

Good-enough representation in plural and singular pronominal reference: Modulating the Conjunction Cost

Sungryong Koh¹, Anthony J Sanford², Charles Clifton³, Jr., Eugene J Dawydiak²

¹ Seoul National University

² University of Glasgow.

³ University of Massachusetts at Amherst

Correspondence to:

Tony Sanford tel +44 141 330 4058 email tony@psy.gla.ac.uk

Dept of Psychology

University of Glasgow

Glasgow, G12 8QQ

Scotland, UK.

This paper concerns the nature of representations set up when two individuals can be referred to by means of plural pronouns. The conditions under which plural pronominal reference is possible, or preferred from a processing perspective, has been the subject of recent psycholinguistic research (Albrecht & Clifton, 1998; Koh & Clifton, 2002; Eschenbach, Habel, Herweg, & Rehkampser, 1989; Kaup, Kelter, & Habel, 2002; Moxey, Sanford, Sturt, & Morrow, 2004; Sanford & Moxey, 1995). As part of the attempt to understand plural reference, the concept of complex reference object has been used as an explanatory construct: plural reference is deemed possible if a plural reference object can be formed (see Eschenbach et al., 1989, Kaup et al., 2002, and Koh & Clifton, 2002 for descriptions). The issue then becomes translated into what permits a complex reference object to be formed.

In this paper, we are concerned with singular and plural anaphoric reference to one or more individuals evoked by a previous sentence, as in (1):

(1) Stan and Pam asked the usherette for assistance.

Such a sentence, containing a noun phrase (NP) with two conjoined individual names (denoting atomic individuals), can be followed by a pronominal reference either to the pair of people (*They appreciated the help*) or to one individual (e.g., *He appreciated the help*), and still be intelligible. The same applies to a sentence like *Stan mowed the lawn with Pam*. There has been some interest in the conditions making plural reference possible, and in just what it is that swings the balance in favor of plural or singular pronominal reference during processing. One major factor in favouring plural pronominal reference to two “atomic” referents is if they occur in a conjoined

NP, as in (1) Thus Albrecht and Clifton (1998; see also Garrod & Sanford, 1982; Moxey, Sanford, Sturt & Morrow, 2004) demonstrated slower reading times for a sentence in which the pronoun referred to one individual than one in which it referred to the pair, and slower times for a sentence containing a singular pronoun that referred to one of the conjoined pair than for a sentence containing a singular pronoun that referred to a third individual. The effect, known as the Conjunction Cost, appeared both in whole-sentence reading times in self-paced reading experiments and in the region of the pronoun or shortly afterwards in eye-tracking experiments. Furthermore, Moxey et al. (2004) showed that as singular reference became disadvantaged through the use of a conjoined NP, plural reference became facilitated.

Basis of the Conjunction Cost

Two possible factors bringing about the conjunction cost have been identified. The first is syntactic. Albrecht and Clifton (1998) argued that it reflected a mechanism of splitting the conjoined NP apart to gain access to its constituent individuals. Since, in the Albrecht and Clifton eye-tracking study, the effect appeared on the pronoun (plus a following adverb) when the pronoun unambiguously took one of the conjoined names as its antecedent, it was supposed that the splitting mechanism operated on the syntactic phrase structure of the sentence, or some structure closely related to surface structure. However, it is not simply association through being in a conjoined NP that leads to the conjunction cost. Sanford and Moxey (1995) suggested that what was important for plural reference to be felicitous was that two individuals played a common role in a discourse. Thus, whether or not atomic referents are evoked by a conjoined NP, a

conjunction cost should occur if they share a common role.¹ According to their theory, a complex reference object is effectively a mapping of individuals into a common role in background knowledge.

Moxey et al. (2004) compared the conjunction cost for three types of sentence, in which the atomic individuals were introduced in three different ways:

- (2) John and Mary painted the room. {syntactic-conjoined NP; common role(agent)}
- (3) John painted the room with Mary. { Common role (coagents)}
- (4) John painted the room for Mary. {Benefactive; different roles (agent/beneficiary)}

In an eye-tracking study, the largest conjunction cost occurred for the conjoined NP, and the smallest for the benefactive, but the co-agent condition fell in between, and showed a conjunction cost also. Moxey et al. argued that the conjoined NP is a strong cue for the atomic individuals being mapped into a common role, whereas although the co-agent condition would lead mainly to co-agent interpretations, small differences in role (e.g., difference in who had the most control, or expertise, John or Mary, or even construing Mary as an instrument, as in body-action painting) might dilute the effect of being mapped into a common role. So in addition to superficial phrase-splitting, role-mapping is a major cue leading to the conjunction cost, and through syntactic joining in a conjoined NP, common role mapping is maximized.

In this chapter, we suggest that there is a third, discourse-based factor that we

¹ This is a simplification. In their theory, Sanford and Moxey (1995) argue that different mappings can occur even if different individuals are mapped into the same main role, if background knowledge permits other mappings into different roles too. For instance, in our examples with John and Mary, John, being a male-name, carries a mapping into knowledge structures tagging this name as male; with Mary the mapping is to knowledge about female names. The balance between same-role mappings and different role mappings for any pair of individuals determines how differentiated the individuals are in the mental representation, and hence how appropriate a plural or a singular referential pronoun is to refer to one or both individuals.

believe influences the conjunction cost, and that is discourse theme, or thematic subject. Specifically, if two individuals have been introduced in a conjoined phrase, then the cost associated with using a pronominal reference to one of the individuals may be associated with a shift in thematic subject, from a text about **both** individuals to one about just one of them. From a communication perspective, a text in which two individuals are introduced as playing a common (undifferentiated) role is very different from a text in which two individuals play completely different roles. An unprincipled or unheralded break from a discourse about both to being about just one could disrupt processing. If, on the other hand, the shift from both individuals to just one is justified in some obvious way, then one would expect no disruption, and so no observed conjunction cost.

We conjecture that there are two possible justifying conditions for changing from a plural thematic subject to a singular one. First, if an action that is typically carried out by one person is done on behalf of the pair, then this should not be perceived as being a thematic shift. Second, if a shift is to be made, it could be signaled by a device in the discourse, e.g., referring to one person with a proper name. We examine each of these in turn, reporting experiments that test our conjectures.

Experiment 1: Singular actions on behalf of two, and maintaining thematic unity

We propose that a simple contrast can be drawn that embodies the first condition discussed above. First consider example (5):

(5a) Last night John and Mary went to an Italian restaurant. He really enjoyed the food.

(5b) Last night John and Mary went to an Italian restaurant. They really

enjoyed the food.

The intuition that the use of *he* in (5a) is strained fits with a further intuition, that by going on to additionally use *she* somehow renders the split into singulars more acceptable:

(6) Last night John and Mary went to an Italian restaurant. He really enjoyed the food, but she thought it was pretty mediocre.

Of course, what has happened in (6) is that the thematic shift to John, which we claim here is a major source of processing disruption, is repaired by reintroducing Mary, in this case in a contrastive manner. In this way, from a communication point of view, the shift is justified, since the very point is that we might have expected them to play a common role (i.e., both react in the same way). Another way in which a shift may be signalled (in spoken language) is by putting stress on a pronoun. For instance, if the second sentence of (6) were to be ***HE*** *really enjoyed the food*, then because the stress brings about a contrast between what he did and what she must have done, the continuation becomes more acceptable.

This line of reasoning opens up a further possibility. If the use of singular pronoun is related to an action that does *not* lead one to question whether the two characters are reacting or acting in the same way (preserving a common role), then it should not lead to a conjunction cost. One striking case where this appears possible is where one of the individuals carries out some action that is consistent with the two of them being in a common role. Such an example is where an individual does something on behalf of the two of them. Consider the following:

(7a) Last night John and Mary went to an Italian restaurant. He asked for a table.

(7b) Last night John and Mary went to an Italian restaurant. They asked for a table.

In (7a), the action of asking for a table, although typically (physically) carried out by one person, is an action that may be carried out by one on behalf of both protagonists. We propose that when someone reads (7a), their natural interpretation will be that *John* asked for a table for both of them. In (7b), the act of asking for the table is also ascribed to both individuals, because they both want the table, but in all probability the enactment of this would have been carried out by only one of them. We propose that with this example, it simply doesn't matter whether the action is depicted as being carried out by one or both individuals. It is a Number-indifferent action in the present context. Later we shall discuss the notion of number-indifference in more detail.

Interestingly, such materials are not typical of the ones that have been used in experiments showing the conjunction cost. On the other hand, examples like (5), where the shift to a singular is unmotivated, are typical of these experiments. Our proposal is that in Number-sensitive instances, a conjunction cost will be observed, whereas with Number-indifferent instances, it will not, because it does not constitute a true shift in thematic subject. We first demonstrate that it is possible to develop materials that by consensus fit these two types, above identified only intuitively. We shall discuss what these intuitions may be tapping into later.

Validation of Materials

Sixteen materials based on examples like (5) and (7) were constructed. Each

discourse began with a sentence that introduced one couple (one male, one female name). The discourse continued with a singular (*he* or *she*) pronoun reference to the first member of the couple. The sentence where this reference occurred either described an action that was of the number-indifferent or the number-sensitive type, according to experimenter intuitions. To validate the experimenters' judgments, sixteen University of Massachusetts undergraduates completed a questionnaire that contained both versions of all 16 discourses. One version (number-indifferent or number-sensitive) was randomly chosen to appear in the first half of the questionnaire, and the other appeared in the second half. Participants were instructed to rate the second sentence of each discourse on a four-point scale, ranging from 1 ("almost certainly done by just one person on behalf of the couple") to 4 ("almost certainly done just for the person himself or herself; both people could do the same thing"). They were given several examples intended to illustrate the decision, and then asked to evaluate all 32 discourses. The mean rating of the number-indifferent versions was 1.34, while the mean rating of the number-sensitive versions was 3.10 ($t(15) = 12.31$, $p < .001$), confirming our intuitions. Most of the items clearly satisfied our criterion of differing in whether the actions reflected being number-indifferent or number-sensitive.

Method

A whole-sentence self-paced reading procedure was used to measure the speed with which 16 of the short pre-tested discourses were read.

Participants. Sixty undergraduates at the University of Massachusetts participated for course credit. Each was tested individually in a session that lasted less than 25 minutes. One-quarter of the participants were tested on each of the four counterbalanced lists described below.

Materials. The sixteen discourses from the materials evaluation were used². As shown in Table 1, each came in four versions: two with a singular pronoun, as examined in the materials evaluation, and two with the plural pronoun *they*. Thus, the four versions of each sentence were determined by the factorial combination of singular versus plural pronoun and actions that were number-indifferent or number-sensitive. In

----- Table 1 about here -----

half of the items the singular pronoun referred to the female and in half, to the male. Standard counterbalancing procedures ensured that each participant saw an equal number of sentences in each of the four conditions (balanced over gender of pronoun) and that, over the entire experiment, each sentence was tested equally often in each condition.

These 16 discourses were embedded in a list of 64 short passages. Half of the items were followed by a wh-question or a yes-no question. Participants were to choose the correct one of two answers that appeared on the video screen by pulling a trigger under the correct answer. A 6-item practice list was also constructed, with three sentences followed by questions.

Procedure. After being tested on the practice list, the 64 passages were presented to each participant in an individually-randomized order. Each sentence was presented individually, at the left edge of the screen, and remained on the screen until the participant pulled a trigger to advance to the next sentence. On half the trials, the second sentence in a discourse was followed by the word "QUESTION" for 500 ms and then by the presentation of a question and two answers. The time to read each of the two sentences in a discourse and the accuracy of the question answer were recorded.

² The materials are available from the authors on request.

Results and discussion

The questions that appeared after half the items were answered with 95% or better accuracy in each condition. The primary data of interest are the reading times for the second sentence of a discourse. (No differences in reading times for the first sentence approached significance; all $F < 1$.) The means of these times appear in Table 2. Individual times over 5000 ms were eliminated (1.3% of the data). An analysis of variance was carried out with the factors singular vs. plural pronoun and typical singular vs. Number-sensitive, plus the factor of counterbalancing groups or counterbalancing item sets as recommended by Pollatsek & Well, 1995. As predicted, this indicated a significant interaction between pronoun plurality and Number-sensitivity: $F(1, 56) = 4.33$, $p < .05$; $F(1, 10) = 6.15$, $p < .04$. Sentences with a plural pronoun were read a significant 156 ms faster than ones with a singular pronoun when the discourse was Number-sensitive, [$t(59) = 2.62$, $p < .03$; $t(13) = 2.31$, $p < .03$] but the difference for Number-indifferent was nonsignificant ($t < 1$). In other words, the conjunction cost appears to be present in the case of the number sensitive materials, but absent in the case of the number indifferent materials, as expected.

*** TABLE 2 ABOUT HERE ***

A 156 ms conjunction cost was observed for **number-sensitive** actions like (5). Sentences with a plural pronoun were read more rapidly than sentences with a singular pronoun whose antecedent was inside a conjoined NP. This effect basically replicates Garrod and Sanford (1982) and Albrecht and Clifton (1998). However, the conjunction cost disappeared for **number-indifferent** actions, where the relevant role was one typically played by a single individual on behalf of both.

One apparent complication in the data is that, while reading times for a plural pronoun sentence depicting a Number-sensitive action were shorter than for a plural pronoun sentence depicting a Number-indifferent action, reading times for singular pronouns were equally long in both Number-sensitive and Number-indifferent scenarios. In principle, the reading time for the singular pronoun sentence should be longer in the Number-sensitive condition. However, it is inappropriate to treat this comparison too seriously, since largely different content is being compared, and the sentences differ in length. A second complication in the data comes from the possibility that making plural reference in a Number-indifferent predicate is implausible or infelicitous.³ We claim that the disappearance of conjunction cost in Number-indifferent scenarios reflects an increased plausibility of using a singular reference in these scenarios, compared to singular reference in Number-sensitive scenarios. However, this difference could reflect a decreased plausibility of the plural reference in Number-indifferent situations. The pattern of data is not precisely what this suggestion would entail. Reading times were not notably long for plural pronouns in Number-indifferent situations. However, one could argue that plural pronoun sentences were actually processed faster across-the-board than any singular pronoun sentences, but that the advantage of plural reference was offset by the implausibility of the plural pronoun sentence in a Number-indifferent discourse. The following plausibility rating study was conducted to assess this possibility.

Experiment 2: Plausibility Ratings

³ We thank Lyn Frazier for this suggestion.

Method

The 16 items of Experiment 1 were used in a written questionnaire study, in which 44 University of Massachusetts undergraduates (one was eliminated for failure to complete the questionnaire) rated each item on a five-point scale from "odd or clumsy" (1) to "perfectly OK" (5). Four forms of the questionnaire were prepared. In each form, four items appeared in each version used in Experiment 1 (Number-indifferent vs. Number-sensitive X singular vs. plural pronoun). The four questionnaire forms were counterbalanced, so that each item occurred in each version in one form. Eight items of questionable plausibility were added to the questionnaire to define the range (e.g., *Susan and Keith were cooking up a big holiday dinner. She decided to go and exercise.*) Each form was separately randomized.

Results and Discussion

The mean plausibility ratings appear in Table 3. The interaction was highly significant ($F(1, 42) = 18.1, p < .001$; $F(1, 15) = 12.56, p < .01$), as were both main effects, reflecting the low rated plausibility of a singular pronoun sentence in a Number-sensitive context. There was no support for the concern that implausibility of plural pronoun sentences in Number-indifferent actions discourse masked an underlying across-the-board advantage of plural reference. Indeed, the plausibility ratings reflect the same factor that affected reading times: There is a penalty for referring to one of the individuals in a conjoined NP if that individual is not performing an action on behalf of both of the individuals.

So, Experiments 1 and 2 support the view that when an action by an individual is done of behalf of both characters, it does not disrupt the coherence of the text if the thematic subject is changed from both people to one person.

*** TABLE 3 ABOUT HERE ***

Experiment 3: Type of anaphor and thematic shift

We conjectured that if part of the Conjunction Cost is due to a shift in thematic subject, then it should be possible to eliminate it by signaling that such a shift will take place. Experiment 3 examined the speed of reading essentially the same scenarios used in Experiment 1, except that sentences with a singular pronoun were compared with sentences containing the proper name of the referent. A substantial literature demonstrates slower reading time when a repeat of the proper name is used to refer to an individual that may be felicitously referred to by means of a pronoun (the "repeated name penalty;" e.g., Gordon, Grosz, & Gilliam, 1993). In the present experiment, we applied a similar idea to the status of singular pronouns in Number-sensitive and Number-indifferent settings. In a Number-sensitive setting, a singular pronoun is inappropriate, since it is not bound to something that can be classed as being done on behalf of both. We have argued that in such cases, there is effectively a shift in thematic subject from both individuals to just one. Vonk, Hustinx, and Simons (1992) showed that using full noun-phrases or proper names as anaphors served to reintroduce the denoted individuals as the new topic. So, in the Number-sensitive case, we would expect reading to be facilitated when a repeat-name is used rather than the corresponding singular pronoun, since it accommodates the change in discourse topic. On the other hand, we would expect the proper name to be either of no particular advantage, or even to be a disadvantage to processing in the Number-

indifferent case (as in the repeated-name-penalty effect), since there is no shift in topic.

Method

Participants and procedure. Eighty-four University of Massachusetts undergraduates were tested using the same procedure described in Experiment 1.

Materials. The 16 2-sentence quadruples of Experiment 1 were modified by replacing the plural pronoun with the name of the person referred to by the singular pronoun, as illustrated in (8) and (9). These 16 discourses were embedded in a total of 64 sentences, as was done in Experiment 1. Half were followed by questions, as in Experiment 1.

(8a). Last night John and Mary went to an Italian restaurant. He asked for a table. [Singular pro; number indifferent]

(8b). Last night John and Mary went to an Italian restaurant. John asked for a table. [Name; number indifferent]

(9a). Last night John and Mary went to an Italian restaurant. He really enjoyed the food. [Singular Pro; number sensitive]

(9b). Last night John and Mary went to an Italian restaurant. John really enjoyed the food. [Name; number sensitive]

Results and discussion

The questions that appeared after half the items were answered with 93% or better accuracy in each condition. The mean reading times in ms for the second sentences appear in Table 4. Because the names were systematically longer than the pronouns, we present times linearly adjusted for length, following the regression equation procedures

described by Ferreira and Clifton (1986), and also Trueswell, Tanenhaus and Garnsey (1994). The regression parameters were based on all 64 passages used in the experiment. Times longer than 5000 ms were eliminated (0.3% of the data). Analyses of variance were conducted with the factors name vs. pronoun and number-indifferent vs. number-sensitive.

*** TABLE 4 ABOUT HERE ***

The critical interaction between pronoun vs. name and type of scenario was significant [$F(1,80) = 5.14, p < .03$; $F(1, 12) = 5.66, p < .05$]. As predicted, sentences with a name were read marginally faster than sentences with a pronoun following number-sensitive actions, albeit marginally by materials (41 ms faster than predicted on the basis of length for the name data, vs. 35 ms slower than predicted on the basis of length for the pronoun data; $t(83) = 2.10, p < .04$; $t(15) = 1.87, p = .081$). For number insensitive actions, there is no reliable difference [$t(83) = 1.15$; $t(15) = 1.65$, NS]. Thus, the experiment offers support for the idea that using a proper name facilitates processing of a shift to one of the individuals under the number sensitive condition, but not under the number-indifferent condition.

We suggest that this is because singling out one individual's action results in an unprincipled, unheralded, and unaccounted for change of thematic subject when this cannot be accommodated as "on behalf of both". The use of a repeat name accommodates this shift in the way a pronoun cannot, as predicted on the basis of the observations of Vonk et al. (1992), that specifying an NP more fully than through a pronoun serves to signal a forthcoming change in thematic subject (i.e., which individual is in focus). Taken together, the results of Experiments 1, 2 and 3 support

our ideas regarding boundaries on the Conjunction Cost: There is no global cost associated with singular pronouns when the action occurs on behalf of both protagonists, and the use of a repeat name serves to cue the shift in thematic subject in the number-sensitive cases.

Indifference and Good-Enough representation

The experiments described up to now suggest that the processing system is effectively indifferent to a shift to a single individual if, from a narrative point of view, this does not force a shift in thematic subject. An interesting question is whether under this condition of acceptable shift the mental representation of the text actually fails to distinguish between both protagonists taking an action, and just one protagonist taking an action. There is evidence from several sources showing that language input is not necessarily represented uniformly, but may sometimes result in a shallow, or incomplete (underspecified) representation (Sanford & Sturt, 2002), and that the level of specification achieved during interpretation may be just that which is “good enough” for the tasks of interpretation at hand (Ferreira, Ferraro, & Bailey, 2002).

One way of thinking about the representation of an action by an individual that is taken on behalf of a pair is that possible pronominal reference is not really differentiated between singular and plural. For instance, once we have learned that *Jack and Jill drove to the station*, it simply doesn’t matter whether *They* or *He* parked the car at the useful level of granularity of the event representation. To see how this might work, consider the level of granularity required to understand the sentence *Jack and Jill drove to the station*. What is not specified is who actually operated the pedals and the steering wheel, yet clearly only one of them could actually do it at a time. It’s

simply the case that the sentence does not need that level of specification to be understood. By the same token, *They parked the car* does not need to be specified either. Clearly they didn't both work the controls to get the car into a parked position, though they might have taken it in turns in some frustratingly difficult situation, or one might have "directed" while the other steered, etc. The thing is that outside of some guiding context, there is simply no need to go to that level of specification. So, at the level of granularity adopted during reading these sentences, whether he, she or they parked doesn't matter, because the attributes necessary to make the appropriate distinctions simply aren't activated. If a continuation to both *driving to the station* was *he wanted to pick up his niece*, then there is a clear need to represent that fact at a level of granularity that differentiates *he/him* from *them*. The shift in grain is part-and-parcel of the shift in thematic subject and discourse topic.

In Experiment 4, we tested this idea using a text-change procedure (e.g., Sanford & Sturt, 2002), in which a text is shown under self-paced reading conditions, and then shown a second time after a brief delay. On the second exposure, one of the words might be changed. Such a technique has been shown to detect influences of contrastive focus (Sturt, Sanford, Stewart & Dawydiak, 2004) and syntactic load (Sanford, Bohan, Sanford, & Molle, 2003) on detection of changes. In the present context, we can make the prediction that if an action can be carried out by one person on behalf of two, then a change from a plural to a singular reference would be noticed less easily than would a change to singular when the action was judged not to be on behalf of two.

Experiment 4 Change detection and representation

Method

Design and Materials. The test materials consisted of the 16 2-sentence materials of Experiment 1 that were adapted by the addition of a further sentence to each of them. In all cases in the test materials, the first presentation consisted of the plural anaphor version, while in the second presentation the pronoun was changed to a singular pronoun corresponding to a reference to the first individual in the conjoined NP that introduced the characters. An example material for the number-indifferent case is shown in (10):

(10). Jared and Kathleen went to the mall on Sunday. They (→ He) found a parking space near the entrance. Suddenly, it started to rain heavily.

Here, (→ He) denotes a change from *They* to *He* in the second exposure. For the number-sensitive case, the corresponding example had the second sentence (12):

(11). They (→ He) walked toward the south entrance.

In addition, various fillers were incorporated. There were 16 fillers with the same general form as the 16 test materials, except that they were used in a no-change condition. The pronoun was the same (plural) for both presentations. A further 16 fillers based on simple 3-line narratives were used, these not having conjoined NPs. These contained singular and/or plural pronouns, but did not include a change to a pronoun. Rather, in this set, changes to nouns were made in the second presentation, and these were distributed over a very wide range of locations, from the third word of the first sentence to near the end of the third sentence. The word-changes used here

were semantically large, and designed to be easily detected, so that the participants would expect changes to occur at any physical location. Finally, a set of 32 further items from another study using changes in verbs was incorporated, 16 of which had changes in sentences 2 and 3, and 16 of which had no changes. Thus the overall proportion of trials on which a change took place was 60%.

Participants 16 native-English speaking undergraduates from the University of Glasgow took part. They were naïve with respect to the aims of the study

Procedure The materials were presented under computer control using the Psyscope experimental package (Cohen, MacWhinney, Flatt, & Provost, 1993). Participants pressed a button on a button-box to initiate a trial, which began with a display of the complete paragraph. They then read it at their own pace, being instructed to read as they would normally for meaning, and not to re-read after the first pass through. The presence of the experimenter in the room induced a compliance with this request. They pressed the button again when they had finished reading, and the paragraph was replaced by a gray screen for 500 msec, after which the passage re-appeared. They were instructed to re-read at their own pace, primarily for meaning, but were told that a word may be changed on some occasions, and if they noticed it, to indicate, again without systematically re-reading. The trial was ended when the participant pressed the button again. If they believed that they had detected a change, they were instructed to say what the change was. It was stressed that the primary objective was simply to read through the text for meaning, without going over the text more than once, and that we were interested in the time it took them to read the passages. Spotting changes was portrayed as a secondary task.

Participants were credited with detecting a change if they correctly stated which word had changed and which word it had changed to. For the experimental materials,

as anticipated, the detection rate for changes from a plural to a singular pronoun was lower for the Number-indifferent materials, at 38.7% (7.1 items, $se = .258$) than for the Number-sensitive materials, at 44% (6.19 items, $se = .368$). Although numerically small, this is a reliable difference, with $t1(15) = 2.448$, $p < .027$; $t2(15) = 2.210$, $p < .043$). Overall detection rate for the non-experimental materials was 41%, and false alarms were low at a mean of 4.3 per participant. False alarms were distributed unsystematically with respect to position in the paragraphs.

There are reasons why the observed difference should be small. First, overall detection rate was rather low, suggesting that the task was difficult. More crucially, it is possible that some of the critical detections occurred based on the change in form from “they” to “he” rather than being based on a difference in the discourse representation (e.g., the identity of the thematic subject). Only the latter detections should reflect the number-sensitivity of the predicate. Nonetheless, the observed difference was reliable and in the direction predicted. We therefore conclude that readers are more indifferent to the choice of plural or singular pronoun in the cases where the action could be carried out by one on behalf of both, or be depicted as being carried out by both, than in the cases where the singular pronoun singles out an action carried out by just one individual.

Discussion

The conditions that lead to preferences for plural reference over singular reference have been the subject of recent enquiry. In this chapter, we assume that if two protagonists play a common role in an action or episode, then that constitutes grounds for using a plural pronoun for those individuals, provided they are properly focused (c.f. Moxey et al., 2004; Sanford & Moxey, 1995). Syntactic structure, in the form of conjoined NPs,

also leads to a preference for plural reference, though this is as yet not properly untangled from the common role constraint.

An important experimental procedure for looking at preferences is to see when a singular pronoun is infelicitous, and when under conditions where the atomic individuals play a common role (or are in a conjoined NP), use of a singular pronoun is disadvantaged – the so-called conjunction cost. In the present chapter, we claim that at least some of the conjunction cost may be due to factors at the discourse level. That is, if a shift from a discourse about two individuals in a common role suddenly becomes about just one of them in an unmotivated way, then there will be a cost in terms of processing effort while the reader accommodates this shift. Our experiments are a test of this idea.

We distinguished between shifts to singulars in situations that are number-sensitive and those that are number-indifferent. A number-indifferent situation is one in which an action that is undertaken by just one of two individuals can be construed as being carried out on behalf of both individuals, while a number-sensitive situation is one where the actions of a single individual cannot be construed as being on behalf of both. Experiment 1 showed that the conjunction cost is absent in the first case, and present in the second case, as predicted. Experiment 2 showed that this pattern is present in the judgments of plausibility, which we take as being indicative of felicity.

A second issue we addressed is whether an appropriate cue might facilitate the transition from a plural to a singular thematic subject. Our argument is that the conjunction effect comes about typically because a shift from a plural thematic subject to a singular one is not properly motivated or accommodated. In Experiment 3, we showed that using a proper name in the place of a singular pronoun is an advantage when the action is number-sensitive, and suggest that this is because the use of proper

names serves to indicate a shift in thematic subject, and so facilitates the shift.

What then is the conjunction cost? We suggest that it is a complex phenomenon. Certainly, eye-tracking evidence suggests that there is a small conjunction cost quite early on in processing, shortly after the relevant pronoun is encountered. If text is set up with two conjoined individuals, and a singular pronoun is introduced before the action in which the character it denotes is encountered, then there is a small, syntactically-based conjunction cost (Albrecht & Clifton, 1998; Moxey, Sanford, Sturt & Morrow, 2004; Sanford, Sturt, Moxey, Morrow & Emmott, 2004). The effects we have demonstrated show another factor at work, that of shift in thematic subject. Being number-indifferent only becomes obvious at the predicate of the critical sentence, and so can only reduce or eliminate the conjunction cost after the predicate has been read, not before. The global absence of a conjunction cost in the Number-indifferent condition of Experiment 1 should therefore be seen as an accommodation and swamping of this early effect.

The effects we obtained are, we believe, related to the granularity of representations resulting from an interpretation of the materials. Consider (12):

(12) John and Mary went for a meal.

We assume that when this sentence is interpreted, John and Mary are mapped into a common role in an elicited background-knowledge structure (Sanford & Moxey, 1995). But this means that the level of granularity afforded the representation can only be at a level where it is possible for them both to be in the same role. This might seem very straightforward in a case like (12), where the background situation is unlikely to be much more than having a goal of getting to a restaurant. It is more obviously an issue

with a case like (13):

(13) John and Mary drove to the station.

If they are mapped into a common role, it simply cannot be one that specifies that they both sat in the driving seat, both worked the pedals and the steering wheel, both kept the car on track, and both watched the road and the rear view mirror to control the trajectory of the vehicle. The interpretation, we suggest, is at a cruder level of grain, where they both used a car, with one of them in control (unspecified), to get to a destination.

Further actions will be interpreted against these scenarios, unless that cannot be done. So, if after (12), the action is *He asked the waiter for a table*, this will easily be accommodated as meeting a goal of both protagonists, and so is the equivalent of both of them asking for a table (i.e., both individuals are effectively mapped into the role of asking for a table). Similarly, if after (13), the action is *He parked the car near the concourse*, this action again realizes something that is part of both driving, and so by default leads both protagonists being mapped into the role of agent in parking. The new actions thus preserve previously established role-mappings.

Experiment 4, in which we used text-change detection, showed a reduced capacity to detect a change from *they* to *he/she* when the action was number-indifferent, showing that on some occasions at least, an action by one individual led to a representation that was not different from the representation for both individuals carrying out the action.

The argument put forward above is the most extreme version of role-mapping, in that the idea is that using *he/she* or *they* can be completely interchangeable. In

practice, we believe that it is probably not, and that some differentiation may occur, such that when a singular pronoun is used, there will always be a mapping into the fact that the protagonist was male or female and singular. But at the same time, both individuals will be mapped into the principal scenario. For this reason, the effect in Experiment 3 is not absolute, although it is perfectly reliable.

Summary

- Conjoining individuals into complex NPs through the use of a conjunction leads to a preference for reference to the individuals through a plural pronoun (i.e., to both) rather than a singular pronoun (i.e., to just one of them) under many conditions.
- The preference shows itself in longer reading times to sentences with singular pronominal grammatical subjects rather than plural ones. This is the Conjunction Cost.
- Part of the conjunction cost results from a shift in thematic subject from a plurality to a singular. If such a shift is not motivated by a cue in the discourse, then it constitutes an infelicitous change, and causes a processing difficulty.
- A singular pronoun can be used felicitously if the action carried out by the person singled out by the pronoun can be construed as being “on behalf of both”.
- If it is so construed, then at the level of granularity of the representations involved in understanding the discourse, there is effectively no discrimination between one person doing the action and both doing the action.

This research is intended to add to our understanding of plural reference, specifically with respect to instances when individuals are effectively individuated and when they are not.

References

- Albrecht, J., & Clifton, C., Jr. (1998). Accessing singular antecedents in conjoined phrases. Memory & Cognition, 26(3), 599-610.
- Cohen, MacWhinney, Flatt, & Provost, 1993. PsyScope: A new graphic interactive environment for designing psychological experiments. Behavior Research Methods, Instrumentation, and Computers, 25, 257-271.
- Eschenbach, C., Habel, C., Herweg, M., & Rehkamper, K. (1989). Remarks on plural anaphora. In Proceedings of 4th European chapter of the Association for Computational Linguistics, (pp 161-167). University of Manchester.
- Ferreira, F., & Clifton, C. Jr. (1986). The independence of syntactic processing. Journal of Memory and Language, 25, 348-368.
- Ferreira, F, Ferraro, V., & Bailey, K.G.D. (2002). Good-enough representations in language comprehension. Current Directions in Psychological Science, 11, 11-15.
- Garrod, S., & Sanford, A. (1982). The mental representation of discourse in a focused memory system: Implications for the interpretation of anaphoric noun phrases. Journal of Semantics, 1, 21-41.
- Gordon, P. C., Grosz, B. J., & Gilliam, L. A. (1993). Pronouns, nouns, and the centering of attention in discourse. Cognitive Science, 17, 311-349.
- Kaup, B., Kelter, S., & Habel, C. (2002). Representing referents of plural expressions and resolving plural anaphors. Language and Cognitive Processes, 17, 405-450.
- Koh, S., & Clifton, C., Jr. (2002). Resolution of the antecedent of a plural pronoun: Ontological categories and predicate symmetry. Journal of Memory and Language, 46, 830-844.
- Moxey, L. M., Sanford, A. J., Sturt, P., & Morrow, L. (2004). Constraints on

the formation of plural reference objects: the influence of role, conjunction, and type of description. Journal of Memory and Language, 51, 346-364.

Pollatsek, A., & Well, A. D. (1995). On the use of counterbalanced designs in cognitive research: A suggestion for a better and more powerful analysis. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21, 785-794.

Sanford, A.J., & Garrod, S. (1998). The role of scenario mapping in text comprehension, Discourse Processes, 26, 159 - 190.

Sanford, A. J., & Moxey, L. (1995). Notes on plural reference and the scenario-mapping principle in comprehension. In G. Rickheit & C. Habel (Eds.), Focus and coherence in discourse processing (pp. 18-34). New York: Walter de Gruyter.

Sanford, A. J. & Sturt, P. (2002). Depth of processing in language: not noticing the evidence. Trends in Cognitive Sciences, 6, 382-386.

Sanford, A. J., Sturt, P., Moxey, L. M., Morrow, L., & Emmott, C. (2004, in press). Production and comprehension measures in assessing plural object formation. In M. Carreiras and C. Clifton, (Eds.), The on-line study of sentence comprehension: Eye-tracking, ERP, and beyond. Brighton: Psychology Press.

Sanford, Alison, Bohan, J., Sanford, A. J. & Molle, J. (2003). Detecting changes as a function of load and extent of change: what's the mechanism? Poster at the conference Architectures and Mechanisms of Language Processing (AMLaP), Glasgow, August 25-27.

Sturt, P., Sanford, A. J., Stewart, A., & Dawydiak, E. J. (2004). Linguistic focus and good-enough representations: an application of the change-detection paradigm. Psychonomic Bulletin and Review, 11, 882-888.

Trueswell, J. C., Tanenhaus, M. K., & Garnsey, S. M. (1994). Semantic influences on parsing: Use of thematic role information in syntactic disambiguation. Journal of Memory and Language, 33, 285-318.

Vonk, W., Hustinx, L.G.M.M., & Simons, W.H.G. (1992). The use of referential expressions in structuring discourse. Language and Cognitive Processes, 7, 301-333.

Table 1: A Sample Item from Experiment 1

<u>Sentence Condition</u>	<u>Example</u>
Lead-in (Sentence 1)	Jerry and Lisa entered the opera house on time.
Singular/Number Indifferent	He gave the tickets to the usher.
Plural/Number Indifferent	They gave the tickets to the usher.
Singular/Number Sensitive	He looked around the beautiful lobby.
Plural/Number Sensitive	They looked around the beautiful lobby.

Table 2 Mean reading times in ms for sentence 2, experiment 1, as a function of condition, including standard errors.

Content	Pronoun	
	Singular	Plural
Number-indifferent	1891 (76)	1899 (87)
Number-sensitive	1898 (73)	1742 (67)

Table 3: Mean Plausibility Ratings, Experiment 2

Content	Pronoun	
	Singular	Plural
Number-indifferent	4.19	4.31
Number-sensitive	3.56	4.40

Table 4: Mean Adjusted Reading Times (with SE), ms, Sentence 2, Experiment 3

	Name	Pronoun
Number-indifferent	23 (30)	79 (34)
Number-sensitive	35 (27)	-41 (28)

Authors Note

This research was supported in part by grants HD-18708 from NIH to the University of Massachusetts. The third and fourth authors would also like to acknowledge support from the ESRC through grants R000223622, R000223497, and R000239888. Portions of these data were presented at AMLaP, Leiden, The Netherlands, September 2000.