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## Frequency and working memory effects in incidental learning of a complex agreement pattern

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### Abstract

Complex grammatical structures have been assumed to be best learned implicitly (Krashen, 1982, 1994; Reber, 1989). However, research to date has failed to support this view, instead finding that explicit training has overarching beneficial effects. The present study attempted to elucidate this issue by examining how type and token frequencies in incidental learning input and individual differences in the learner's working memory (WM) combine to affect the receptive and productive learning of a complex agreement pattern in a novel language. The findings indicated that type frequency significantly enhanced receptive knowledge acquisition even more than explicit instruction. Performance on the productive knowledge retrieval task was poor under all learning conditions but most accurate under the explicit learning condition. WM was not implicated in incidental learning, possibly indicating that all learners experience high cognitive demand imposed by the target structure regardless of variation in WM capacity.

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### 1. Introduction

A subject of long-standing debate has been whether a complex grammatical pattern can be more successfully learned under implicit (Krashen, 1982, 1994; Reber, 1989) rather than explicit learning conditions (Hulstijn and de Graaff, 1994). To date, extensive second language acquisition (SLA) research has determined that explicit training/classroom instruction is generally more beneficial than implicit training for learning a complex structure in L2 (DeKeyser, 1995; Ellis, 1993; Norris and Ortega, 2000; Robinson, 1996; Spada and Tomita, 2010). However, it may be that it is the combined effects of multiple factors that trigger successful knowledge acquisition in incidental learning contexts, a facet we currently know little about. Importantly, with regard to considering incidental learning, Hulstijn (2005) highlighted that it is essential to understand the interactions among the following factors rather than studying each factor in isolation: “(1) the complexity of the system underlying the data; (2) the frequency with which the linguistic structures are presented to the learners in the input; and (3) learners’ individual differences with respect to knowledge, skills, and information processing” (p. 133).

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The linguistic complexity of the structure is often associated with cognitive complexity or learning difficulty (DeKeyser, 2005; Housen, 2014; Marsden et al., 2013), which is affected in turn by individual differences in cognitive abilities, including working memory (WM) capacity variability (Grey et al., 2015; Juffs and Harrington, 2011; Tagarelli et al., 2016). In addition, it has been posited that the complexity of a linguistic structure interacts with its input-related properties, such as the frequency of the occurrence of the structure in the input, making it more or less accessible for acquisition (Housen and Simoens, 2016). Hence, frequency may mediate adult incidental learning by creating a more or a less effective learning context. For L1 acquisition of complex morphologies, type and token frequencies are known to be vital (Tomasello, 2000, 2008). The present study thus attempts to understand the effects of type and token frequencies on adult acquisition of a complex L2 pattern and the extent to which the manipulation of type and token frequencies in the incidental learning condition impacts the effectiveness of learning such a structure. In particular, this paper focuses on the acquisition of a complex noun–adjective agreement pattern in a richly inflected language (Russian) by adult novice learners (who are speakers of an L1 with a less rich morphology) in terms of comprehension and production modalities. Further, this paper examines how individual differences in learners' WM mediate this acquisition under different learning conditions.

L2 morphology is known to be one of the major stumbling blocks for the novice adult learner, particularly if the learner's L1 does not share the feature to be acquired in L2 (DeKeyser, 2005; Larsen-Freeman, 2010). Although numerous studies have examined the acquisition of inflectional morphology (Brooks et al., 2011; Kempe et al., 2010; Kempe and MacWhinney, 1998), few have devoted attention to its incidental acquisition (Brooks and Kempe, 2013; Rogers et al., 2015), and to our knowledge, no studies have explored the combined effect of frequency and WM during the incidental learning of such complex systems.

## 2. Background

### 2.1. Definition of terminology

First, it is important to introduce the applicable terminology. Although the terms incidental learning and implicit learning are used interchangeably in the literature, implicit learning is typically understood as a process of acquiring a target structure without intention and awareness that results in the accumulation of implicit knowledge (Williams, 2009). By contrast, explicit learning is a process during which the learner is consciously involved in the processing of the stimulus input. The term incidental learning is used to denote the experimental condition in which the learner is directed to the meaning rather than to the grammatical structure of interest and is not informed regarding any testing to follow (Rebuschat and Williams, 2012). Accordingly, learning under such conditions may or may not result in implicit knowledge. The present paper does not address the issue of conscious/unconscious knowledge developed under these conditions. Sometimes, the notion of the "implicit learning condition" is used to refer to a similar experimental paradigm (Morgan-Short et al., 2010, 2012). In the present study, we follow Rebuschat and Williams (2012) and adopt the definition of incidental learning as a training condition. In contrast, we use the term explicit learning condition to refer to a condition where knowledge acquisition is fostered by providing metalinguistic information about the target structure (Spada and Tomita, 2010; Robinson, 1996).

We begin the paper by reviewing the literature on the incidental learning of complex structures, frequency and WM. We then present and discuss our investigation of the incidental learning of a number agreement pattern in a novel natural and fusional language (Russian) that simultaneously marks gender and case.

### 2.2. Acquisition of complex grammatical patterns under incidental learning conditions

Various studies have employed different understandings of complexity, including pedagogical, linguistic and psycholinguistic complexities (Collings et al., 2009; see Spada and Tomita, 2010 for meta-analysis). Most commonly, however, research has adopted the absolute or the relative approach to defining the complexity of language structure. The present study utilizes the absolute (Dahl, 2004; McWhorter, 2001, 2007) or structural approach (Bulté and Housen, 2012; Miestamo, 2008; Pallotti, 2015), which asserts that the more parts a system has, the more complex it is. Based on this definition, a morphological pattern similar to the subject of the present study, which has inflectional markers signalling agreement based on number, gender and case, would be considered complex as opposed to a morphological pattern that factors in only one of these features. The relative approach (Kusters, 2003), in contrast, defines complexity in terms of processing costs and difficulty for language users, predicting that linguistically complex structures also demand that more cognitive resources be expended by the learner.

DeKeyser (2005) further distinguishes formal structural complexity, which emphasizes the complexity of the form, such as the number of forms in a paradigm, and suggests – consistent with the taxonomic model of L2 complexity (Bulté and

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