., *chairman*), older readers spent an average of 120 ms refixating the role name and 179 ms refixating the reflexive pronoun, times that were more than 100 ms longer than the corresponding look-back times to the role name and reflexive pronoun when the male-specific *himself* followed a *man*-suffix role name (both $ps < 0.05$). More important, the 120 ms spent refixating the role name in the *man-herself* condition was also significantly longer than the 52 ms spent refixating the role name in the *neutral-herself* condition, $t(31) = 2.36$, $p < 0.03$, and the 179 ms spent refixating the reflexive pronoun in the *man-herself* condition was significantly longer than the 94 ms spent refixating the reflexive pronoun in the *neutral-herself* condition, $t(31) = 3.02$, $p < 0.01$. This pattern of results suggests that, like their younger counterparts, older adult readers demonstrated a strong male bias in response to *man*-suffix role names. Although they did not show evidence of having detected the gender mismatch when first fixating the reflexive pronoun, older readers appeared to have difficulty recovering from a falsified gender expectation as reflected in the long time they spent refixating the role name, and especially the reflexive pronoun region when exposed to *man-herself* pairing. We think these disproportionately long refixation times indicate that older readers had difficulty repairing their interpretations of the *man*-suffix terms from male to female referents. Of course, older readers may simply need more time to repair any inconsistency during reading. Indeed, a recent eye movement study revealed that older adults spent longer than younger adults looking back to semantically anomalous noun phrases after detecting an inconsistency (Daneman et al. 2006).

Even though older adults spent less time revisiting the role name and reflexive pronoun in the *neutral-herself* pairing than in the *man-herself* pairing, the look-back fixation times in Fig. 3b suggest that older adults appeared to have some difficulty with the *neutral-herself* pairing in that this condition led to more time spent in regressive fixations

than did the *man-himself* and *neutral-himself* conditions. For example, older readers spent almost twice as long refixating the reflexive pronoun in *neutral-herself* passages than in *man-himself* passages (94 ms vs. 48 ms), $t(31) = 2.09$, $p < 0.05$, and they spent almost twice as long refixating the verb in this condition than in the *neutral-himself* condition (127 ms vs. 64 ms), $t(31) = 2.07$, $p < 0.05$. On the other hand, look-back times to the role name, verb, and pronoun for the *neutral-himself* condition did not differ from those in the *man-himself* condition ($ps > 0.17$). This pattern of findings suggests that older readers tended to prefer a male interpretation for the explicitly gender-neutral terms such as *chairperson* or *foreperson*, possibly because of greater susceptibility to the gender stereotypes for these role names.

In summary, the on-line eye fixation data provided strong evidence that *man*-suffix words evoked the expectation of a male referent in older adult readers. However, unlike for the younger adults, the interference effects did not emerge immediately on the female-specific reflexive pronoun itself. At some point later on in the sentence, older readers must have registered the gender inconsistency because they tended to spend a considerable amount of time looking back to the *man*-suffix role name and the reflexive pronoun itself. Older adults also appeared to have more difficulty assigning a female interpretation to the explicitly gender-neutral role names than did their younger counterparts because the *chairperson-herself* pairing caused them some disruption, albeit not as much as the *chairman-herself* pairing. This pattern differed from the one for younger adults who experienced no disruption to comprehension when encountering *herself* or *himself* following an explicitly gender-neutral role name.

Conclusions

The relative paucity of empirical research on language users' interpretation of the generic *man* stands in stark contrast to the extent of political debate on the topic. Discussions of sex biases in language have traditionally evoked strong opinions from both sides of the debate. On the one side, feminists have argued that the generic use of masculine terms reflects and reinforces the view of women as marginalized and excluded from positions of power in our society (Kennedy 1993; Martyna 1980), and they have pushed for the eradication of generic forms. Responding to these concerns, numerous academic and commercial publishing houses instituted language reform initiatives in the 1970s; see, for example, "Guidelines for Nonsexist Language in APA Journals" (APA Publication Manual Task Force 1977). On the other side of the debate, opponents have scoffed at the language reform movement, calling it "Ms-guided" (Kanfer 1972, p. 79) and "linguistic lunacy" (Van Horne 1976, p. 51). Given the relatively widespread attempts to promote more gender-inclusive language forms, at least in written language, we thought it would be timely to address the empirical question of how generic *man* terms, and their purportedly gender-neutral alternatives, are actually and spontaneously interpreted by language users.

Previous approaches to investigating language users' interpretations of generic masculine terms have relied on indirect or off-line methods that required participants to make a deliberate and considered response or judgement after reading (or even repeatedly reflecting upon) the linguistic construction(s) of interest (e.g., McConnell and Fazio 1996; Schneider and Hacker 1973). In the current study, we took advantage of eye-tracking methodology to tap the spontaneous interpretations that readers give to *man*-suffix words and explicitly gender-neutral alternatives when encountering them during the course of reading natural prose passages.

The benefit of time also brings a fresh perspective to the question of how language users interpret generic masculine terms because three decades have passed since the language reforms of the 1970s. Presumably, people today are more familiar with gender-neutral constructions (e.g., *chairperson* and *foreperson*) than they would have been when the move away from *man* terms was originally initiated. The inclusion of two different generations of language users allowed for further exploration of these issues.

The results of our study suggest that both younger and older adults presuppose a male interpretation for *man*-suffix terms, such as *foreman*, resulting in an increase in processing time when the term later specifies a female referent. Despite the likelihood that our older adults would have been exposed to generic uses of *man* to a greater extent than our younger adults who had not experienced the era prior to non-sexist language reform, these older readers showed as much, if not more, difficulty with female interpretations of *man*-suffix terms when compared to their younger counterparts. This pattern of results suggests that today's young adults are more acutely aware of the movement to eradicate sex bias in language, and so even though they were seduced into presupposing a male-only referent when encountering the *man*-suffix role names, they were able to register the presence of a gender mismatch immediately, and could recover the alternative interpretation of the *man*-suffix word more readily than their older counterparts. Of course, it is also possible that younger adults are generally faster at recovering from any type of inconsistency than are their older counterparts (cf. Daneman et al. 2006).

The results concerning the interpretation of explicitly gender-neutral terms showed an age difference as well. In general, the eye movement data suggested that younger adults treated the explicitly gender-neutral terms as truly gender neutral, whereas older adults appeared to lean towards a male interpretation of them. This age-related difference is inconsistent with the findings from the gender stereotype questionnaire data which showed that younger adults gave the explicitly gender-neutral role names a more strongly male rating than did older adults. The discrepancy between the implications of the questionnaire responses and the eye movement behavior again underscores the importance of incorporating on-line measures of language processing, rather than relying exclusively on measures that allow language users to give a more reflective response.

Acknowledgments This research was supported in part by a grant from the Natural Sciences and Engineering Research Council of Canada to M. Daneman. We thank Jiye Shen for technical assistance.

References

- APA Publication Manual Task Force. (1977). Guidelines for nonsexist language in APA journals: Publication Manual change sheet 2. *American Psychologist*, 3(2), 487–494.
- Baltes, P. B. (1997). On the incomplete architecture of human ontogeny. *American Psychologist*, 52, 366–380.
- Daneman, M., Hannon, B., & Burton, C. (2006). Are there age-related differences in shallow semantic processing of text? Evidence from eye movements. *Discourse Processes*, 42, 177–203.
- Daneman, M., Lennertz, T., & Hannon, B. (2007). Shallow semantic processing of text: Evidence from eye movements. *Language and Cognitive Processes*, 22, 83–105.
- Duffy, S. A., & Keir, J. A. (2004). Violating stereotypes: Eye movements and comprehension processes when text conflicts with world knowledge. *Memory & Cognition*, 32, 551–559.
- Duffy, S. A., & Rayner, K. (1990). Eye movements and anaphor resolution: Effect of antecedent typicality and distance. *Language & Speech*, 33, 1003–1019.
- Harper & Row Publishers Inc. (1976). *Harper & Row guidelines on equal treatment of the sexes in textbooks*. New York: Harper & Row.
- Holt, Rinehart & Winston (College Division). (1976). *The treatment of sex roles and minorities*. New York: Holt, Rinehart & Winston.

- Johnson, R. E. (2003). Aging and the remembering of text. *Developmental Review*, 23, 261–346.
- Kanfer, S. (1972). Sispeak: A Ms-guided attempt to change herstory. *Time*, 100(October 23), 79.
- Kennedy, D. (1993). Nonsexist language: A progress report. *Canadian Journal of Education*, 18, 223–238.
- Kreiner, H., Sturt, P., & Garrod, S. (2008). Processing definitional and stereotypical gender in reference resolution: Evidence from eye-movements. *Journal of Memory and Language*, 58, 239–261.
- MacKay, D. G. (1980). Psychology, prescriptive grammar, and the pronoun problem. *American Psychologist*, 35, 444–449.
- Martyna, W. (1980). Beyond the “he/man” approach: The case for nonsexist language. *Signs*, 5, 482–493.
- McConnell, A. R., & Fazio, R. H. (1996). Women as men and people: Effects of gender-marked language. *Personality and Social Psychology Bulletin*, 22, 1004–1013.
- Merritt, R. D., & Kok, C. J. (1995). Attribution of gender to a gender-unspecified individual: An evaluation of the people = male hypothesis. *Sex Roles*, 33, 145–157.
- Moulton, J., Robinson, G. M., & Elias, C. (1978). Sex bias in language use: “Neutral” pronouns that aren’t. *American Psychologist*, 33, 1032–1036.
- Murphy, D., Daneman, M., & Schneider, B. A. (2006). Why do older adults have difficulty following conversations?. *Psychology and Aging*, 21, 49–61.
- Osterhout, L., Bersick, M., & McLaughlin, J. (1997). Brain potentials reflect violations of gender stereotypes. *Memory & Cognition*, 25, 273–285.
- Prentice-Hall Inc. (1975). *Prentice-Hall author’s guide* (5th ed.). Englewood Cliffs, NJ: Prentice-Hall.
- Random House. (1975). *Guidelines for multiethnic/nonsexist survey*. New York: Random House.
- Raven, J. C. (1965). *The Mill Hill Vocabulary Scale*. London: Lewis.
- Rayner, K., & Duffy, S. A. (1986). Lexical complexity and fixation times in reading: Effects of word frequency, verb complexity, and lexical ambiguity. *Memory & Cognition*, 14, 191–201.
- Rubin, D. L., Greene, K., & Schneider, J. W. (1994). Adopting gender-inclusive language reforms. *Journal of Language and Social Psychology*, 13, 91–114.
- Schneider, B. A., Daneman, M., & Murphy, D. (2005). Speech comprehension difficulties in older adults: Cognitive slowing or age-related changes in hearing? *Psychology and Aging*, 20, 261–271.
- Schneider, J. W., & Hacker, S. L. (1973). Sex role imagery and the use of generic “man” in introductory texts: A case in the sociology of sociology. *American Sociologist*, 8, 12–18.
- Shen, J., Reingold, E. M., & Pomplun, M. (2003). Guidance of eye movements during conjunctive visual search: The distractor-ratio effect. *Canadian Journal of Experimental Psychology*, 57, 76–96.
- Sturt, P. (2003). The time-course of the application of binding constraints in reference resolution. *Journal of Memory and Language*, 48, 542–562.
- Van Horne, H. (1976). Women’s movement foolishly assaults the English language. *Rocky Mountain News* (February 19), 51.