



Original Articles

Direct speech quotations promote low relative-clause attachment in silent reading of English

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ABSTRACT

The implicit prosody hypothesis (Fodor, 1998, 2002) proposes that silent reading coincides with a default, implicit form of prosody to facilitate sentence processing. Recent research demonstrated that a more vivid form of implicit prosody is mentally simulated during silent reading of direct speech quotations (e.g., *Mary said, "This dress is beautiful"*), with neural and behavioural consequences (e.g., Yao, Belin, & Scheepers, 2011; Yao & Scheepers, 2011). Here, we explored the relation between 'default' and 'simulated' implicit prosody in the context of relative-clause (RC) attachment in English. Apart from confirming a general low RC-attachment preference in both production (Experiment 1) and comprehension (Experiments 2 and 3), we found that during written sentence completion (Experiment 1) or when reading silently (Experiment 2), the low RC-attachment preference was reliably enhanced when the critical sentences were embedded in direct speech quotations as compared to indirect speech or narrative sentences. However, when reading aloud (Experiment 3), direct speech did not enhance the general low RC-attachment preference. The results from Experiments 1 and 2 suggest a *quantitative boost* to implicit prosody (via auditory perceptual simulation) during silent production/comprehension of direct speech. By contrast, when reading aloud (Experiment 3), prosody becomes *equally salient* across conditions due to its explicit nature; indirect speech and narrative sentences thus become as susceptible to prosody-induced syntactic biases as direct speech. The present findings suggest a shared cognitive basis between default implicit prosody and simulated implicit prosody, providing a new platform for studying the effects of implicit prosody on sentence processing.

1. Introduction

The implicit prosody hypothesis (IPH) proposes that a default, implicit form of prosody (e.g., speech intonation, stresses, rhythms) is mentally activated during silent reading of written text (Fodor, 1998, 2002). Research shows that such implicit prosody can bias syntactic attachment interpretation in structurally ambiguous sentences. For example, in a sentence like "*Someone shot the servant of the actress who was on the balcony*", the relative clause (RC) "*who was on the balcony*" can be attached either *high* to the complex noun phrase "*the servant of the actress*" (NP1) or *low* to the more recent noun phrase "*the actress*" (NP2). English native speakers typically prefer the low attachment interpretation when reading such sentences (e.g., Carreiras & Clifton, 1993, 1999). Implicit prosody is *assumed* to bias RC-attachment interpretation because the latter is influenced by prosodic features such as pitch accents (Maynell, 1999; Quinn, Abdelghany, & Fodor, 2000) and prosodic boundaries (Clifton, Carlson, & Frazier, 2002; Lovrić, Bradley, & Fodor, 2000, 2001) when sentences are overtly spoken. However, the

effect of implicit prosody on RC-attachment has not yet been studied in the context of quotations.

New research suggests that implicit prosody may be enhanced during silent reading of direct speech quotations (e.g., *Mary said: "The dress is beautiful"*) as compared to indirect speech sentences (e.g., *Mary said that the dress was beautiful*). Most notably, enhanced implicit prosody becomes evident in higher activation of temporal voice areas in the auditory cortex (Yao, Belin, & Scheepers, 2011, 2012; see also Belin, Zatorre, Lafaille, Ahad, & Pike, 2000). Moreover, implied speech rates of quoted speakers were shown to influence the speed of silent reading, but only in direct speech quotations (e.g., Stites, Luke, & Christianson, 2013; Yao & Scheepers, 2011). This more enhanced implicit prosody may rely on audible speech-like representations that are mentally *simulated* (Barsalou, 1999) specifically during silent reading of direct speech quotations. Little is known, however, about the precise relationship between mentally 'simulated' implicit prosody (SIP) in direct speech and Fodor et al.'s 'default' implicit prosody (DIP) which is assumed to be activated regardless of pragmatic reporting style (direct

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speech, indirect speech, or narrative).

Theoretically, DIP and SIP may entail distinct cognitive processes. DIP is routinely projected onto written stimuli during silent reading. It adds a constant channel of information to aid parsing, especially when syntactic or semantic disambiguation cues are unavailable. In contrast, SIP is a speech-like experience that is highly dependent on linguistic context and pragmatics. It allows readers to mentally re-enact *how* a described protagonist spoke. These differences, however, do not necessarily rule out a common underlying cognitive basis for DIP and SIP. Acoustic properties of DIP and SIP are both correlated with that of explicit prosody in speech (Lovrić et al., 2000, 2001; Yao & Scheepers, 2011, 2015), indicating the involvement of similar mental representations. Yao and Scheepers (2015) therefore conjectured that SIP may be an enriched form of DIP. They proposed to embed ambiguous RC-attachment structures in direct speech quotations so as to examine whether attachment preferences during silent reading of such structures would be ‘enhanced’ when compared to those in meaning-equivalent narrative sentences (Yao & Scheepers, 2015, p. 301). The absence of such an enhancing influence of direct speech (vs. narrative) on attachment preferences would suggest that DIP and SIP are cognitively distinct.

The present studies tested this hypothesis. English RC-attachment structures were embedded in direct speech, indirect speech or narrative sentences. Participants either completed sentence fragments ending in incomplete RCs (Experiment 1) or rated the felicity of unambiguous low vs. high RC-attachments in silent reading (Experiment 2) and in oral reading (Experiment 3), respectively. Given the general low RC-attachment bias in English, we expected that this bias should be more pronounced for direct speech quotations than for indirect speech or narrative sentences in Experiment 1 (sentence completion). For Experiment 2 (comprehension), we predicted, apart from a general low-attachment preference, a more pronounced felicity difference between low vs. high RC-attachments in the direct speech condition than in the indirect speech or narrative condition. By contrast, we expected no such enhancement of the low RC-attachment bias in direct speech under oral reading instructions (Experiment 3). This is because oral reading activates *explicit* prosody, which should enhance the salience of prosody (and in turn, its influence on syntactic preferences) *equally* across the three conditions. Thus, we only expected an overall low RC-attachment preference (regardless of reporting style) in Experiment 3.

2. Experiment 1

Participants in all three experiments gave written consent and the experimental procedures were approved by the Research Ethics Committee at the University of Manchester.

2.1. Participants

Fifty-four native English speakers (mean age 23 years, $SD = 6.9$, 41 females) from the University of Manchester participated in exchange for £2. The experiment took about 15 min.

2.2. Materials and design

Twenty-four sets of written scenarios were created (Appendix A). Each set contained a common background sentence to set up a scenario. This was followed by a critical sentence that was either a direct speech (DS), an indirect speech (IS), or a narrative sentence (NS). Each critical sentence contained a matched target sentence fragment (underscored in Table 1). The fragment consisted of a subject noun phrase followed by a verb and a complex object noun phrase with a prepositional-phrase modifier. The fragments ended in a relative pronoun (*that* or *who*), prompting the generation of a sentence-final relative clause that could either attach *low* to the most recent noun-phrase (NP2, *the church*) or *high* to the whole preceding object noun-phrase (NP1, *the bells of the*

Table 1
Example stimuli for Experiment 1 and 2.

Experiment 1		
<i>Frank and his friends were visiting some lovely places on their trip to Germany last year.</i>		
DS		<i>He told the group: “I really liked the bells of the church that ...</i>
IS		<i>He told the group that he really liked the bells of the church that ...</i>
NS		<i>It seemed that he really liked the bells of the church that ...</i>
Experiments 2 and 3		
<i>Frank and his friends were visiting some lovely places on their trip to Germany last year.</i>		
DS	LA	<i>He told the group: “I really liked the bells of the church that was right next to the town hall.”</i>
	HA	<i>He told the group: “I really liked the bells of the church that were chiming every hour.”</i>
IS	LA	<i>He told the group that he really liked the bells of the church that was right next to the town hall.</i>
	HA	<i>He told the group that he really liked the bells of the church that were chiming every hour.</i>
NS	LA	<i>It seemed that he really liked the bells of the church that was right next to the town hall.</i>
	HA	<i>It seemed that he really liked the bells of the church that were chiming every hour.</i>

DS = direct speech; IS = indirect speech; NS = narrative sentence; LA = low attachment; HA = high attachment.

church). The critical host noun-phrases were either both animate or both inanimate and differed in number such that NP1 was plural in half of the items and singular in the other half. Contrasting number marking in this way aided later response scoring; e.g., in “the bells of the church that was beautiful” and “the bells of the church that were beautiful”, relative-clause attachment was determined by assessing whether the RC-verb was singular or plural. The reading materials were allotted to three stimulus lists, counterbalanced using a Latin square (6 stories per condition per list). The order of the stories was pseudo-randomised for each list. Each list was assigned to 18 participants.

2.3. Procedure

The RC completions were collected using pen and paper. Participants read written instructions and practised on an example trial. The stimuli were printed on A4 sheets. Each story was printed in two or three lines. The target sentence fragment was always presented in a single line to prevent structural biases via line breaks. The fragment ended in an underscored blank space “_”, prompting participants to complete the fragment. There was no time limit to the task.

2.4. Results

2.4.1. Response coding

Responses were independently coded by two condition-blind annotators. Target completions were coded as low attachment (LA), high attachment (HA) or unclassifiable (UC). The classification was based on the number of the verb (singular or plural) in the completed RC and/or on plausibility criteria (e.g., “the bells of the church that stood near the town hall” was coded as LA, and “the bells of the church that chimed every hour” was coded as HA). Ambiguous and controversial completions were coded as UC, which also included ungrammatical responses or responses that did not result in a RC. Cross-tabulation of response codes indicated ‘strong’ inter-coder agreement (82%, expected agreement *by chance*: 41%, *Cohen’s Kappa* = 0.687, $p < .001$). Cases of disagreement were re-inspected and discussed to determine a final classification. The distribution of the final classifications is summarised in Table 2.

2.4.2. Analysis

Generalised Linear Mixed Models (GLMMs) were fitted using the *glmer* function in R. We dummy-coded the three conditions into two

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