

Interpreting pronouns and demonstratives in Finnish: Evidence for a form-specific approach to reference resolution

Elsi Kaiser

*Department of Linguistics, University of Southern California, Los Angeles,
CA, USA*

John C. Trueswell

*Department of Psychology, University of Pennsylvania, Philadelphia,
PA, USA*

Two Finnish language comprehension experiments are presented which suggest that the referential properties of pronouns and demonstratives cannot be reduced straightforwardly to the salience level of the antecedent. The findings, from a sentence completion study and visual-world eye-tracking study, reveal an asymmetry in which features of the antecedent Finnish pronouns and demonstratives are most sensitive to, both in terms of their final interpretations

Correspondence should be addressed to Elsi Kaiser, Department of Linguistics, 3601 Watt Way, GFS 301, University of Southern California, Los Angeles, CA 90089-1693, USA. E-mail: elsi.kaiser@usc.edu

This article is based on research reported in Elsi Kaiser's dissertation (2003, University of Pennsylvania) and presented at the 16th Annual CUNY Conference on Human Sentence Processing in Boston in March 2003, and at the Architectures and Mechanisms for Language Processing conference in Glasgow in August 2003. Preliminary analyses of some of the data reported here appeared in Kaiser and Trueswell (in press).

Thanks to Jennifer Arnold, Cassie Creswell, Eleni Miltsakaki, Kimiko Nakanishi, Ritva Laury, Ellen Prince, Jeffrey Runner, Maribel Romero, Michael Tanenhaus, Jennifer Venditti, and the psycholinguistics lab groups at the University of Pennsylvania and the University of Rochester for many useful comments and suggestions. Many thanks also to all those in Finland who made these experiments possible. We gratefully acknowledge Kelly Rulison, Mike Muscianesi, and Noreen Stackhouse for their help with stimulus preparation and coding.

This research was partially supported by a grant from the National Institutes of Health (1-R01-HD37507) awarded to the second author.

and during real-time processing. In particular, the syntactic role and linear position of the antecedent, two factors which have been claimed to influence referent salience, have different effects on the interpretation of pronouns and demonstratives. Contrary to what is commonly assumed, pronouns and demonstratives cannot be mapped onto a unified salience hierarchy, because they exhibit different degrees of sensitivity to syntactic role and word order. We offer an alternative approach to anaphor resolution, the form-specific multiple-constraints approach.

INTRODUCTION

During language comprehension, we are continuously occupied with the task of reference resolution. To understand a sentence, a comprehender needs to add to her mental model the new information it conveys. To do this successfully, she must also link it to what she already knows. Pronouns (e.g., ‘they’, ‘s/he’) and demonstratives (e.g., ‘this’, ‘that’) play a central role in this information management process and are frequent in both written and spoken language. However, due to their shorthand nature, they appear to pose a challenge for successful comprehension. Pronouns and demonstratives are informationally impoverished and do not, on their own, provide enough information to identify the intended referent.

It is generally agreed that there exists a correlation between the type of referential form used to refer to an entity and the level of salience/prominence of the entity: The more reduced an anaphoric expression is, the more prominent its referent needs to be in the speaker’s and listener’s mental models of the discourse (e.g., Arnold, 1998, p. 4). This view is reflected in the referential form hierarchies that have been proposed by a range of researchers, including Gundel, Hedberg, and Zacharski (1993), Givón (1983) and Ariel (1990). Part of the standard hierarchy is shown in (1), where the forms that are further to the left are used for more salient referents.

(1) null > pronoun > demonstrative > full Noun Phrase ...

Connecting reduced referential forms and salient referents seems plausible, since ‘[a]n expression that has little semantic content ... can contribute little or nothing to the identification process, and can only be used where identification of the referent is either straightforward or not an issue’ (Garnham, 2001, p. 55). However, referential forms cannot always be distinguished based on their informativeness. For example, the English pronoun *it* and the demonstratives *this/that* ‘are indistinguishable with respect to the description they provide for the intended referent (an inanimate object)’ (Ariel, 2001, p. 29). Nevertheless, it is commonly agreed

that demonstratives are used for less salient referents than pronouns.¹ Many salience hierarchy-based approaches specifically claim that pronouns have more salient antecedents than demonstratives, and that the referential properties of different forms follow from their positions on the hierarchy, not from differences in informativeness.

In this paper, we take a closer look at the referential properties of pronouns and demonstratives in Finnish, in order to investigate the validity of the salience hierarchy approach and to improve our understanding of what it means for a referent to be salient/prominent. Based on the results of a sentence completion study and an eye-tracking experiment, we suggest that the referential properties of pronouns and demonstratives cannot be reduced straightforwardly to the salience level of the antecedent. Our data reveal an asymmetry in terms of which features of the antecedent Finnish pronouns and demonstratives are most sensitive to, both in terms of their final interpretations and during real-time processing. In particular, our findings show that the syntactic role and linear position of the antecedent, two factors which have been claimed to influence referent salience, have different effects on the interpretation of pronouns and demonstratives. In light of these findings, we argue that pronouns and demonstratives cannot be mapped onto a unified salience hierarchy, because they differ in terms of the properties they ‘value’ most highly in their antecedents.

Which factors influence referent salience?

Previous research has found that reference resolution – assumed to be an indicator of referent salience – is influenced by a range of factors, including syntactic role, word order, information structure (distinctions such as old/given vs. new information), anaphoric form, discourse connectives and verb semantics (see Arnold, 1998 for an overview).

Effects of syntactic role on referent salience have been observed many times. Researchers claim that, at least in English, (agentive) subjects are more salient than non-subjects (e.g., Chafe, 1976; Brennan, Friedman, & Pollard, 1987; Crawley & Stevenson, 1990; see also Gordon, Grosz, & Gilliom, 1993, Gordon & Chan, 1995. For research on non-agentive subjects see Turan, 1995, 1998; Di Eugenio, 1998; Gordon & Chan, 1995).

What grants subjects this special prominence? In a language like English, with relatively fixed subject-object order, there are at least two possible

¹ The fact that some referential forms in some languages provide information about things such as number, gender, animacy, or ‘humanness’ (e.g., English ‘it’ vs. ‘she/he’) etc. is, in our opinion, incontrovertible and thus we do not address it here (see Arnold et al., 2000; Greene, McKoon, & Ratcliff, 1992; Garrod & Sanford, 1982; Albrecht & Clifton, 1998; inter alia, for work on gender and number). In this paper we focus on choices in referential form that cannot be explained by these kinds of factors.

explanations for this: (i) subjects precede objects and (ii) agentive subjects differ thematically/semantically from objects. To disentangle these possibilities, researchers have turned to languages with flexible word order. The results, so far, are rather controversial. For German, Rambow (1993) claims that word order can influence reference resolution (see Gernsbacher & Hargreaves, 1988; Gordon et al., 1993 on order-of-mention in English). Strube and Hahn (1996, 1999) make similar claims for German, arguing that hearer-old (familiar/known to the hearer) entities are ranked above hearer-new ones (see Prince, 1992). It follows from these claims that if information structural factors (especially hearer-status) guide word order, word order influences referent salience (see also Hajičová & Vrbová, 1982; Hajičová, Kuboň, & Kuboň, 1990). In contrast, Turan (1998) and Hoffman (1998) claim that in Turkish, referent salience correlates with grammatical (or semantic) role, not word order. Prasad and Strube (2000) make similar claims for Hindi. According to these approaches, the factors driving word order variation are independent of reference resolution (see also Vallduví, 1993).

These conflicting findings may stem partly from the fact that word order variation does not occur for the same reasons in all languages and all constructions. A constituent can be located in a noncanonical position for a range of reasons, e.g., because it has been previously mentioned, or because it contrasts with something else in the discourse (e.g., Kiss, 1995; Vilkuna, 1995). In this paper, we focus on the effects of word order variation driven by a particular kind of discourse information, namely the given/new distinction.

One factor or multiple factors?

So far in this discussion, it has been implicitly assumed that a single factor determines salience. However, in contrast to the views of Hoffman and Strube and Hahn, other researchers, including Ariel (1990), Arnold (1998), and Lappin and Leass (1994), regard salience as a ‘compound’ notion resulting from the interaction of multiple factors or constraints. Various psycholinguistic experiments (e.g., Arnold et al., 2000; Badecker & Straub, 2002; Gordon et al., 1993; Järvikivi et al., 2005) also suggest that anaphor resolution can be influenced by multiple constraints.

Thus, loosely speaking, there are two main approaches to referent salience: (i) the single-factor approach, which assumes that one factor – be it word order, linear order or something else – determines a referent’s salience, and (ii) the multiple-factor approach, which assumes that multiple weighted constraints contribute towards a referent’s salience. In this paper, based on earlier work by Kaiser (2003, 2005b), we explore an idea that extends the second approach, the multiple constraints view (see also Brown-Schmidt, Byron, & Tanenhaus, 2004; Brown-Schmidt, Byron, & Tanenhaus, 2005). We hypothesise that not only is reference resolution sensitive to

multiple constraints, but that different anaphoric forms – at least those that are informationally equivalent – can differ in how sensitive they are to different factors. According to this *form-specific* approach, it could be the case that one particular anaphoric form is primarily sensitive to word order, and another form is primarily sensitive to syntactic role, or sensitive to both word order and syntactic role but to different degrees. (We use the term ‘(anaphoric) form’ to refer to different referential expressions, i.e., different lexical items. Pronouns, demonstratives and full nouns are treated as different anaphoric forms. Different inflected forms of a particular pronoun (e.g., *s/he* inflected for different cases) count as occurrences of the same anaphoric form.) What is at stake is the question of whether or not anaphoric forms align along a unified salience scale. Even though the single-factor approach and the multiple-factor approach differ in their view of what contributes to a referent’s salience level, to the best of our understanding they both agree that different anaphoric forms can be characterised in terms of the salience of their antecedents; for example, pronouns refer to more salient referents than demonstratives. The form-specific multiple-constraints approach, in contrast, allows for a situation where the referential properties of anaphoric forms cannot be described in terms of a unified notion of antecedent salience.

Finnish

Two main typological characteristics of Finnish make it well-suited for investigating whether anaphoric forms differ in their sensitivities to different information types. First, Finnish displays discourse-driven word order variation, which allows us to uncouple contributions of word order and syntactic role. Second, standard Finnish has two kinds of third person anaphors than can be used to refer to humans, namely the gender-neutral pronoun *hän* ‘s/he’ and the demonstrative *tämä* ‘this’. Given the claims of accessibility-hierarchy-based approaches, these forms can be used as tools to test the salience of referents.

Finnish word order is very flexible. The canonical order is SVO, but all six permutations of S, V, and O are grammatical in the appropriate contexts (Vilkuna, 1989, 1995). We focus on the information-structural properties of SVO vs. OVS variation. The choice between SVO and OVS is guided by whether or not the arguments have been mentioned in the preceding discourse (e.g., Chesterman, 1991; Hiirikoski, 1995; see also Helasvuo, 2001 on pronominal subjects). Since standard Finnish has no definite or indefinite article, the SVO/OVS variation plays an important role in conveying the distinction between discourse-new and discourse-old information. (For discussion of other word orders, including the role of contrastive focus in SOV and OSV order, see Vilkuna, 1989, 1995.)

Subjects in a noncanonical, postverbal position are used to refer to discourse-new referents, as in (2a). In contrast, subjects in a canonical preverbal position usually refer to entities mentioned in preceding discourse, as in (2b). In a discourse-initial all-new sentence, a preverbal subject can also be interpreted as referring to a discourse-new entity.²

- (2a) Pylvääseen nojasi solakka tummahiuksinen nainen (Remes, 1997, p. 369)
column-ILL leaned slim-NOM dark-haired-NOM woman-NOM
'A slim, dark-haired woman leaned against the column.'
- (2b) Nainen puhui hänen kanssaan saksaa. (Remes, 1997, p. 343)
woman-NOM spoke he-GEN with German-PART
'The woman spoke German with him.'

An object in a noncanonical preverbal position in an OVS sentence, as in (3a), is interpreted as discourse-old information. In the canonical postverbal position, objects can be interpreted as new or old information, as in (3b) and (3c). Välimaa-Blum (1988) notes that, when no contrastive focus is present, sentences with preverbal subjects and postverbal subjects can both have the default intonation pattern of Finnish, i.e., a gradually descending F0 contour (see also Iivonen, 1998; Sulkala & Karjalainen, 1992). The sentences discussed in this paper do not involve contrastive focus.

- (3a) autoa ajoi kolmas henkilö
car-PART drove third-NOM person-NOM
'a third party drove the car.'
(from the newspaper *Viitasaaren Seutu*, June 2006)
- (3b) kunnes eräs meistä osti auton
until one-NOM us-ELAT bought car-ACC
'until one of us bought a car'
(from www.ttk oulu.fi/tyoharjoittelu/raportit/Leverkusen_TMD4.htm)
- (3c) Aalto osti auton
Aalto-NOM bought car-ACC
'(a man called) Aalto bought the car' [context: discussing the fate of a 1965 Ford]
(from the newspaper *Aamulehti* 4/7/2006)

The anaphoric paradigm of Finnish has two forms that can be used to refer to third person human referents: the gender-neutral pronoun *hän* 's/he' and the demonstrative *tämä* 'this'. The pronoun *hän* is commonly described as referring to the most important character in a particular situation, to the character in the foreground (e.g., Kalliokoski, 1991; see also Vilppula, 1989).

² Abbreviations used: NOM = nominative case, ACC = accusative, PART = partitive, GEN = genitive, ILL = illative, ELAT = elative, INESS = inessive, ADESS = adessive, poss = possessive suffix.

According to Saarimaa (1949), subjects are more in the foreground than other constituents and thus *hän* tends to refer to entities in subject position. Evidence supporting this claim comes from a corpus study by Halmari (1994) who found that *hän* is usually used to refer back to a preceding subject.³ An example is given in (4).

- (4a) **Koskela** marssitti joukkueensa parakin eteen.
Koskela-NOM marched troops-ACC-poss barrack-GEN in-front-of
 ‘**Koskela** had his troops march to the front of the barracks.’
- (4b) Kotvan **hän** seisoskeli aivan kuin miettien miten aloittaisi. (Linna, 1954/1999, p. 10)
 moment-ACC **he-NOM** stood exactly as-if thinking how
 start-CONDITIONAL
 ‘**He** stood there for a moment, as if thinking about how he should start.’
- (4c) # Kotvan **tämä** seisoskeli aivan kuin miettien miten aloittaisi.

The demonstrative *tämä* ‘this’ has multiple uses in Finnish. Similar to the English proximal demonstrative ‘this’, it can be used as a demonstrative pronoun or a discourse deictic (e.g., Etelämäki, 1996). Consider, for example, ‘This is my sister’ and ‘James pushed Julie. This surprised her’. However, unlike English ‘this,’ *tämä* can also be used anaphorically to refer to third person human referents. Our focus in this paper is on this particular use of *tämä*. In contrast to *hän*, *tämä* is often characterised as referring to characters in the background (e.g., Varteva, 1998). According to Sulkala and Karjalainen (1992), *tämä* is ‘used to indicate the last mentioned out of two or more possible referents’ (1992, pp. 282–283). An example is given in (5). Crucially, we cannot replace *hän* in (4b) with *tämä* (4c), because use of *tämä* in these kinds of contexts hinges on the presence of a second salient referent, and using *tämä* to refer to the only salient referent results in infelicity.⁴

- (5a) Koskela alkoi tuijottaa laulavaa **vänrikkiä**.
 Koskela-NOM started to-stare singing-PART **second-lieutenant-PART**
 ‘Koskela started to stare at the singing **second lieutenant**.’
- (5b) **Tämä** jatkoi aluksi lauluaan, mutta alkoi sitten vaivautua ... (Linna, 1954/1999, p. 285)

³ In this paper, we focus on standard Finnish. Dialects of colloquial Finnish have somewhat different anaphoric systems, see e.g., Laitinen (1992), Seppänen (1998) and Vilppula (1989).

⁴ As discussed in Kaiser (in press), there are certain special contexts, involving logophoricity (i.e., from the perspective of the person whose speech, thoughts, or feelings are being reported), where *tämä* can be used to refer to what seems, at first blush, to be a salient referent. However, as Kaiser (in press) shows, a closer look at these kinds of examples shows that even in these contexts (where the logophoric referent is very salient), the defining characteristics of *tämä* is that it is used to refer to characters that are not the most salient, not at the centre of attention.

This-NOM continued in-beginning song-poss, but started then to-be-bothered
 bothered
 ‘First **he** (second lieutenant) continued singing, but then started to be a bit bothered’

In sum, since Finnish has flexible word order and two anaphoric forms that can be used for third person human antecedents, it provides a good testing ground for evaluating the validity of the form-specific multiple-constraints approach.

The question of whether *hän* and *tämä* are influenced by word order in the same way has not received much attention in the Finnish anaphor resolution literature. In one of the earliest papers on *hän* and *tämä*, Saarimaa (1949) appears to support a single-factor approach relying on grammatical role, as his claims suggest that *tämä* refers to a recent non-subject, and *hän* to a subject. A more recent study by Halmari (1994), based on intuitions from seven native speakers, suggests that with SVO order, pronouns prefer subjects and demonstratives prefer objects. However, Halmari did not obtain clear results for OVS order, perhaps due to absence of context and the presence of plausibility biases in her materials. Existing corpus studies on *hän* and *tämä* in standard Finnish (e.g., Halmari, 1994; Kaiser, 2000) have failed to shed much light on this matter, due to the difficulties of finding sufficiently large numbers of the relevant types of examples in a non-tagged corpus.

Some preliminary evidence in favour of the form-specific multiple-constraints approach is provided by the results of a small-scale sentence completion experiment on the interpretation of *hän* and *tämä* following SVO and OVS order, reported in Kaiser (2003, 2005b). The results suggested that *hän* and *tämä* are affected in different ways by word order. Both SVO/Hän and OVS/Hän conditions exhibited a subject preference regardless of word order; the pronoun *hän* was interpreted as referring to the subject in 63% and 61% of the cases respectively. (On the interpretation of *hän* following SVO/OVS order, see also Järvikivi, van Gompel, Hyönä, and Bertram, 2005, discussed in the General Discussion section.) In contrast, with *tämä*, changing the word order from SVO to OVS had a striking effect. In the SVO/Tämä condition, *tämä* showed a strong object preference (83% object continuations), but in the OVS/Tämä condition, *tämä* was split between subject and object (33% and 38% respectively, as well as some other types of continuations. See also discussion of Experiment 1 below). Thus, the results of this sentence completion experiment (Kaiser 2003, 2005b) show that, in contrast to *hän*'s sensitivity to syntactic role, with *tämä* both linear order and syntactic role matter.

However, this experiment used only a small number of target items and presented the SVO and OVS sentences out of context. The absence of context introduces a serious asymmetry between the SVO and the OVS conditions,

given that the SVO/OVS variation is driven by the discourse status of the subject and object. An SVO sentence with no preceding context is perceived as more felicitous, and processed significantly faster and more easily, than an OVS sentence out of context (Halmari, 1994; Hyönä & Hujanen, 1997). Adding a supportive discourse context significantly decreases the processing difficulties associated with OVS order (see Kaiser & Trueswell, 2004). Thus, the absence of preceding context introduces a strong felicity asymmetry between SVO and OVS. Given that OVS order is crucial to disentangling the contributions of syntactic role and word order, testing it in a situation where it is known to be infelicitous and hard to process raises concerns regarding the validity of the findings.

Aims of this paper

Our main aim is to investigate the validity of the single-factor and multiple-factor approaches to reference resolution – in particular the feasibility of the form-specific approach – by testing how different kinds of information influence the referential properties of Finnish pronouns and demonstratives. We first looked at the off-line referential properties of *hän* and *tämä* by means of a sentence-completion experiment, using context to ensure that both SVO and OVS sentences are felicitous. Second, we investigated the real-time processing of these forms by means of the visual-world eye-tracking paradigm, to gain insights into the time-course with which different factors influence reference resolution. With an on-line measure such as eye-tracking we can find out whether effects of syntactic role and word order are temporally distinct or whether they both influence processing simultaneously.

General predictions

The word order single-factor approach predicts that word order, and in particular the information structure it encodes, determines the referential properties of *hän* and *tämä*, presumably starting at the earliest stages of processing. This predicts that when *hän/tämä* is preceded by a sentence with SVO or OVS order, *hän* is interpreted as referring to the preverbal and *tämä* to the postverbal argument. In contrast, the syntactic role single-factor approach claims that from the onset of reference resolution processes, *hän* is interpreted as referring to an entity whose most recent antecedent was in subject position⁵ and *tämä* to an entity whose most recent antecedent was in object position, regardless of word order.

⁵ In the rest of this paper, we will often say, for the sake of brevity, that the pronoun/demonstrative refers to the subject/object – even though this is not strictly speaking correct, since the referential form actually, in the end, picks out the *entity* whose most recent antecedent was in subject/object position.

The multiple constraints view offers a third possibility: both word order and syntactic role have an effect. The prediction is that *hän* and *tämä* are both sensitive to some combination of word order and syntactic role,⁶ potentially even during the earliest stages of processing. For SVO order, the predictions are straightforward, since word order and syntactic role are aligned: *hän* is predicted to refer to the subject, and *tämä* to the object. For OVS order, the precise predictions depend on the relative weights of word order and syntactic role. If word order and syntactic role are weighted equally, neither *hän* nor *tämä* will show a clear preference for subject or object; both forms should be split between the two potential referents. Regardless of the weights, this approach predicts that *hän* and *tämä* will divide up the referential labour evenly, such that they will be interpreted as referring to distinct referents.

The form-specific approach claims that multiple factors play a role but also allows for the possibility that *hän* and *tämä* do not exhibit the same degree of sensitivity to word order and syntactic role. The results of the preliminary sentence completion study (Kaiser, 2005b) suggest that, at least in terms of final interpretation, this is indeed the case. On the basis of that experiment, we predict that (i) the pronoun *hän* is sensitive primarily to syntactic role and prefers subjects regardless of word order, and (ii) the demonstrative *tämä* is sensitive to a combination of syntactic role and word order, such that in SVO order it prefers the postverbal object, and in OVS order it is split between the postverbal subject and the preverbal object.

EXPERIMENT 1: SENTENCE COMPLETION

Method

Participants. Sixteen adult native Finnish speakers volunteered for participation in the experiment. They were not paid for their participation. They were recruited over the internet.

Materials. This experiment used a standard sentence completion task to investigate the effects of word order and syntactic role on the referential properties of *hän* and *tämä*. Each target item consisted of a short narrative that contained an SVO or OVS sentence, which was followed by the first word of the next sentence (in nominative case, which signals that it is the subject), either *hän* 's/he' or *tämä* 'this'. Anaphor type and word order were crossed to create four conditions: (a) SVO/*Hän*, (b) OVS/*Hän*, (c) SVO/*Tämä*, (d) OVS/*Tämä*. The critical SVO/OVS sentences were preceded by a

⁶ In this paper we focus on the effects of word order and syntactic role. For related research on the effects of anaphoric form, see Kaiser (2003), Kaiser (2005a).

brief, two-sentence context which mentions the entity that the preverbal argument of the critical sentence refers to (i.e., S in SVO, O in OVS). The postverbal argument of the critical sentence is not mentioned in the preceding context. Thus, both SVO and OVS sentences are felicitous, because in both orders the preverbal argument is discourse-old and the post-verbal argument is discourse-new.⁷ A sample item in the SVO/Hän condition is given in (6).

- (6) Niina oli ostoksilla ruokakaupassa.
 Niina-NOM was shopping-ADESS grocery-store-INNESS
 ‘Niina was shopping at the grocery store.’ [*first sentence*]

Jonossa odottaessaan hän näki takanaan valkohattuisen **kokin**.
 Line-INNESS waiting-INNESS-poss she-NOM saw behind-poss white-hatted-
 ACC **cook-ACC**
 ‘While waiting in line, she saw **a cook** with a white hat behind her.’
 [*second sentence*]

Kokki töni jonon hännillä seisovaa **leipuria**.
Cook-NOM pushed line-GEN tails-ADESS standing-PART **baker-PART**
 ‘**The cook-SUBJ** pushed **a baker-OBJ** standing at the back of the line.’
 [*SVO critical sentence*]

or **Kokkia** töni jonon hännillä seisova **leipuri**.
Cook-PART pushed line-GEN tails-ADESS standing-NOM **baker-NOM**
 ‘**A baker-SUBJ** standing at the back of the line pushed the **cook-OBJ**.’
 [*OVS critical sentence*]

Hän ...
 S/he-NOM ...
 ‘S/he ...’ [*prompt word*]

In order to be able to felicitously refer to both referents in the critical SVO/OVS sentence (the third sentence) with full NPs, another referent was also introduced into the context (e.g., Niina in (6)). The first sentence introduces this referent, and at the beginning of the second sentence, s/he is referred to with a pronoun.

⁷ Word order (first vs. second mention) was confounded with repeated mention; the first mentioned character had already been mentioned, using a full noun. Existing work indicates that repeated mention can contribute to reference resolution and/or referent topicality in English (see e.g. Kameyama, 1996; Levy, 1982; see also Ariel, 1990). For simplicity, we refer to effects of this factor as a word-order effect. However, we recognise that any such effects could also be due to repeated mention. The conclusions we draw at the end of this paper do not hinge upon this interpretation choice.

There were 16 critical items and 32 fillers. Four presentation lists were constructed by combining the 16 target stories with the 32 filler stories. The target items were separated from each other by at least one filler item. Within a presentation list, eight of the target trials appeared with the SVO structure and eight appeared with the OVS structure. For each of these sentence structure types, four were followed by the pronoun *hän* and four by the demonstrative *tämä*. Each target item was then rotated through these four conditions, generating four different presentation lists. Reverse order lists were also generated to control for trial order. The nouns used for the subject and object in the critical items were all professions or other ‘roles’ (e.g., doctor, stewardess, reporter, student), and all verbs had agentive subjects.

Procedure and data analysis

Participants were asked to provide natural-sounding continuations for the sentence fragments. Participation took place over the internet, via a webpage where participants could type in their responses. Participants’ continuations were coded according to which of the referents in the preceding sentence (the first- or second-mentioned NP) the participants chose as the referent of the pronoun. When it was not clear which referent the participant had interpreted as being the referent of the pronoun or demonstrative, the continuation was marked as ‘unclear’. In addition, if the demonstrative *tämä* was not used as an anaphor for one of the characters mentioned in the preceding sentence (e.g., it was used as a discourse-deictic, as in ‘*This* was rather strange’), the continuation was coded as a ‘demonstrative’ use. Examples are in Appendix 1.

Results

Table 1 shows the percentage of different continuation types for each of the four conditions. Continuations were grouped based on whether the

TABLE 1

Percentages of different continuation types in the four conditions of the sentence continuation task, showing which referent the anaphoric expression was used to refer to. (The number in parentheses is the actual number of continuations, out of a total of 64 continuations in each of the four conditions.)

	<i>1st-mentioned ref</i>	<i>2nd-mentioned ref</i>	<i>Dem</i>	<i>Unclear/other</i>
SVO.Hän	64% (41)	13% (8)	0% (0)	23% (15)
OVS.Hän	13% (8)	64% (41)	0% (0)	23% (15)
SVO.Tämä	0% (0)	88% (56)	9% (6)	3% (2)
OVS.Tämä	9% (6)	44% (28)	30% (19)	17% (11)

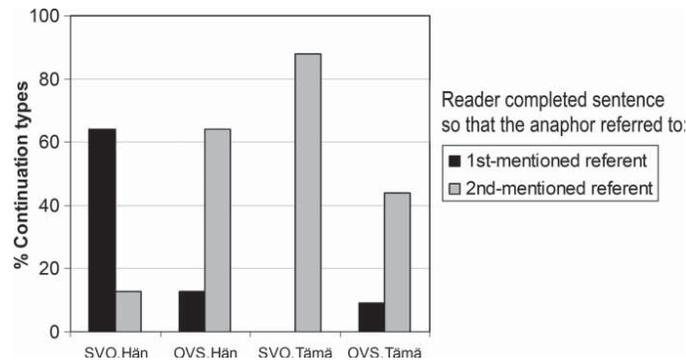


Figure 1. Percentage of continuations in which the anaphoric expression is interpreted as referring to the first-mentioned referent or the second-mentioned referent in the sentence continuation task (Experiment 1), plotted for each of the four conditions.

participant interpreted the pronoun/demonstrative as referring to the first-mentioned referent of the previous sentence (subject in SVO, object in OVS), the second-mentioned referent (object in SVO, subject in OVS), or other. In addition, the data for first-mentioned and second-mentioned continuations are plotted in Figure 1. As the figure illustrates, the pronoun *hän* shows a subject preference regardless of word order. In both the SVO/*Hän* condition and the OVS/*Hän* condition, *hän* is interpreted as referring to the subject of the preceding sentence in 64% of the continuations. This resembles the results of the out-of-context experiment (Kaiser, 2005b), which found 63% subject continuations in the SVO/*Hän* condition and 61% subject continuations in the OVS/*Hän* condition.

The results for the demonstrative *tämä* in the SVO and OVS conditions are less parallel. With SVO order, *tämä* prefers the second-mentioned (i.e., postverbal) object (88%), which mirrors the results of the earlier out-of-context experiment. With OVS order, *tämä* has a preference for the postverbal subject over the preverbal object (44% subject continuations, 9% object continuations) – but this is a weaker preference than in the SVO/*Tämä* condition. It also differs from the out-of-context experiment, where *tämä* preceded by OVS order was split between subject and the object (33% subject interpretations, 38% object interpretations).

Table 1 also shows the number of so-called ‘demonstrative’ continuations, i.e., cases where people treated *tämä* not as an anaphor but as a demonstrative or a discourse deictic. The number of demonstrative interpretations is higher in the OVS/*Tämä* condition than in the SVO/*Tämä* condition (30% and 9% respectively). A possible explanation for this is discussed below.

To analyse the data statistically, we used first-mentioned advantage scores. These scores were calculated by subtracting the proportion of continuations

referring to the second-mentioned referent from the proportion of continuations referring to the first-mentioned referent. A positive number indicates more continuations referring to the first-mentioned referent than to the second-mentioned one, and a negative number signals that there were more continuations referring to the second-mentioned referent than the first-mentioned one.

The mean first-mentioned advantage scores were calculated for each participant in each condition and each item in each condition. The resulting participant and item means were entered into separate analyses of variance (ANOVAs). All ANOVAs had these four factors: Word order (SVO or OVS), Anaphor type (pronoun or demonstrative), Order (forward or reverse list) and List (four levels) in the participant analysis and Item Group (four groups) in the item analysis.

The ANOVAs show that the first-mentioned advantage scores (i.e., how strongly an anaphoric element prefers the first-mentioned referent over the second-mentioned post-verbal referent) are significantly influenced by anaphor type: *hän* or *tämä*, $F_1(1, 8) = 178.94$, $p < .001$, $F_2(1, 12) = 51.27$, $p < .001$, and word order (SVO or OVS, $F_1(1, 8) = 11.38$, $p = .01$, $F_2(1, 12) = 22.59$, $p < .001$.⁸ There is also a significant interaction, $F_1(1, 8) = 64.93$, $p < .001$, $F_2(1, 12) = 49.34$, $p < .001$.

In other words, whether an anaphoric expression is interpreted as referring to the preceding subject or object depends on whether the anaphor is *hän* or *tämä*, and whether the word order of the preceding sentence is SVO or OVS. In addition, the significant interaction between word order and anaphor type reveals the asymmetrical behaviour of *hän* and *tämä*. As Figure 1 shows, word order has no effect on *hän*, but does have an effect on *tämä*.

Discussion

The results of Experiment 1 show that word order has strikingly different effects on the interpretation pronouns and demonstratives. The pronoun *hän* is sensitive primarily to syntactic role, and prefers subjects regardless of word order. In contrast, the demonstrative *tämä* prefers postverbal referents (i.e., O in SVO and S in OVS), but this preference is modulated by the syntactic role of the postverbal argument: *tämä* prefers objects over subjects.

As a whole, the results of Experiment 1 do not fit with the single-factor approaches, nor with a multiple-constraint approach assuming all forms to be subject equally to the same constraints. One of the single-factor predictions outlined above was that grammatical role determines what *hän*

⁸ There were reliable effects involving control variables in some of the analyses we conducted in this paper. Because we believe that they have no bearing on the proposals that we will be making, these effects will not be reported.

and *tämä* refer to, with *hän* predicted to refer to the subject, and *tämä* to the object, regardless of order. This prediction does indeed seem to match the results for *hän*.

If syntactic role is crucial for locating the antecedent of the pronoun *hän*, then it seems natural to expect that it will also guide the interpretation of the demonstrative *tämä*. However, this is not the case: *tämä* shows a significant preference for the postverbal referent with both SVO and OVS order. At first glance, the results for *tämä* appear to be compatible with the prediction that only word order is relevant. Nevertheless, despite showing a preference for postverbal referents, *tämä* is also sensitive to syntactic role: There are more postverbal object continuations in the SVO/Tämä continuation than there are postverbal subject continuations in the OVS/Tämä condition, indicating that effects of linear order are modulated by syntactic role. Our claim that *tämä*'s sensitivity to word order is modulated by syntactic role receives further support from the distribution of demonstrative continuations in the different conditions, as shown in Table 1: OVS/Tämä prompts more demonstrative continuations than SVO/Tämä. Using *tämä* demonstratively rather than anaphorically can be regarded as signalling that neither the subject nor the object is a good enough antecedent for *tämä* – in other words, it provides participants with an ‘escape hatch’ in a situation where neither argument is a good antecedent for *tämä*. Thus, the increased proportion of demonstrative uses in OVS/Tämä (30%) as compared to SVO/Tämä (9%) suggests that postverbal subjects are not as well-suited to be antecedents of *tämä* as postverbal objects.

Interestingly, in the original experiment that did not provide a felicitous context for OVS order (Kaiser, 2005b), OVS/Tämä shows no clear preference for either the subject or the object – but in Experiment 1, in the same condition but now with a supportive context that renders OVS felicitous, *tämä* shows a significant preference for the postverbal subject. This difference highlights the importance of investigating noncanonical word orders in an appropriate context and also suggests that *tämä*'s sensitivity to word order has to do with the discourse-level/pragmatic information conveyed by Finnish word order. By adding an appropriate discourse context, the information structural function of OVS order is fully realised and can thus have a clear effect on the referential properties of *tämä*.

As a whole, the results of Experiment 1 support the form-specific approach which claims that referential forms can show different degrees of sensitivity to different factors. This asymmetrical pattern is not compatible with either of the single-factor approaches or with a multiple-constraints approach that assumes all forms will be equally sensitive to the same constraints.

EXPERIMENT 2: EYE-TRACKING STUDY

In this section we report the results of a study that investigates people's interpretation of anaphoric expressions in a highly incremental, on-line manner, by following their eye movements. The results of Experiment 1 show that the final interpretation of the pronoun *hän* is guided primarily by syntactic role, whereas the final interpretation of the demonstrative *tämä* is sensitive to both linear order and syntactic role. This leaves open the question of when, in the course of processing, these factors exert their influence. Existing research demonstrates that eye-movements to objects in a display are closely time-locked to potential referents that a listener is considering as language unfolds over time (Cooper, 1974; Tanenhaus et al., 1995; for a review see Tanenhaus & Trueswell, 2006). Thus we can use eye-movements to shed light on what participants consider as potential referents for pronouns and demonstratives during real-time processing.

Method

Participants. Sixteen adult native Finnish-speaking participants, mainly students at the Helsinki University of Technology and the University of Helsinki, took part in this experiment. They received approximately \$5 for participation in the experiment.

Procedure. An eye-movement-during-listening paradigm was employed in which participants heard descriptions of clip-art generated pictures (similar to Altmann & Kamide, 1999; Arnold, Eisenband, Brown-Schmidt, & Trueswell, 2000). Participants saw large colour pictures of simple scenes involving human or animal characters and listened to a short pre-recorded story about each scene. Participants were told that in some cases, the story might not match the picture, and that in such cases, their task was to correct (by speaking out loud) the story according to what they saw in the picture.

A digital camera was used to record participants' eye movements during the experiment. On each trial, the participant was shown a large colour picture, and above this picture was a SONY DVcam digital camcorder with audio-lock recording. The DVcam camcorder was centred directly above the picture, and recorded the participant's face and eyes, the auditory stimuli, and the participant's spoken responses. The pre-recorded sound files were played by a Dell laptop over external stereo speakers. Analysis of the eye movements and speech onsets, described below, were done by hand on the videotapes at a later date, using a SONY DSR-30 digital VCR with jog-shuttle control. This video-based eye gaze process was used because the data were collected in Finland, where neither author had access to a head-mounted eye-tracking system.

Materials. The colour pictures used in this study were made using clip-art and Adobe Photoshop, and were printed on 11 × 16 inch paper using a high-resolution colour ink-jet printer. At a typical viewing distance of 1 metre, the visual angle of the scene subtended approximately 23 degrees. Typically, the pictures contained two to four characters (people or animals) as well as other objects that made up a coherent scene. Brief verbal passages were prepared that described a simple story involving the participants shown in the picture. The stories were spoken with neutral intonation and recorded using the Syntrillium CoolEdit program on a laptop PC. The same female native Finnish speaker's voice was used for all sound files.

There were 16 critical items (picture-story pairs) in the experiment. All critical items contained two human characters. Both characters were approximately the same size and positioned on opposite sides of the picture; one on the left and one on the right. (Pilot testing was done to determine that the characters were far enough apart to enable coders to easily distinguish eye movements to each character from the video record.) Figure 2 presents an example scene, which was presented with the verbal passage shown in (7).



Figure 2. Sample scene for the eye-gaze experiment.

(7)

(a) Liisa astuu sisään erään suuren firman päätoimistoon.

'Liisa steps into the main office of a big company.'

(b) Hän huomaa sihteerin, joka puhuu puhelimesta.

'She notices a secretary who is talking on the phone.'

'(c) Hetken päästä sihtööri moittii juuri sisään tullutta liikemiestä [SVO]

Moment-GEN after secretary-NOM criticises just entered businessman-PART

'After a moment the secretary-SUBJ criticises a businessman-OBJ who has just walked in'

(c') Hetken päästä sihteerää moittii juuri sisään tullut liikemies [OVS]

Moment-GEN after secretary-PART criticises just entered businessman-NOM

'After a moment the secretary-OBJ criticises a businessman-SUBJ who has just walked in'

(d) samalla kun printterit tulostavat päivän raportteja.

'while the printers are churning out the day's reports.'

(e) Hän // tämä seisoo valokopiokoneen lähellä.

'S/he // This is standing near a photocopier.'

Each story began with an opening sentence which describes what a character called Liisa (not shown in the visual scenes) is doing. Then, in the second sentence, a new referent is introduced (here, a secretary). This referent is mentioned again in the next sentence, which has SVO or OVS order. In both SVO and OVS conditions, the preverbal noun is discourse-old, as it is mentioned in the preceding sentence. Thus, both SVO and OVS sentences are felicitous. In the pictures, the position of the character to which the preverbal noun refers was distributed between the left and right sides of the scene.

The critical sentence (sentence (e) above) begins with either *hän* 's/he' or *tämä* 'this'. Crucially, this sentence is incorrect with respect to both of the characters in the picture, since both are standing next to something but neither is standing next to a photocopier. Participants were expected to correct it (e.g., by saying *No, s/he is standing next to a deskla plant*). This design has two benefits: (i) it allows the experiment to be as neutral as possible, since participants are not biased to interpret *hän* or *tämä* as referring to a particular referent on the basis of preceding items, and (ii) it allows us to collect information regarding participants' final interpretation of the anaphoric expression.

The sentence with the word order manipulation is separated from the critical anaphor-initial sentence by an intervening clause which serves as a 'look-away' to encourage participants to look at some other object(s) in the scene. The entities mentioned in this look-away clause are not potential referents for *hän* or *tämä* due to number and/or animacy.

In addition to the 16 target items, 32 fillers were constructed. The fillers varied in terms of the number and location of characters. In addition, the characters used in the target items and the fillers were different, so that no participant saw the same character twice. Twenty-four fillers were correct and eight contained mismatches. This was done to ensure that over the entire experiment, half of the trials were correct and half contained mismatches/mistakes.

We constructed four presentation lists by combining the 16 target items with the 32 fillers. All target items were separated by at least one filler. Within a presentation list, eight target trials had OVS order and eight had SVO order. For each order type, four of the eight trials contained the pronoun *hän* and four contained the demonstrative *tämä*. Each target item was rotated through the four conditions, which resulted in the creation of four presentation lists. We also created reverse versions of the lists to control for trial order.

Data analysis and coding. The videotapes of the participants' eyes were analysed as follows. A native Finnish speaker went through the audio portion of each video and, using a Sony DRS-30 digital VCR (which allows for frame-by-frame inspection of the video and audio components, at the frequency of 30 frames per second), located the frame where the critical sentence begins, i.e., the onset of the anaphor. (Onset coding followed the procedure used by Snedeker, Thorpe, & Trueswell, 2001; Snedeker & Trueswell, 2004). The video was then analysed frame-by-frame (with the sound turned off) until the end of the trial, beginning 30 frames (1 second) before the onset of the anaphoric expression. Coders recorded, frame-by-frame, whether the participant was looking to the left, right, middle, or elsewhere. Since the sound was turned off, the coders were blind to experimental condition. The eye movement coding was used to establish which characters participants had looked at over time, relative to the onset of the anaphoric form. To determine the reliability of the eye gaze coding, the first 1500 ms of the video record of three participants was double coded. The two scorers disagreed on the left vs. right direction of gaze on less than 2% of the video record.

Our lab has used this type of eye gaze technique successfully on adult and child participants (see Kaiser & Trueswell, 2004; Snedeker et al., 2001; Snedeker & Trueswell, 2004). Snedeker and Trueswell (2004) discuss the nature and validity of this kind of eye gaze technique in more depth, and provide a detailed comparative analysis showing that a free-head video-based eye gaze procedure produces data equivalent to that of an ISCAN head-mounted eye-tracker. This method can be thought of as a descendent of preferential-looking studies with children, which are known to result in very

high inter-coder reliability when frame-by-frame coding is used (Hirsh-Pasek & Golinkoff, 1996).⁹

Predictions. Eye-tracking allows us to investigate the time-course of processing and can tell us how the different sensitivities that *hän* and *tämä* demonstrate in Experiment 1 unfold during the course of real-time processing. If anaphor resolution is accomplished via a form-specific, multiple-constraints mechanism, we predict that the asymmetric behaviour of *hän* and *tämä* should be present even during the early stages of processing, and is not merely an epiphenomenon resulting from discrete single-factor processing. Specifically, in light of what we saw in the sentence completion experiment, we predict that participants will show an early and persistent preference to interpret the pronoun *hän* as referring to the preceding subject, regardless of whether the order is SVO or OVS. For the demonstrative *tämä*, we predict that when it is preceded by an SVO sentence, participants will interpret *tämä* as referring to the postverbal object, and that when it is preceded by an OVS sentence, the pattern might be less clear, but participants will nevertheless prefer the postverbal argument over the preverbal one. In terms of linear order, our prediction is that SVO/Hän is the only condition to prompt more looks to the first-mentioned referent than to the second-mentioned referent (i.e., exhibit a first-mention advantage). The other three conditions – SVO/Tämä, OVS/Hän, and OVS/Tämä – are all expected to trigger more looks to the second-mentioned, postverbal referent than to the first mentioned referent. Thus, we predict a word order × anaphor type interaction.

It is also worth noting that *tämä*, unlike *hän*, is temporally ambiguous because in addition to its anaphoric use, it can also function as a prenominal modifier (e.g., *tämä mies* ‘this man’) or a discourse deictic (e.g., ‘This was fun’). We might thus expect to see a difference in participants’ responses to the demonstrative *tämä* as compared to *hän*, since it will not be clear until the next word that *tämä* is being used anaphorically.

For the off-line mismatch correction component of the eye-tracking experiment, we predict that *hän* and *tämä* should again pattern asymme-

⁹ It is important to note that with this eye-gaze method, it is not possible to distinguish looks to very close-together objects, such as the man and the plant in the sample scene. Thus, one might be concerned that noise is introduced because looks to nearby objects may be incorrectly coded as looks to the target characters. The presence of such noise is unlikely to distort our results significantly, given that each character has the grammatical role of the subject in one condition and the grammatical role of the object in another condition (see example item) and given how objects are distributed: The 16 targets fall into four groups: object next to left character (3 items), object next to right character (4 items), no objects next to either character (1 item) or an object next to each character (8 items). As a result, any noise resulting from looks to other objects is predicted to affect subject entities and object entities approximately equally.

trically. However, we acknowledge that the correction task may result in noisier data than the off-line sentence completion study in Experiment 1, due to stronger competition from the dispreferred antecedent triggered by the mismatch-based nature of the task (neither of the characters pictured in the scene fits the sentence containing the anaphor). In the sentence completion task, in contrast, there was no mismatch to trigger explicit consideration of the other referent.

Results

The presentation of the results is divided into three main sections. First, a general description of participants' eye-movements is provided. Second, detailed statistical analyses of fixation proportions to different referents over time are reported. Third, information is provided regarding participants' off-line correction responses.

Overview of the eye movement patterns

Figure 3 shows the strength of the first-mentioned advantage preference for the different conditions. The first-mentioned advantage was calculated by subtracting the proportion of looks to the second-mentioned referent from the proportion of looks to the first-mentioned referent, and thus a positive number indicates more looks to the first-mentioned referent than to the second-mentioned one, and a negative number signals that there were more looks to the second-mentioned referent than to the first-mentioned one. Crucially, using advantage scores allows us to take into account looks to

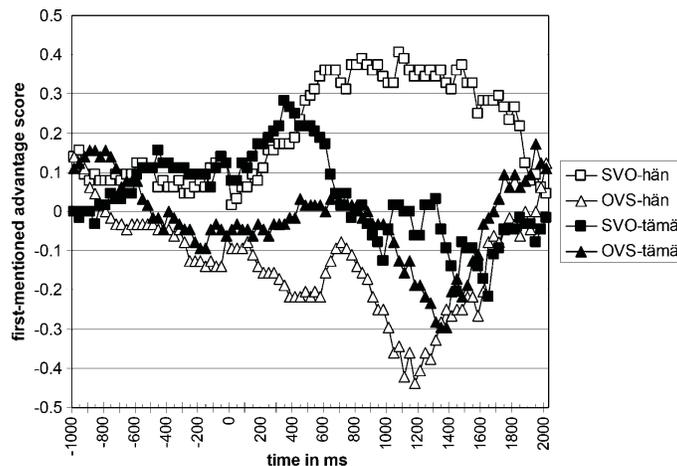


Figure 3. First-mentioned advantage scores for pronouns and demonstratives as a function of time. The first-mentioned advantage score is calculated by subtracting the proportion of looks to the second-mentioned character from the proportion of looks to the first-mentioned character. The onset of the anaphor is at 0 ms.

either of the two referents at any point in time, which is arguably a more complete measure than an approach that focuses only on looks to one referent (see also Arnold et al., 2000, Arnold, Brown-Schmidt, & Trueswell, 2007, on advantage scores). However, for completeness we also provide figures showing the proportion of looks to the first-mentioned referent and second-mentioned referents separately (Figures 4 and 5).

SVO conditions. Figure 3 shows that for approximately the first 400 ms after the onset of the anaphor (which is at 0 ms), both SVO/Hän and SVO/Tämä show a sharp rise in first-mentioned advantage scores, after which the *tämä* conditions show a sudden downturn away from the first-mentioned referent. The first-mentioned advantage scores for SVO/Hän, however, keep rising until they plateau at about +0.35. These patterns can also be seen in Figure 4 and Figure 5. For SVO/Tämä, we observe a sharp increase in looks to the second-mentioned referent (Figure 5) beginning right around the same time as the downturn in looks to the first-mentioned referent (Figure 4). For SVO/Hän, as expected, we see that the looks to the first-mentioned referent (Figure 4) keep rising until they reach about 0.64, whereas the looks to the second-mentioned referent remain relatively low (Figure 5). We discuss the SVO/Tämä pattern in more detail below.

OVS conditions. Figure 3 shows that OVS/Hän is almost a mirror image of SVO/Hän, and shows a strong anti-first-mention preference. Thus, both OVS/Hän and SVO/Hän show a subject preference. Figures 4 and 5 show that the rise in looks to the preceding subject begins early in both conditions. In the OVS/Tämä condition, there is clearly no first-mention (object)

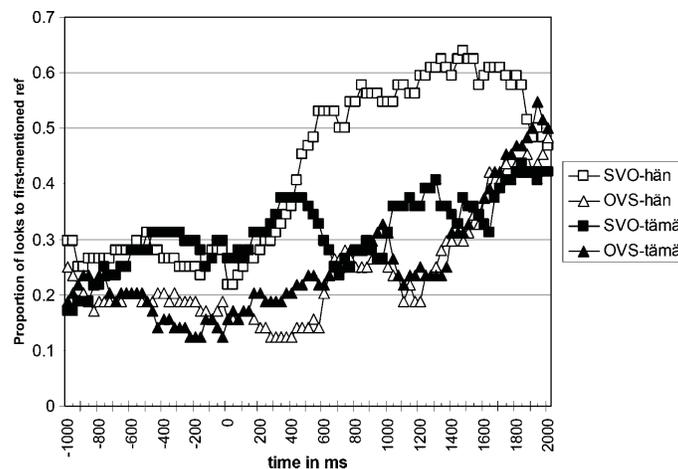


Figure 4. Probability of fixating the first-mentioned referent as a function of time in each of the four conditions.

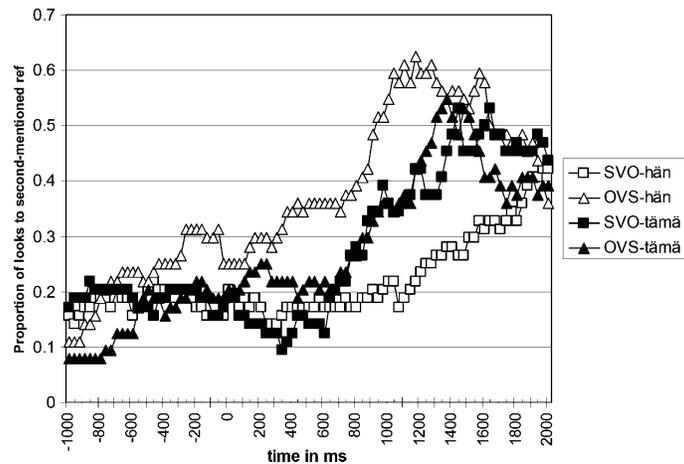


Figure 5. Probability of fixating the second-mentioned referent as a function of time in each of the four conditions.

preference (Figure 3). The first-mention scores hover around 0 until around 700 ms, at which point there is a sharp downturn towards the second-mentioned referent, a pattern that is also evident in Figures 4 and 5. Putting together the patterns for SVO/Tämä and OVS/Tämä, it becomes clear that despite the unexpected, transient subject looks in the SVO/Tämä condition, *tämä* is patterning very unlike *hän*. There is no hint of a general object preference that would complement the clear subject preference we see for *hän*.

Statistical analysis of eye movement patterns

To analyse the time course of the eye movement patterns in detail, we conducted analyses of variance (ANOVAs) on seven 400 ms time-slices, starting 800 ms before the onset of the anaphoric expression and continuing for 2000 ms after the onset. For each time slice, participant and item means of first-mentioned advantage scores (the proportion of looks to the first-mentioned referent subtracted from the proportion of looks to the second-mentioned referent) were entered into separate ANOVAs with four factors: Word order (SVO or OVS), Anaphor type (*hän* or *tämä*), Order (forward or reverse list), and List (4 levels) in the participant analysis and item group (4 groups) in the item analysis.¹⁰

¹⁰ Whenever an ANOVA was conducted on an advantage score calculated on the basis of proportions of looks, a parallel ANOVA was conducted on an arcsine transformation of the data ($\arcsin(\sqrt{x})$). This was done to adjust for the fact that a proportion is bounded at 0 and 1. Throughout the paper, we report the F values, p values and means from the untransformed data. Unless otherwise noted, any effect that was reliable in the untransformed data was also reliable in the transformed data.

During the *first two time slices* (–800ms to –400ms, –400ms to 0 ms, anaphor onset), there are no significant effects of anaphor type or word order in the subjects or the items analyses. However, there is a marginal effect of word order during the second time slice in the items analysis, $F_1(1, 8) = 1.73$, $p = .225$, $F_2(1, 12) = 3.8$, $p = .075$, with SVO exhibiting a stronger first-mention advantage score than OVS. This effect is also marginal in the items analysis of the arcsine transformed data, $F_2(1, 12) = 3.589$, $p = .082$.

During the *third time slice* (0–400 ms, where 0 ms refers to anaphor onset), we see an effect of word order that is significant by items and marginal by subjects $F_1(1, 8) = 3.8$, $p = .087$; $F_2(1, 12) = 9.51$, $p < .01$. [In the arcsine transformed data, the word order effect is significant by both subjects and items, $F_1(1, 8) = 5.632$, $p < .05$, $F_2(1, 12) = 9.086$, $p < .05$.] As Figure 3 shows, during this time slice, first-mentioned advantage scores are higher with SVO than OVS order, as people are looking more at the subject with SVO than with OVS. There are no effects of anaphor type and no interaction.

During the *fourth time slice* (400–800 ms), the word order effect persists, $F_1(1, 8) = 7.02$, $p < .05$; $F_2(1, 12) = 38.33$, $p < .01$, and there is also a significant word order-anaphor type interaction, $F_1(1, 8) = 7.21$, $p < .05$; $F_2(1, 12) = 6.16$, $p < .05$. There are no significant main effects of anaphor type. As can be seen in Figure 3, it is during this time slice that SVO/Tämä separates from SVO/Hän, and takes a sudden plunge towards the second-mentioned referent. The difference in the first-mentioned advantage scores in the SVO/Hän and the SVO/Tämä conditions thus becomes bigger than the corresponding difference in the OVS/Hän and OVS/Tämä conditions, which shows up as a significant interaction.

This pattern persists in the *fifth time slice* (800–1200 ms), where there is a significant main effect of word order, $F_1(1, 8) = 11.09$, $p = .01$; $F_2(1, 12) = 26.95$, $p < .01$, with SVO resulting in a higher first-mention advantage score than OVS. There is also a significant word order-anaphor type interaction due to the fact that only SVO/Hän triggers a high proportion of looks to the first-mentioned referent, $F_1(1, 8) = 8.62$, $p < .05$; $F_2(1, 12) = 16.33$, $p < .01$. There are no significant effects of anaphor type.

Similarly, in the *sixth time slice* (1200–1600 ms), we see a continuing main effect of word order, $F_1(1, 8) = 13.67$, $p < .01$; $F_2(1, 12) = 15.7$, $p < .01$, and an anaphor-word order interaction that is marginal by subjects and significant by items, $F_1(1, 8) = 3.8$, $p = .087$; $F_2(1, 12) = 4.76$, $p = .05$. There is also a marginal main effect of anaphor type, $F_1(1, 8) = 4.786$, $p = .061$, $F_2(1, 12) = 3.238$, $p = .097$, but the presence of the word order-anaphor interaction indicates that it is primarily the SVO/Hän condition that is triggering a high proportion of looks to the first-mentioned referent.

The word order-anaphor type interaction is also significant in the *final time slice* (1600–2000 ms) by subjects, $F_1(1, 8) = 5.56$, $p < .05$, but not by items ($p = .146$).¹¹

Planned comparisons were conducted on the first-mentioned advantage scores (looks to first mentioned minus looks to second mentioned referent) and subject-advantage scores (looks to subject minus looks to object) of *hän* and *tämä* for each time slice. The analyses reveal that in the *hän* conditions, the *first-mentioned advantage scores* are influenced significantly by word order in the third, fourth, fifth and sixth time slices: third time slice: $F_1(1, 8) = 5.67$, $p < .05$; $F_2(1, 12) = 6.86$, $p < .05$; fourth time slice: $F_1(1, 8) = 11.37$, $p = .01$; $F_2(1, 12) = 33.78$, $p < .01$; fifth time slice: $F_1(1, 8) = 6.38$, $p < .05$; $F_2(1, 12) = 22.45$, $p < .01$; sixth time slice: $F_1(1, 8) = 6.4$, $p < .05$; $F_2(1, 12) = 14.19$, $p < .01$.¹² In other words, in the *hän* conditions, OVS order triggers a significantly lower proportion of looks to the first-mentioned referent than SVO order, starting less than 400 ms after the onset of the anaphor. In contrast, word order has no significant effect during any time slice on the *subject advantage scores* for the pronoun.

In the *tämä* conditions, the first-mentioned advantage scores are not significantly influenced by word order at any point in time, with the exception of a marginal effect of word order during the third time slice in the items analysis of the arcsine transformed data $F_2(1, 12) = 3.589$, $p = 0.083$. It is during this time slice that looks to the subject (first-mentioned referent) are still increasing in the SVO/*Tämä* condition, before the sharp downturn towards the (second-mentioned) object. After this point, SVO and OVS both induce comparable proportions of looks to the first vs. second-mentioned referents. Turning to the subject advantage scores, we see a significant effect of word order in the sixth time slice (1200–1600 ms, $F_1(1, 8) = 7.06$, $p < .05$; $F_2(1, 12) = 5.29$, $p < .05$). In that segment, there are significantly more looks to the (second-mentioned) subject in OVS order than to the (first-mentioned) subject in SVO order. The subject advantage scores for other time slices do not show significant effects of word order, indicating that the (un)likelihood of *tämä* to refer to the subject is not significantly influenced by word order, except during the 1200–1600 ms time slice.

¹¹ Analyses of the arcsine transformed data show a trend towards a word order-anaphor type interaction by subjects in the final time slice, $F_1(1, 8) = 3.55$, $p = .096$, but not by items ($p = .118$).

¹² In the arcsine transformed data, there is also a marginal effect of word order in the final time slice in the subjects analysis, but not in the items analysis, $F_1(1, 8) = 5.105$, $p = .054$, $F_2(1, 12) = 2.286$, $p = .156$.

Off-line referential judgements

As shown in Figure 6, in the SVO/Hän condition, 81% of the responses treated the pronoun as referring to the preceding subject.¹³ In the OVS/Hän condition, 62% of the responses treated the preceding subject as the antecedent of the pronoun. Although participants are more likely to interpret *hän* as referring to the subject than the object in both SVO and OVS conditions, the strength of the subject preference is not equally strong with SVO and OVS, in contrast to Experiment 1.

The results for the demonstrative conditions show that, as we already saw in the eye-movement data and in Experiment 1, *tämä* does not exhibit an overwhelming sensitivity to the syntactic role of the antecedent. With OVS/Tämä, participants show a clear bias to interpret the second-mentioned, postverbal referent as the antecedent of the demonstrative (76% corrections towards the postverbal subject). In the SVO/Tämä condition, 54% of responses treated the second-mentioned referent as the antecedent of the demonstrative. Although postverbal interpretations are more frequent in both SVO/Tämä and OVS/Tämä conditions, the rate of postverbal object choices in SVO/Tämä is lower than expected on the basis of Experiment 1.

For data analysis, first-mentioned advantage scores were calculated by subtracting the proportion of corrections towards the second-mentioned referent from the proportion of corrections towards the first-mentioned referent. Participant and item means of first-mentioned advantage scores were entered into separate ANOVAs with four factors: Word order (SVO or OVS), Anaphor type (*hän* or *tämä*), Order (forward or reverse list), and List

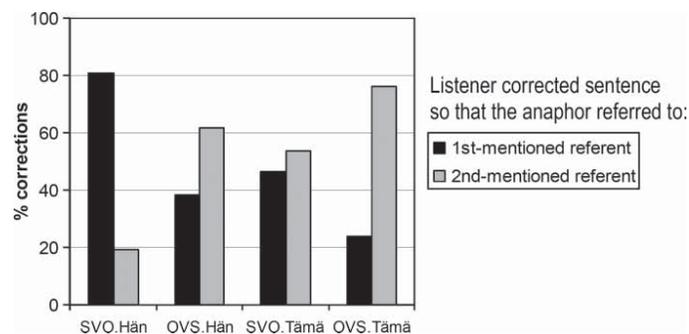


Figure 6. Percentage of corrections towards the first-mentioned referent and the second-mentioned referent for pronouns and demonstratives. (Ambiguous responses are excluded.)

¹³ Some of the corrections were ambiguous (e.g., ‘No one is standing next to a photocopier’). The percentages reported here exclude these ambiguous responses. However, the patterns do not change even if these responses are included, because the proportion of ambiguous responses in the four conditions is very similar.

(four levels) in the participant analysis and item group (four groups) in the item analysis.

The ANOVAs show that the first-mentioned advantage scores are significantly influenced by anaphor type $F_1(1, 8) = 10.44$, $p = .012$, $F_2(1, 12) = 12.83$, $p < .01$, and by word order $F_1(1, 8) = 12.76$, $p < .01$, $F_2(1, 12) = 53.7$, $p < .001$). Thus, overall the *hän* conditions result in more corrections towards the first-mentioned referent (as compared to the second-mentioned referent) than the *tämä* conditions, and SVO order triggers more corrections towards the first-mentioned referent than OVS order. There is also a marginal anaphor type \times word order interaction $F_1(1, 8) = 3.96$, $p = .08$, $F_2(1, 12) = 3.85$, $p = .07$, which is slightly stronger when the analyses are conducted on arcsine-transformed data, $F_1(1, 8) = 4.77$, $p = .06$, $F_2(1, 12) = 3.85$, $p = .07$. As Figure 6 shows, the strength of the preference for the first-mentioned referent relative to the second-mentioned referent is more influenced by word order (SVO vs. OVS) in the *hän* conditions than in the *tämä* conditions.

Discussion

As a whole, the results of the eye-tracking study shows that participants' interpretation of *hän* and *tämä* is influenced by the antecedent's position (pre- vs. postverbal) and syntactic role (subject vs. object) to different degrees. The strong subject preference we observe in participants' eye-movements in the *hän* conditions, combined with the absence of a corresponding overarching object preference for *tämä*, is compatible with the form-specific multiple-constraints approach, but not with either of the single-factor approaches or by a multiple-constraints approach that assumes all forms are equally sensitive to the same constraints.

As the eye-tracking results show, the asymmetrical behaviour of *hän* and *tämä* emerges early during processing. The pronoun *hän* shows a sensitivity to syntactic role beginning shortly after the onset of the anaphor, with SVO/Hän showing a steep rise in first-mention advantage scores and OVS/Hän showing an early increase in looks to the second-mentioned referent. Even though the eye-movement data for the demonstrative *tämä* are less clear, they crucially reveal a striking asymmetry relative to *hän*, since there is no overarching syntactic role sensitivity with *tämä*.

The eye-movements in the SVO/Tämä condition show a temporary initial rise in looks to the subject, which we suggest may be a garden-path effect made possible by two properties of Finnish coinciding: (i) SVO order appears to create the expectation that the subject will be mentioned again in the next sentence, and (ii) *tämä* can function as a prenominal modifier (e.g., 'this man'). As can be seen in Figure 3, SVO conditions have a slightly higher first-mentioned advantage than OVS conditions even before the anaphor. As

it turns out, this is what Centering Theory (Grosz, Joshi, & Weinstein, 1995, *inter alia*) predicts: A situation in which a preceding discourse-old subject is mentioned again in subject position is claimed to be easy to process and thus predicted to occur frequently (see also Givón, 1983; Arnold, 1998; Prince, 1992). In other words, a discourse-old referent in subject position is likely to be mentioned again in subject position. The pronoun *hän* allows the system to fulfil this expectation, but the demonstrative *tämä* does so only if *tämä* is parsed as a modifier referring to the preceding subject. Indeed, participants' eye-movements suggest that they are initially interpreting *tämä* as modifying a noun referring to the preceding subject, e.g., 'this man'.

The idea that the transient early subject looks in the SVO/Tämä condition are due to a word-order driven expectation combined with *tämä* interpreted temporarily as a modifier is compatible with the duration of the anaphor. The average duration of the demonstrative was about 230 ms and the average duration of the pronoun was 180 ms. The sound files were measured using Praat software (Paul Boersma and David Weenink, Institute of Phonetic Sciences, University of Amsterdam). The duration of *tämä* – combined with the fact that it takes about 150–200 ms to launch and program an eye movement (see e.g., Matin, Shao, & Boff 1993; see also Altmann & Kamide, 2004; Dahan, Magnuson, Tanenhaus, & Hogan, 2001; Saslow, 1967) – is compatible with the timing of the downturn, which starts around 400 ms after the onset of the anaphor. This suggests that once it becomes clear that *tämä* is not modifying a subsequent noun but rather acting as a free-standing anaphoric form, the parser realises its mistake and this triggers looks away from the subject.

Even after it has become clear that *tämä* is being used anaphorically, the strength of the object preference demonstrated by *tämä* in the SVO/Tämä condition is not as strong as we might expect on the basis of Experiment 1. We hypothesise that this stems at least partially from a lingering effect of the garden path. As Christianson et al. (2001) observed, even after a sentence has been re-analysed, aspects of the initial parse can still persist, i.e., the initial interpretation is not necessarily fully eradicated (see also Tabor, Galantucci, & Richardson, 2004). In our case, this would mean that the interpretation of *tämä* as modifying a noun referring to the subject would linger, and weaken the predicted object preference of anaphoric *tämä*.

The main effect of word order that we found in participants' eye-movements, indicative of a bigger first-mentioned advantage with SVO order than OVS order, is another sign that SVO/Tämä is not patterning as we expected. The prediction was that only SVO/Hän would show a clear first-mentioned advantage and all other conditions would show a clear second-mentioned advantage, resulting in a word order \times anaphor interaction and no main effect of word order.

Nevertheless, if we consider the eye-movement patterns in all four conditions as a whole, the asymmetry between *hän* and *tämä* is clear. Even though SVO/Tämä does not pattern quite as we predicted, it clearly fails to fit the predictions of either the single-factor approach or a multiple-constraints approach that assumes all forms share the same sensitivities. Thus, the results are compatible with our hypothesis that *hän* and *tämä* differ in how sensitive they are to different kinds of information.

Participants' off-line corrections are also compatible with the claim that *hän* and *tämä* differ in how sensitive they are to the linear position and syntactic role of potential antecedents. Other approaches are unable to account for the data patterns satisfactorily: The corrections in the SVO/Hän condition show a subject preference and those in the OVS/Tämä condition also have a preference for the (now postverbal) subject – a pattern which is not compatible with an account based only on the effects of syntactic role. Moreover, when this pattern is combined with the absence of an object preference in OVS/Hän condition, it also becomes clear that a pure linear order account is not supported by the data. Furthermore, a multiple-constraints account according to which syntactic role and linear order are weighted equally cannot explain the subject preference in the OVS/Tämä condition.

However, the patterns in the off-line correction data are not as clear as in the sentence completion patterns of Experiment 1. This may be due to (i) the hypothesised garden-pathing in the SVO/Tämä condition and (ii) stronger competition from the dispreferred antecedent, as discussed in the Predictions section of Experiment 2. More specifically, it is possible that the difference in results between the *completion* data in Experiment 1 and the *correction* data in Experiment 2 reflects something about the tasks. In Experiment 2, the sentence containing the critical anaphor does not match either of the pictured characters (e.g., neither is standing next to a photocopier), and the participant – in correcting the sentence-scene mismatch – must report some accommodation of the sentence that would make it match the scene. This might introduce participant-specific strategies that are unrelated to pronoun resolution, which would in turn make the results noisier than those seen in the sentence completion experiment. Note for instance that the order and direction of all effects are the same across both experiments (compare Figures 1 and 6) but the pattern is simply less clear in Experiment 2. Nevertheless, it is also worth noting that in the off-line correction data, the subject preference is not equally strong with SVO/Hän and OVS/Hän, a finding that seems compatible with claims made by Järvikivi et al. (2005).

The fact that *tämä* is temporally ambiguous whereas *hän* is not raises the question of whether the asymmetrical behaviour of the demonstrative and pronominal forms could stem from this difference. Do the different

referential preferences of *hän* and *tämä* stem from the fact that one form is temporally ambiguous and the other is not?

In our opinion, the ambiguous/unambiguous distinction could not generate the asymmetrical sensitivity to word order and grammatical role that we observe for *hän* and *tämä*. It seems like the ambiguity of *tämä*, combined with the expectations triggered by SVO order, results in the SVO/Tämä condition initially patterning just like SVO/Hän, i.e., showing a subject/first-mentioned preference. As a result, SVO/Tämä and SVO/Hän initially group together by preferring the first-mentioned referent, and OVS/Hän and OVS/Tämä resemble each other in preferring the second-mentioned referent over the first-mentioned one. Thus, if anything, the garden-pathing (which makes SVO/Tämä initially pattern like SVO/Hän) should prevent the word order \times anaphor type interaction from emerging. Our finding that a significant word order \times anaphor type interaction (with *tämä* being more sensitive to word order than *hän*) emerges after the hypothesised garden-pathing does not seem to be derivable from – in fact, seems to go against the consequences of – the ambiguity of *tämä*.¹⁴ Our results would be stronger if the garden-pathing were not present.

Furthermore, even though we do not believe this to be the case for our results, it would be theoretically and empirically interesting if temporally ambiguous anaphoric forms show a fundamentally different behaviour from unambiguous forms. A number of languages resemble Finnish in allowing demonstratives to be used both anaphorically for human referents and in prenominal modifier position (e.g., German and Dutch). Even English ‘that’ contrasts with ‘it’, since ‘that’ can occur on its own (‘Could you put that on the table?’) as well as prenominally (‘that book’). Finding that temporary ambiguity results in these forms patterning differently from unambiguous pronouns would offer an interesting explanation for why the forms pattern differently, and would not necessarily be incompatible with the form-specific account.

In sum, Experiment 2 corroborates the lack of a single unifying factor behind *hän* and *tämä*; they pattern distinctly, as predicted by the form-specific approach. The eye-tracking results show that even on an incremental level, we cannot maintain an approach which assumes that pronouns and demonstratives are sensitive to a single notion of salience. *Hän* and *tämä* should not display different sensitivities to different factors if what they correspond to are simply two different rankings on a one-dimensional salience hierarchy.

¹⁴ One could, of course, try to connect ambiguity and referential properties by stipulating that temporarily ambiguous referential forms are more sensitive to word order than unambiguous forms. However, we do not pursue this possibility because we have not encountered any evidence that would support or motivate this claim.

GENERAL DISCUSSION

The main aim of this research was to study the referential properties of pronouns and demonstratives in Finnish, in order to investigate the validity of the assumption that all referential forms can be ranked along a unified salience scale. The work more generally was aimed at improving our understanding of what it means for a referent to be salient. We wanted to test the validity of the form-specific multiple-constraints approach to reference resolution, which was supported by earlier off-line results for Finnish pronouns and demonstratives (Kaiser, 2003, 2005b). The sentence completion experiment and the eye-tracking study presented in this paper indicate that the pronoun *hän* 's/he' and the demonstrative *tämä* 'this' are sensitive to different factors, as predicted by the form-specific approach. In the kinds of contexts investigated here, *hän* is interpreted as referring to preceding subjects, whereas *tämä* prefers postverbal, discourse-new referents, especially objects. Thus, whereas the interpretation of the pronoun *hän* is driven primarily by the syntactic role of potential antecedents, the demonstrative *tämä* exhibits a sensitivity to both word order/information structure and syntactic role. These results are problematic for an approach that treats *hän* and *tämä* as being sensitive to the same 'kind' of salience (whether it be determined by a single factor, such as syntactic role or information structure, or by a set of factors). Rather, they provide support for a multi-dimensional approach, where anaphoric forms can be sensitive to different factors to different degrees. In this form-specific approach, each anaphoric form has its own set of weighted constraints that guide its interpretation.

It is worth contrasting this approach with a more extreme interpretation: namely that *hän* is sensitive only to syntactic information and only *tämä* is sensitive to more than one kind of information. We do not want to make such a strong claim, because we think it likely that all anaphoric forms are sensitive to more than one constraint, but to varying degrees. In the case of *hän*, our view is that Finnish listeners are implicitly aware that the grammatical roles of preceding entities are of primary relevance for computing the referent of *hän*, but this does not preclude using other information sources. For example, *hän* can be used without a linguistic antecedent if the referent is sufficiently salient in the extra-linguistic context. Consider a situation where an unknown person just rode by very quickly on a bicycle. In this situation, a speaker could exclaim 'Boy, was he fast!', and use *hän* without a linguistic antecedent, without making reference to a preceding subject. A second example of another information source having an effect on the interpretation of *hän* comes from repeated occurrences of a pronoun. Kaiser (2003, 2005a) found that the referential form of the preceding subject and object (full NP vs. pronoun) can have an effect on

the interpretation of a subsequent pronoun. She hypothesises that a chain of pronouns patterns differently from the initial use of *hän* to refer to a full NP (see also Kameyama, 1999; Beaver, 2004), and proposes a referent-tracking system that builds on this distinction. Thus, we suggest that even if a form is primarily sensitive to a particular constraint, this does not prevent other constraints from also playing some role in the reference computation process.

The form-specific multiple-constraints approach also receives support from research on Estonian pronouns and demonstratives (Kaiser & Vihman 2006; 2008). Estonian, a Finno-Ugric language with flexible word order and closely related to Finnish, can also use pronouns (*ta* 's/he') and demonstratives (*see* 'this') to refer back to third-person human antecedents. A sentence completion study, modelled on Experiment 1, shows that the Estonian pronoun *ta* 's/he' is sensitive to the syntactic role of its antecedent, whereas *see* 'this' is sensitive to both syntactic role and word order. In both Finnish and Estonian, pronominal anaphors show a primary sensitivity to the syntactic role of the antecedent, but the demonstrative anaphors are not 'mirror images' of the pronouns – i.e., they do not simply refer to entities with lower-ranked syntactic roles.

To investigate the form-specific multiple-constraints approach in the within-sentence domain, Kaiser, Runner, Sussman, and Tanenhaus (in press-a, in press-b) investigated the interpretation of English pronouns and reflexives. The results suggest that pronouns and demonstratives in sentence-internal contexts such as *Peter told Andrew about the picture of himself/him* differ in the degree of sensitivity they exhibit to structural and non-structural factors, further supporting the form-specific approach.

The form-specific multiple-constraints approach is compatible with the growing body of research indicating that reference resolution is influenced by multiple factors (see e.g., Ariel, 1990; Arnold, 1998; Arnold et al., 2000; Badecker & Straub, 2002). Subsequent to the completion of the experiments reported in this paper, Järvikivi, van Gompel, Hyönä, and Bertram (2005) also reported results from a visual-world eye-tracking study investigating the interpretation of the pronoun *hän* when preceded by SVO and OVS order. In a visual-world eye-tracking study with SVO and OVS sentences, Järvikivi et al. found that *hän* exhibits an initial sensitivity to syntactic role (preferring subjects) 480 ms to 690 ms after the onset of the pronoun, followed by effects of both syntactic role and word order from 690 ms onwards. Their experimental design differs somewhat from ours, especially in that they did not have context sentences preceding the critical SVO/OVS sentences. As discussed in conjunction with the review of the Kaiser (2005b) results, previous work on Finnish has shown that OVS order, if presented out of context, causes significant processing difficulties, unlike SVO order which is felicitous in an all-new context. It is not clear how this felicity asymmetry between SVO and OVS may have affected Järvikivi et al.'s results. As a whole,

although the results of Järvikivi et al. (2005) differ somewhat from ours, in our opinion they are not incompatible with our main claim, namely that the pronoun *hän* and the demonstrative *tämä* differ in how sensitive they are to different types of information.

Given our claim that our findings cannot be reconciled with a traditional view of salience, should the notion of salience be discarded? In our opinion, one should not abandon the basic observation that more informative referential forms (e.g., ‘the man with the straw hat’, ‘that man’) can be used to refer to less salient referents than informationally impoverished forms (e.g., ‘he’) (Givón, 1983; Ariel, 1990; Gundel et al., 1993, *inter alia*). The implications of our findings are most relevant for languages that have two (or more) anaphoric forms that cannot be distinguished on the basis of their informativity, such as Finnish *hän* and *tämä* or English *it* and *this/that* (see Ariel 2001, p. 29). Moreover, even when these forms display asymmetric sensitivities, one could potentially pursue an alternative approach that incorporates the notion of salience somewhat more indirectly, namely the idea that *hän* and *tämä* cause comprehenders to preferentially probe different types of representations when trying to locate the most likely referent for each form. The different sensitivities that *hän* and *tämä* exhibit to word order and syntactic role are, according to this view, reflexes of a more fundamental difference between the two referential forms, namely the representational level on which they are resolved. According to this approach, when a comprehender processes the sentence containing *hän* or *tämä*, two representations of the prior linguistic input remain activated and are relevant for anaphor resolution:

- a. the syntactico-semantic representation of the preceding sentence, which we assume includes information about grammatical and thematic roles.
- b. the comprehender’s mental model of the discourse, which we assume includes information about the situation or event being described and the entities involved in it. In our view, this mental discourse model is not a representation of a text (see Glenberg, Kruley, & Langston, 1994) but rather a discourse model that the comprehender constructed on the basis of the preceding discourse (see Johnson-Laird, 1983; Van Dijk & Kintsch, 1983).

Existing work supports the idea that these two types of representation are accessed during processing. For example, research on verb-phrase ellipsis suggests that a syntactico-semantic representation of the preceding sentences needs to be maintained, at least temporarily (see Fiengo & May, 1994; Shapiro & Hestvik, 1995; Shapiro, Hestvik, Lesan, & Garcia, 2003). The role of various types of mental models has been investigated by a range of

researchers, including Van Dijk and Kintsch (1983), Glenberg et al. (1994) and Johnson-Laird (1983).

This approach would allow us to maintain the notion of salience by hypothesising that the relevant entities are ranked in terms of their salience on the syntactico-semantic level as well as on the mental discourse model level. In light of existing research, it seems reasonable to hypothesise that (a) on the syntactico-semantic level, agentive subjects are more salient than non-agentive objects and oblique arguments, and (b) on the level of the mental representation of the discourse, salience is influenced by a range of factors, in particular information-structural factors. Thus, under this approach *hän* would be described as preferring referents that are salient on the syntactico-semantic level and *tämä* as preferring referents that are lower in salience on the discourse model level.

The asymmetrical sensitivities of *hän* and *tämä* raise the question of why referential forms differ in the kind of information they are most sensitive to. Why is *tämä* ‘this’ more sensitive to word order and information structure than *hän* ‘s/he’? We do not offer a definitive answer, but note that the difference may be related to the generally discourse-bound nature of *tämä*. In addition to functioning as an anaphor for human referents, this form is also used as a proximal demonstrative and a discourse deictic. In these uses, the referent of *tämä* is extremely context-dependent and often does not have an antecedent that is a linguistic constituent. This contrasts with the pronoun *hän*, which is used to refer to concrete human entities. In light of these differences, the finding that syntactic role does not play as important a role for *tämä* as it does for *hän* no longer seems very surprising.

The finding that syntactic role is not the primary determinant of a demonstrative’s antecedent is also supported by eye-tracking work by Brown-Schmidt et al. (2004, 2005) investigating *it* and *that* in English. They found that both *it* and *that* are sensitive to extra-linguistic information, such as how easily two objects could be viewed as a composite. For instance, given a command like ‘Put the cup on the saucer. Now put that over by the shovel’, participants interpreted *that* as referring to the composite ‘cup-and-saucer’ 88% of the time. Perhaps the preference of *that* to refer to composite entities is related to the information-structural sensitivity of *tämä*, another form that can be used to refer to entities that do not have linguistic antecedents.

In sum, our investigation of the referential properties of the pronoun *hän* ‘s/he’ and the demonstrative *tämä* ‘this’ in Finnish suggests that not all referential forms within a single language are sensitive to the same salience-influencing factors to the same degree. As our results show, *hän* and *tämä* differ in the degree of sensitivity they exhibit to the syntactic role and linear position of potential antecedents – a finding which is not compatible with single-factor approaches to reference resolution, nor with a multiple-factor

approach assuming that all referential forms are equally sensitive to different kinds of information. We interpret our results as support for the form-specific multiple-constraints approach, and we also explore the possibility that the different referential properties of *hän* and *tämä* are due to these forms prompting comprehenders to preferentially probe different sorts of representations when trying to locate the most likely referent within the discourse.

Manuscript received September 2006

Revised manuscript received October 2007

First published online May 2008

SOURCES

- Internet, websites of the newspapers *Aamulehti* and *Viitasaaren Seutu*.
 Linna, V. (1954/1999). *Tuntematon Sotilas*. Helsinki: Werner Söderström Oy.
 Remes, I. (2000). *Pääkallokehräjä*. Helsinki: Werner Söderström Oy.

REFERENCES

- Albrecht, J. E., & Clifton, C., Jr. (1998). Accessing singular antecedents in conjoined phrases. *Memory and Cognition*, 26, 599–610.
- Altmann, G. T. M., & Kamide, Y. (2004). Now you see it, now you don't: Mediating the mapping between language and the visual world. In J. M. Henderson & F. Ferreira (Eds.), *The interface of language, vision, and action: Eye movements and the visual world* (pp. 347–386). New York: Psychology Press.
- Ariel, M. (1990). *Accessing NP antecedents*. London: Routledge, Croom Helm.
- Ariel, M. (2001). Accessibility theory: an overview. In T. Sanders, J. Schilperoord, & W. Spooren (Eds.), *Text representation, linguistic and psycholinguistic aspects* (pp. 29–87). Amsterdam/Philadelphia: John Benjamins.
- Arnold, J. (1998). *Reference form and discourse patterns*. Ph.D. dissertation, Stanford University, Stanford, CA.
- Arnold, J. E., Brown-Schmidt, S., & Trueswell, J. C. (2007). Children's use of gender and order-of-mention during pronoun comprehension. *Language and Cognitive Processes*, 22, 527–565.
- Arnold, J. E., Eisenband, J. G., Brown-Schmidt, S., & Trueswell, J. C. (2000). The rapid use of gender information: Evidence of the time course of pronoun resolution from eyetracking. *Cognition*, 76, B13–B26.
- Badecker, W., & Straub, K. (2002). The processing role of structural constraints on the interpretation of pronouns and anaphors. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 28, 748–769.
- Beaver, D. (2004). The optimization of discourse anaphora. *Linguistics and Philosophy*, 27(1), 3–56.
- Brennan, S., Friedman, M., & Pollard, C. (1987). A centering approach to pronouns. *Proceedings of the 25th Annual Meeting of the Association for Computational Linguistics* (pp. 155–162). Stanford, CA.

- Brown-Schmidt, S., Byron, D. K., & Tanenhaus, M. (2005). Beyond salience: Interpretation of personal and demonstrative pronouns. *Journal of Memory and Language*, 53, 292–313.
- Brown-Schmidt, S. B., Byron, D., & Tanenhaus, M. K. (2004). That's not it and 'it's' not 'that': The role of conceptual composites in in-line reference resolution. In M. Carreiras & C. Clifton, Jr. (Eds.), *On-line sentence processing: ERPS, eye movements and beyond*. Hove, UK: Psychology Press.
- Chafe, W. L. (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. In C. N. Li (Ed.), *Subject and topic* (pp. 25–55). New York: Academic Press.
- Chesterman, A. (1991). *On definiteness*. Cambridge, UK: Cambridge University Press.
- Christianson, K., Hollingworth, A., Halliwell, J. F., & Ferreira, F. (2001). Thematic roles assigned along the garden path linger. *Cognitive psychology*, 42, 368–407.
- Cooper, R. M. (1974). The control of eye fixation by the meaning of spoken language: A new methodology for the real-time investigation of speech perception, memory and language processing. *Cognitive Psychology*, 6, 84–107.
- Crawley, R., & Stevenson, R. (1990). Reference in single sentences and in texts. *Journal of Psycholinguistic Research*, 19(3), 191–210.
- Dahan, D., Magnuson, J. S., Tanenhaus, M. K., & Hogan, E. M. (2001). Subcategorical mismatches and the time course of lexical access: Evidence for lexical competition. *Language and Cognitive Processes*, 16, 507–534.
- Di Eugenio, B. (1998). Centering in Italian. In M. A. Walker, A. K. Joshi, & E. F. Prince (Eds.), *Centering theory in discourse* (pp. 115–138). Oxford: Oxford University Press.
- Etelämäki, M. (1996). *Keskutelu tarkoitteesta kamerataiteen oppitunnilla – ja pronominit tuo, se, tämä*. Thesis, Department of Finnish, University of Helsinki.
- Fiengo, R., & May, R. (1994). *Indices and identity*. Cambridge, MA: MIT Press.
- Garnham, A. (2001). *Mental models and the interpretation of anaphora*. Hove, UK: Psychology Press.
- Garrod, S. C., & Sanford, A. J. (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.
- Gernsbacher, M. A., & Hargreaves, D. (1988). Accessing sentence participants: The advantage of first mention. *Journal of Memory and Language*, 27, 699–717.
- Givón, T. (1983). *Topic continuity in discourse: A quantitative cross-language study*. Philadelphia/Amsterdam: John Benjamins.
- Glenberg, A., Kruley, P., & Langston, W. E. (1994). Analogical processes in comprehension. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 609–640). San Diego, CA: Academic Press.
- Gordon, P. C., & Chan, D. (1995). Pronouns, passives and discourse coherence. *Journal of Memory and Language*, 34, 216–231.
- Gordon, P. C., Grosz, B., & Gilliom, L. (1993). Pronouns, names, and the centering of attention in discourse. *Cognitive Science*, 17, 311–347.
- Greene, S., McKoon, G., & Ratcliff, R. (1992). The role of implicit causality and gender cue in the interpretation of pronouns. *Language and Cognitive Processes*, 73(4), 231–255.
- Grosz, B., Joshi, A., & Weinstein, S. (1995). Centering: A framework for modeling the local coherence of discourse. *Computational Linguistics*, 21(2), 203–225.
- Gundel, J., Hedberg, N., & Zacharski, R. (1993). Cognitive status and the form of referring expressions in discourse. *Language*, 69, 274–307.
- Hajičová, E., & Vrbová, J. (1982). On the role of the hierarchy of activation in the process of natural language understanding. In J. Horecký (Ed.), *COLING 82* (pp. 107–113). Amsterdam: North Holland.

- Hajičová, E., Kuboň, V., & Kuboň, P. (1990). Hierarchy of salience and discourse analysis and production. *Proceedings of the 13th Conference on Computational linguistics*, 3, 144–148. Helsinki, Finland.
- Halmari, H. (1994). On accessibility and coreference. *Nordic Journal of Linguistics*, 17, 35–59.
- Helasvuo, M.-L. (2001). *Syntax in the making: The emergence of syntactic units in Finnish conversation*. Philadelphia/ Amsterdam: John Benjamins.
- Hiirikoski, J. (1995). Correlations between some morphosyntactic features and word order in Finnish and English: Some preliminary results of testing the transitivity hypothesis. In B. Wärwik, S. K. Tanskanen, & R. Hiltunen (Eds.), *Organization in discourse, proceedings from the Turku Conference, Anglicana Turkuensia*, 14, 289–299.
- Hirsh-Pasek, K., & Golinkoff, R. M. (1996). The intermodal preferential looking paradigm: A window onto emerging language comprehension. In D. McDaniel & C. McKee (Eds.), *Methods for assessing children's syntax. Language, speech, and communication* (pp. 105–124). Cambridge, MA: MIT Press.
- Hoffman, B. (1998). Word order, information structure and centering in Turkish. In M. A. Walker, A. K. Joshi & E. F. Prince (Eds.), *Centering theory in discourse* (pp. 251–272). Oxford: Oxford University Press.
- Hyönä, J., & Hujanen, H. (1997). Effects of case marking and word order on sentence parsing in Finnish: an eye fixation analysis. *Quarterly Journal of Experimental Psychology*, 50A(4), 841–858.
- Iivonen, A. (1998). Intonation in Finnish. In D. Hirst & A. D. Cristo (Eds.), *Intonation systems: A survey of twenty languages*. Cambridge, UK: Cambridge University Press.
- Järvikivi, J., van Gompel, R. P. G., Hyönä, J., & Bertram, R. (2005). Ambiguous pronoun resolution: Contrasting the first-mention and subject-preference accounts. *Psychological Science*, 4, 260–264.
- Johnson-Laird, P. (1983). *Mental models: Towards a cognitive science of language, inference and consciousness*. Cambridge, MA: Harvard University Press.
- Kaiser, E. (2000). Pronouns and demonstratives in Finnish: Indicators of referent salience. In P. Baker, A. Hardie, T. McEnery, & A. Siewierska (Eds.), *Proceedings of the Discourse Anaphora and Reference Resolution Conference (DAARC 2000)*, University Center for Computer Corpus Research on Language, Technical Papers Vol. 12 (pp. 20–27). Lancaster, UK: University of Lancaster.
- Kaiser, E. (2003). *The quest for a referent: A crosslinguistic look at reference resolution*. Ph.D. dissertation, University of Pennsylvania, Philadelphia, PA.
- Kaiser, E. (2005a). Different forms have different referential properties: Implications for the notion of 'salience'. In A. Branco, T. McEnery, & R. Mitkov (Eds.), *Anaphora processing: Linguistic, cognitive and computational modelling* (pp. 261–282). Philadelphia/Amsterdam: John Benjamins.
- Kaiser, E. (2005b). When salience isn't enough: Pronouns, demonstratives and the quest for an antecedent. In R. Laury (Ed.), *Minimal reference in Finnic: The use and interpretation of pronouns and zero in Finnish and Estonian discourse* (pp. 135–162). Helsinki, Finland: Suomalaisen Kirjallisuuden Seura.
- Kaiser, E. (in press). (Anti)logophoricity in Finnish. In *The Proceedings from the Main Session of the Chicago Linguistic Society's Fortieth Meeting*. Volume 40-1. Chicago, IL: Chicago Linguistic Society.
- Kaiser, E., Runner, J., Sussman, R., & Tanenhaus, M. (in press-a). The interpretation of pronouns and reflexives in picture noun phrases: Effects of non-structural factors. In A. Alcazar, R. Mayoral Hernandez, & M. T. Martinez (Eds.), *Proceedings of the Western Conference on Linguistics 2004*. Fresno, CA: California State University at Fresno.
- Kaiser, E., Runner, J., Sussman, R., & Tanenhaus, M. (in press-b). The real-time interpretation of pronouns and reflexives: Structural and semantic information. In E. Elfner & M. Walkow (Eds.), *Proceedings of the North East Linguistic Society*, 37, GLSA Publications.

- Kaiser, E., & Trueswell, J. C. (2004). The role of discourse context in the processing of a flexible word-order language. *Cognition*, 94(2), 113–147.
- Kaiser, E., & Trueswell, J. C. (in press). Investigating the interpretation of pronouns and demonstratives in Finnish: Going beyond salience. In E. Gibson & N. Pearlmutter (Eds.), *The processing and acquisition of reference*. Cambridge, MA: MIT Press.
- Kaiser, E., & Vihman, V. (2006). On the referential properties of Estonian pronouns and demonstratives. Presented at the 22nd Scandinavian Conference of Linguistics, to appear in the *Proceedings of the 22nd Scandinavian Conference on Linguistics*.
- Kaiser, E., & Vihman, V. (2008). *Reference resolution in Estonian: What guides the interpretation of personal pronouns and demonstratives?* Manuscript in preparation. University of Southern California and University of Tartu.
- Kalliokoski, J. (1991). Emphathy as motivation for style shifting in narrative. In J. Verschueren (Ed.), *Levels of linguistic adaptation. Selected papers of the International Pragmatics Conference Vol II* (pp. 147–161). Philadelphia/Amsterdam: John Benjamins.
- Kameyama, M. (1996). Indefeasible semantics and defeasible pragmatics. In M. Kanazawa, C. Pinon, & H. de Swart (Eds.), *Quantifiers, deduction and context* (pp. 111–138). CSLI Publications: Stanford.
- Kameyama, M. (1999). Stressed and unstressed pronouns: Complementary preferences. In P. Bosch & R. van der Sandt (Eds.), *Focus: Linguistic, cognitive, and computational perspectives* (pp. 306–321). Cambridge, UK: Cambridge University Press.
- Kiss, K. (1995). *Discourse Configurational Languages*. New York: Oxford University Press.
- Laitinen, L. (1992). *Välttämättömyys ja persoona. Suomen murteiden nesessiivisten rakenteiden semantiikkaa ja kielioppia*. Helsinki, Finland: Suomalaisen Kirjallisuuden Seura.
- Lappin, S., & Leass, H. (1994). An algorithm for pronominal anaphora resolution. *Computational Linguistics*, 20(4), 535–561.
- Levy, E. (1982). Toward an objective definition of discourse topic. In K. Truite, R. Schneider, & R. Chametzky (Eds.), *Papers from the eighteenth regional meeting of the Chicago Linguistic Society* (pp. 259–304). Chicago, IL.
- Matin, E., Shao, K. C., & Boff, K. R. (1993). Saccadic overhead: Information processing time with and without saccades. *Perception and Psychophysics*, 53(4), 372–380.
- Prasad, R., & Strube, M. (2000). Discourse salience and pronoun resolution in Hindi. In A. Williams, & E. Kaiser (Eds.), *U. Penn Working Papers in Linguistics*, 6.3, 189–208.
- Prince, E. F. (1992). The ZPG letter: subjects, definiteness and information status. In S. Thompson & W. Mann (Eds.), *Discourse description: diverse analyses of a fund raising text* (pp. 295–325). Philadelphia/Amsterdam: John Benjamins.
- Rambow, O. (1993). *Pragmatic aspects of scrambling and topicalization in German*. Paper presented at the Workshop on Naturally-Occurring Discourse, Institute for Research in Cognitive Science, University of Pennsylvania, PA.
- Saarimaa, E. A. (1949). Kielelme käytäntö. Pronominivirheistä. *Virttäjä*, 49, 250–257.
- Saslow, M. G. (1967). Latency for saccadic eye movement. *Journal of the Optical Society of America*, 57, 1030–1033.
- Seppänen, E.-V. (1998). *Läsnäolon pronominit. Tämä, tuo, se ja hän viittaamassa keskustelun osallistujiaan*. Helsinki, Finland: Suomalaisen Kirjallisuuden Seura.
- Shapiro, L. P., & Hestvik, A. (1995). On-line comprehension of VP-ellipsis: Syntactic reconstruction and semantic influence. *Journal of Psycholinguistic Research*, 24(6), 517–532.
- Shapiro, L. P., Hestvik, A., Lesan, L., & Garcia, A. R. (2003). Charting the time-course of VP-ellipsis sentence comprehension: Evidence for an initial and independent structural analysis. *Journal of Memory and Language*, 49(1), 1–19.
- Snedeker, J., Thorpe, K., & Trueswell, J. (2001). On choosing the parse with the scene: The role of visual context and verb bias in ambiguity resolution. *Proceedings of the 23rd Annual Conference of the Cognitive Science Society*, pp. 964–969.

- Snedeker, J., & Trueswell, J. C. (2004). The developing constraints on parsing decisions: the role of lexical-biases and referential scenes in child and adult sentence processing. *Cognitive Psychology*, 49, 238–299.
- Strube, M., & Hahn, U. (1996). Functional centering. *Proceedings of ACL '96*, 270–277.
- Strube, M., & Hahn, U. (1999). Functional centering: grounding referential coherence in information structure. *Computational Linguistics*, 25, 3.
- Sulkala, H., & Karjalainen, M. (1992). *Finnish*. London: Routledge.
- Tabor, W., Galantucci, B., & Richardson, D. (2004). Effects of merely local syntactic coherence on sentence processing. *Journal of Memory and Language*, 50(4), 355–370.
- Tanenhaus, M. K., Spivey-Knowlton, M. K., Eberhard, K. M., & Sedivy, J. E. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science*, 268, 632–634.
- Tanenhaus, M., & Trueswell, J. (2006). Eye movements and spoken language comprehension. In M. Traxler & M. A. Gernsbacher (Eds.), *Handbook of Psycholinguistics* (2nd ed., pp. 863–900). Amsterdam: Academic Press.
- Turan, Ü. D. (1995). *Null vs. Overt Subjects in Turkish Discourse: A Centering Analysis*. Ph.D. dissertation, University of Pennsylvania, Philadelphia, PA.
- Turan, Ü. D. (1998). Ranking forward-looking centers in Turkish. In M. A. Walker, A. K. Joshi, & E. F. Prince (Eds.), *Centering theory in discourse* (pp. 136–160). Oxford: Oxford University Press.
- Vallduví, E. (1990). *The Informational Component*. Ph.D. dissertation, University of Pennsylvania, Philadelphia, PA.
- Van Dijk, T. A. & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York: Academic Press.
- Varteva, A. (1998). Pronominitt hän ja tämä tekstissä. *Virittäjä*, 2, 202–223.
- Välímää-Blum, R. 1988. *Finnish existential clauses: their syntax, pragmatics and intonation*. Ph.D. dissertation, Ohio State University.
- Vilkuna, M. (1989). *Free word order in Finnish*. Helsinki, Finland: Suomalaisen Kirjallisuuden Seura.
- Vilkuna, M. (1995). Discourse configurationality in Finnish. In K. Kiss (Ed.), *Discourse configurational languages* (pp. 244–268). New York: Oxford University Press.
- Vilppula, M. (1989). Havaintoja hän- ja he-pronominien käytöstä suomen murteissa. *Virittäjä*, 93, 389–399.

APPENDIX A

Sample continuations from Experiment 1 (sentence completion task)

(a) *SVO/Hän condition with subject-continuation*

... Kokki töni jonon hänillä seisovaa leipuria. **Hän** oli vihainen leipurille joka yritti etuilla kassalle

... 'The cook-SUBJ pushed a baker-OBJ standing at the back of the line. **S/he** was angry at the baker who was trying to cut in line.'

(b) *OVS/Hän condition with subject-continuation*

... Rehtoria moitti silmälasipäinen kirjastonhoitaja. **Hän** halusi rehtorin heti palauttavan myöhässä olevan kirjan.

... 'The principal-OBJ criticised a librarian-SUBJ with glasses. **S/he** wanted the principal to return the overdue book immediately.'

(c) *SVO/Tämä condition with object-continuation*

... Sairaanhoitaja onnitteli ohikävelevää lääkäriä. **Tämä** oli suorittanut onnistuneesti vaikean leikkauksen.

... 'The nurse-SUBJ congratulated a doctor-OBJ who was walking by. **This** had successfully completed a difficult operation.'

(d) *OVS/Tämä with subject-continuation*

... Rehtoria moitti silmälasipäinen kirjastonhoitaja. **Tämä** oli tuohtunut rehtorin myöhästyneestä kirjainasta.

... 'The principal-OBJ criticised a librarian-SUBJ with glasses. This was aggravated by the principal's overdue book loan.'

(e) *Demonstrative use of tämä:*

... Pelle pilkkasi häkin vieressä harjoittelevaa jonglööriä. **Tämä** oli Leenasta varsin huvittavaa.

... 'The clown-SUBJ made fun of the juggler-OBJ practicing next to the [animal] cage. **This** was rather amusing, in Leena's opinion.'