

The Effect of Deductive and Inductive Learning Strategies on Language Acquisition

Helen Motha

ANR 966189

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Communication and Information Sciences

Faculty Humanities

Tilburg University, Tilburg

Supervisor: Dr. A. Alishahi

Second Reader: G. Chrupala

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Abstract

The relative merits of implicit and explicit approaches to language instruction have been extensively debated in past research into second language acquisition. Considerable attention has been given to the distinction between inductive and deductive explicit teaching strategies, although studies comparing these remain inconclusive. The present study used an online language tool to examine the effect of deductive and inductive explicit learning strategies on the learning of case-marking in Polish. Participants' response times and accuracy in comprehension and production tasks were used to assess levels of language acquisition using both learning strategies. A sample of 90 participants of mixed age and linguistic backgrounds was used in a mixed experimental design. Overall, little difference was found between participants in the two learning conditions. Response times differed little between the two conditions, with the greatest effect being found in levels of accuracy. This study substantiates earlier studies that show little overall difference in the effectiveness of deductive and inductive methods but highlights how linguistic background should be taken into account when designing language learning methods.

1. Introduction

Learning a second language is a hobby for some and a necessity for others. Opinions on the right approach to learning a language differ as widely as the languages themselves. Independent self-study is a crucial task for any language learner but is often complemented by formal language instruction as part of a study programme. De Graaff and Housen (2009) define second language instruction as “any deliberate attempt to promote language learning by manipulating the mechanisms of learning and/or conditions under which these operate” (p.726). They contrast the interventionist position, those who believe that L2 instruction can have a positive impact on L2 learning, with the non-interventionist view, according to which L2 instruction can have no effect on the rate or manner of L2 acquisition. This paper assumes the former viewpoint, that studying language instruction may help instructors identify the best approach for achieving more effective and faster progression in their students.

There are a number of dimensions across which the approach to second language acquisition can be analysed. The theoretical analysis of existing knowledge below aims to provide a well-informed model of the best approach to a given learning task. It also seeks to highlight existing gaps in the literature and those aspects which remain unclear.

1.1. Implicit and Explicit Learning

Whilst the approach taken by individual language students may differ widely, they all share a common goal of achieving full linguistic proficiency in the target language. Most scholars agree that such proficiency is attained when sufficient implicit knowledge has been acquired (Ellis, 2006). Implicit knowledge is a kind of unconscious skill that enables us to comprehend and produce the target language without conscious effort. In contrast, explicit

knowledge has its basis in some conscious understanding that can be articulated by the student.

The role of implicit and explicit language instruction in the acquisition of both forms of knowledge has been researched and discussed to a great extent historically. Implicit techniques tend to adopt a naturalistic approach to language acquisition and rely to a greater degree on associative forms of learning (DeKeyser, 2005). Explicit methods encompass a wide-range of approaches but all focus on raising-awareness of some grammatical feature, typically involving some form of rule-learning (Ellis, 2010). Whether the acquisition of sufficient implicit knowledge required for full language proficiency can be achieved by means of explicit instruction has been much disputed and has led some scholars to question the effectiveness of formal language instruction. Proponents of the naturalistic teaching methods, such as Krashen (1993), are the most critical of explicit language teaching. According to his input hypothesis, explicit teaching methods can never lead to the acquisition of implicit knowledge and therefore cannot help the learner to achieve second language proficiency. He argues that implicit knowledge can solely be acquired through sufficient exposure to and comprehension of the target language without conscious effort being made to acquire an explicit understanding of the grammar. Similarly, some critics of grammar-oriented instruction believe that learners are unable to apply their explicit knowledge when engaged in real-time communication (Hwu & Sun, 2012).

In contrast to this stand the weak and strong interface hypotheses (Ellis, 2010). These differ in the respect whether implicit and explicit knowledge are viewed as being the same or different kinds of knowledge. Ellis argues for the weak interface hypothesis, in which explicit and implicit knowledge are considered distinct entities and therefore the former cannot possibly be converted into knowledge of the implicit kind. However, this hypothesis does acknowledge that explicit knowledge may facilitate implicit knowledge (Ellis, 2010). For

example, explicit teaching can raise awareness of non-salient features in the target language, prompting the learner to induce their own set of grammar rules and effectively priming them for the acquisition of implicit knowledge (R.Ellis, 1990, 1994, 1997, cited in de Graaff & Housen, 2009). The key here is the idea that explicit knowledge functions as an awareness-raising device. It draws the learner's attention to non-salient linguistic forms, which they might otherwise overlook by making these more noticeable (Ellis, 2010). This is related to Schmidt's (1994) 'Noticing the gap' hypothesis, according to which heightened awareness of the grammatical feature prompts the learner to compare their own inter-language, i.e. their cognitive representation of the L2, with the target language itself. Explicit understanding may therefore be used by the learner in order to accelerate his implicit learning. Hwu and Sun (2012) indicate that findings from numerous psychological studies imply that "prior knowledge influences future learning, that is, those who know more learn better" (p. 507).

The strong interface hypothesis differs from the weak interface hypothesis in respect to its notion of implicit and explicit knowledge. According to this view, implicit and explicit knowledge are considered as opposite ends of a single continuum and therefore explicit knowledge may be converted to implicit knowledge through a process of automatization given sufficient practice. This belief underpins the traditional classroom approach of present-practice-produce (PPP) that assumes declarative knowledge can be converted into procedural knowledge by a process of proceduralisation (DeKeyser, 1998). From this perspective some have argued, rather than try to teach implicit knowledge directly, it is better to present the learner with explicit knowledge in order to equip them with the means to practice the language. In doing so, explicit knowledge can be converted into implicit by a process of proceduralisation.

1.2. Form vs. meaning-focused instruction

Whilst there remains debate over the influence of instruction on the processing and subsequent acquisition of the target language, general consensus exists among interventionists that instruction does indeed benefit the learner to the degree that it can be said to be “effective in its own right” (Norris & Ortega, 2000, p.480). Given the above is true, remaining questions relate primarily to the appropriate form of instruction. Modern instructional approaches can be divided into one of two categories; meaning-focused and form-focused instruction. Form-focused instruction (FFI) encompasses a variety of different approaches, all of which have the emphasis of attention being given to language form, typically grammatical and phonological features, rather than meaning alone (de Graaff & Housen, 2009). Traditional teaching of L2 grammar rules, where grammatical features are isolated from the context or communicative activity, are included in this approach, also known as Focus-on-Forms (FonFs) (De Graaff & Housen, 2009). Having become evident that despite several months or years of teaching most learners under FFI fail to achieve any form of communicative competence, meaning-focused instruction has more recently gained in popularity. Meaning-focus instruction aims for the development of communicative-competence and, as the name implies, stresses the importance of grasping meaning in comprehension and production, rather than achieving linguistic accuracy. This typically takes the form of language immersion programmes.

Formal evaluation of the effectiveness of the two approaches has been inconclusive. However there is evidence that, despite helping the learner to become skilled in their receptive capability, a meaning-focused approach fails to result in a comparable improvement in productive skills (de Graaff & Housen, 2009). Another argument mentioned by de Graaff and Housen is that a focus on communicative content alone detracts attention from lexical and grammatical forms, at the cost of linguistic accuracy. Despite helping students acquire

communicative competence, it has repeatedly been shown that naturalistic teaching has failed to provide students with a high level of grammatical competence. If achieving linguistic accuracy is regarded as desirable goal then there is evidence that FFI may be particularly useful and therefore, some focus-on-form component should be incorporated (Lightbown & Spada, 1990, R.Ellis, 2005 as cited in de Graaff & Housen, 2009). This view is also endorsed by DeKeyser's (2003) literature review where he argues that "a considerable amount of work suggests a positive role for some kind of attention to form..."(p.321). As the meaning-focused and form-focused instruction target different aspects of language acquisition, the best instructional procedure is generally considered one that incorporates elements of both approaches.

However, one should point out that instruction procedures are frequently labelled as the most effective without further specification for whom and for what goal (de Graaff and Housen, 2009). There is a need to define for which learner and what purpose the given instruction is effective and this requires other factors to be taken into account. De Graaff and Housen (2009) argue that effective instruction should be context-oriented, i.e. it is goal-, learner-, and resource-appropriate. Understanding the context requires us to understand the issues involved between the learner and target language. Among the five factors that DeKeyser (2005) identifies as interacting in the learning process are the characteristics of the target language and learner; these are discussed in greater detail below.

1.3. Characteristics of the Learner

Instruction should be appropriate for the learning tendencies and individual aptitudes of the group of learners. It is crucial to consider the age of the learner as there appear to be major differences in learning aptitudes between age groups. As we see with bilingual child learners, children are capable of achieving perfect grammatical competence in an L2 with purely passive, i.e. implicit, exposure. There appear to be developmental patterns that affect

the cognitive functioning of a child once it reaches adolescence and continue into adulthood which inhibit the ability for implicit learning (Doughty, 2003 cited in De Graaff & Housen, 2009). Why children have the stronger cognitive capability to learn an L2 implicitly is unclear but this does affect our consideration of the appropriate form of instruction for the target group. The implication is that adults must rely on their analytic abilities and benefit from teaching that enables them to draw on their explicit learning skills (DeKeyser, 2003). This may initially appear to be a great disadvantage for adult learner. However, adults may be capable of harnessing their superior analytic ability and exploit explicit instruction in order to speed up the process of L2 acquisition quite rapidly. Children acquire knowledge implicitly with greater ease and ultimately achieve a higher level of naturalistic competence but this takes place over a considerable period of time. In contrast, adults can quite quickly gain an explicit understanding of the structure at hand and apply it in practice almost immediately, albeit with conscious effort. In practical terms this means a meaning-focused instruction or simple passive exposure may be best suited for teaching young children, whereas a focus on form component should be included in the teaching of adults as it provides them with the means to exploit their existing skill-set.

1.4. Characteristics of the Target Structure

In addition to being tailored to a specific learner group, aspects of the target language will also influence the learning process. Although learner needs vary enormously depending on their pre-existing knowledge and L1 but there are tendencies in the learning process regardless of the learner background, that help us identify linguistic features best suited to instruction. Obviously, those features that present the average learner with the greatest difficulty are the best candidates for instruction. Ellis (2006) distinguishes between two senses of the term difficulty. It can be the trouble learners have in grasping a specific grammatical structure or alternatively, the way in which they struggle to internalise a feature

to the degree necessary for accurate use in production. Carefully targeted language teaching can help overcome both forms of difficulty. The first aspect is discussed below and the second in section 1.5.

The difficulty of understanding a specific grammatical structure can be overcome by helping learners to gain insight into the form-meaning relationship, identified by DeKeyser (2005) as the core difficulty of acquisition. He argues this is especially true of features such as articles, classifiers and grammatical gender. These features pose a particular challenge to L2 learners because they all “express highly abstract notions that are extremely hard to infer, implicitly or explicitly, from the input” (p.5). Such features are extremely resistant to instruction and tend to suffer from a lack of transparency when establishing the form-meaning relationship.

One reason for the lack of transparency is that these features are typically the components of language involved in morphological transformation. Morphology is highlighted by DeKeyser (2005) as an aspect of language learning which many otherwise communicatively-competent learners persistently have problems with. Similarly, Schwartz (1993, cited in Nahavandi & Mukundan) singles out inflectional endings as one of the most difficult features for adult learners, who master these “with the highest amount of variability and lowest degree of success” (p.160). DeKeyser strongly suggests that morphological accuracy can be improved through intensive training. He argues that this should draw the learner’s attention to morphological cues which give insight into sentence meaning and are often overlooked. The reason being is that there is evidence that the learner draws on different cognitive skills when establishing form-meaning mappings. When the learner is trying to learn abstract patterns, such as is the case in L2 morphology, building form-meaning mappings draws on insight rather than memory (DeKeyser, 2005). Therefore, an explicit focus-on-forms approach appears to be particularly well-suited for learning of morphology

because it raises a consciousness in the learner, not induced through implicit instruction (DeKeyser, 2003).

In this instance, the linguistic background of the learner should also be taken into account. The form-meaning relationship in an L2 is especially difficult to grasp if an equivalent grammatical concept is absent from the mother tongue. Therefore, L1 speakers of a morphologically poor language typically have the greatest problems with such morphological transformations. The concept of case-marking endings commonly found in many Slavic languages and German may be difficult for native English speakers to comprehend. This has practical implications in a classroom setting, where students are often from a wide range of linguistic backgrounds and are likely to struggle with different aspects of the L2 being taught. Nevertheless, the importance of L1 should not be overstated. There is evidence that other individual factors affect L2 acquisition, such as individual cognitive aptitude. For example, a study by Rast (2010) examined the role of input on the variation in performance among adult learners at the earliest stages of learning. She found that the performance of a group of L2 learners who shared a common L1 and were exposed to the same input in the target language differed widely. Her conclusion was that L2 learners do not solely rely on knowledge of their mother tongue when processing input in the L2 and forming their inter-language. Instead she suggests that they use a combination of knowledge stores, for example, their skills in other foreign languages. This implies that individual aptitudes are often a more dominant influence than L1 on the difficulty encountered with linguistic features. The upside of this is that there may be a cross-lingual approach, i.e. one that is optimised for speakers of different languages, although it remains unclear how this could be adapted to the different cognitive aptitudes of individual learners, such as memory. In summary, designing an approach that caters to diversity in characteristics and skills of different learners presents some challenges.

There is also a danger in assuming all grammatical structures are equally suited for explicit teaching. There is evidence that specific target structures are processed differently and therefore, explicit instruction has varying degrees of success. This is substantiated by VanPatten and Borst's (2012) study which established that explicit instruction is effective in the learning of German accusative case-markers. They contrast this to the findings of an earlier study by VanPatten & Cadierno (1993), which discovered that explicit instruction was relatively ineffective in the learning of Spanish clitic object pronouns. They explain this by the fact that German case-marking involves mapping a one-to-one correspondence that may be easy to process during real-time comprehension in contrast to the more complex clitic object pronouns structures in Spanish. This suggests that explicit instruction may be best suited to teaching information that is simple enough for the learner to process in real-time comprehension.

1.5. The Problem of Internalisation

There is a second form of difficulty that Ellis defines: the problem of internalisation, necessary for achieving accuracy in production. Proponents of weak and strong interface hypotheses may differ in their idea of how language is internalised but this does not mean that they disagree completely on the means for achieving this goal. Proponents of the strong interface hypothesis would advocate intensive grammar practice in order to internalise the feature through proceduralisation. Weak-interface supporters may also advocate intensive practice as a consciousness-raising device, making the grammatical feature to be more accessible for the learner in a communicative context where it becomes internalised. Ellis (2006) argues for intensive grammar teaching if it complements more communicative-based tasks. He says that, even if the students may appear to have not immediately acquired the structure in subsequent productive tasks, it may help them to progress more rapidly through the stages that are necessary for the acquisition of that feature. Existing literature fails

however to distinguish between different forms of internalisation. For example, it is unclear whether explicit teaching improves language production, comprehension or both.

To summarise the above, there is substantial evidence that explicit teaching methods in L2 instruction are to be favoured over an implicit learning approach. This is especially true where linguistic accuracy is desired and a FFI component in instruction appears to be necessary in order to achieve this. The instructional design should also be modelled to suit the needs of the learner. It should target aspects of the L2 with which learners have the greatest difficulty but also convey knowledge that is simple enough to be accessible in real-time communication. Explicit teaching is particularly well-suited to adult learners, who can draw on their analytical skills. Research suggests that learners tend to have greatest difficulty with specific grammatical aspects, such as morphological transformation, especially if these are not present in the learner's L1. The difficulty lies not only with the comprehension of such linguistic features but also with their internalisation. Therefore, intensive practice can help such features to be internalised, either through a process of proceduralisation or as a consciousness-raising device.

1.6. Deductive and Inductive Approaches

A wide variety of approaches fall under the rubric of explicit teaching but these may be broadly sub-categorised as either inductive or deductive approaches. If explicit teaching is understood as a process of rule-learning, one can differentiate between methods that achieve this 'deductively, i.e. when learners are presented with the rule, or 'inductively', i.e. when learners are asked to detect the rules themselves from an example text (Ellis, 2010). More specifically Ellis explains that 'deductive explicit instruction involves providing learners with explicit information about a grammatical feature. Inductive explicit instruction provides learners with the data and guidance that they need to derive their own understanding of the grammatical feature' (p.4). Traditional approaches to grammar teaching have used deductive

methods, whereby the student is presented with the rule, which the student subsequently has to practice and re-produce.

The recent trend has been towards an inductive approach, wherein the learner is typically required to search for the rule themselves and demands a higher level of learner autonomy. Whilst comparisons between implicit and explicit methods show a clear advantage for explicit teaching (Norris & Ortega, 2000), studies examining the effectiveness of deductive and inductive methods have been more ambivalent. Szkolne (2005) argues that inductive teaching should be preferred because it requires learners to participate in the process of knowledge construction. Toth et al (2012) quote van Lier (2008) arguing that true learning ‘depends on the activity and initiative of the learner, more so than any “inputs”...transmitted to the learner by teacher or textbook’ (p.162). Ellis (2010) argues that inductive methods, especially those implemented in the form of consciousness-raising (CR) tasks, are sometimes more effective than deductive ones. He cites Bourke’s (1996) observation that they ‘cater to the natural tendency of learners (especially adults) to want to try to work things out, they encourage learners to deal with uncertainty, and they encourage learner autonomy’ (p.18). It is argued that such a proactive approach has the advantage of prompting a deeper level of processing, resulting in the target structure being retained more effectively in memory. This was the case in Herron and Tomasello’s (1992) study which compared a traditional deductive with a Guided Induction approach in the teaching of ten French grammatical structures to 26 university students with a basic level of French. In the deductive condition the written rule was presented to the students and then practised in an oral drill. In the inductive condition the teacher began with the oral drill, prompting students to induce their own hypothesis of the rule, before a sentence completion activity provided students with feedback. Levels of retention were tested one day and one week after instruction by means of a fill-in-the-blanks written test. Their results showed that the

proportion of students with correct answers was higher in the inductive condition than in the deductive condition for nine of ten grammar structures in the immediate test and seven of the ten grammar structures in the test carried out a week later. Therefore, the mean proportion of correct answers was higher in the Guided Induction condition than deductive condition and the grammar rules were retained better in the inductive condition than in the deductive condition overall. Herron and Tomasello attribute the success of the inductive methods to the fact that they allow the opportunity for students to engage in active linguistic hypothesis testing and emphasize the importance of immediate feedback for the effectiveness of student learning.

There are disadvantages however to greater learner autonomy. Szkolne (2005) points out that when engaging in an autonomous self-discovery of rules, learners may reach the incorrect conclusion and when both time and the learner's knowledge are limited, a deductive approach may be more suitable. Van Patten and Borst (2012) also suggest that providing the student with an explicit explanation prior to a language task, enables them to process the input accurately much faster than if such information is withheld. This may be especially true of less linguistically capable students. According to Robinson (1997) learning conditions place different cognitive demands on the learners, therefore variation in individual aptitudes in grammatical sensitivity and memory will result in variation in performance amongst learners. This view was substantiated in a longitudinal study by Hwu and Sun (2012), which did not find significant differences between deductive and inductive approaches on performance but did find an interaction between learner characteristics and instructional conditions. Their study included a number of language aptitude measures, such as memory and grammatical sensitivity, and explored the relationship between these and the instructional approach. Participants included 93 native English speaking university students who had recently begun learning Spanish. Participants were first required to complete an online

training session teaching the Spanish verb construction of 'gustar'. They were then tested on their acquisition of the verb construction at three later stages by means of written sentence production and correction tasks. Hwu and Sun categorised students into high-aptitude and low-aptitude groups based on their memory-for-text scores. They found that high-aptitude learners in the explicit inductive learning condition performed better in the second and third post-tests than high-aptitude learners in the deductive condition (in the first post-test, scores were almost identical). Among low-aptitude students, learners in the deductive condition did slightly better in all three post-tests than those in the explicit induction condition, but not significantly so. This suggests that deductive methods may help compensate for a lack of grammatical understanding among lower-aptitude students but higher-aptitude students benefit from a greater accessibility of knowledge in memory, a product of the inductive learning process. Hwu and Sun conclude that the appropriate combination of learner characteristics and instructional conditions must be found if a statistically significant differential effect between instructional approaches is sought.

1.7. Computer-based Studies

A small number of studies have also compared inductive and deductive techniques using computer-based tools. Evidence in support of deductive methods was provided by a computer-based study by AbuSeileek (2009), which compared the effect of computer-based vs. non-computer based type learning with deductive vs. inductive teaching methods on performance in sentence recognition and production tasks among L2 learners of English. AbuSeileek suggests that there is an interaction between complexity of the target grammar structure and learning method. His findings rule strongly in favour of deductive training in the case of complicated grammar structures, whereas evidence regarding the learning of simple and compound sentences was inconclusive. Like Ellis (2006) and Corder (1988), he

determines that the two techniques are not mutually exclusive and perhaps a differentiated approach using both is best.

Another recent computer-based study by Nahavandi and Mukundan (2013) implemented inductive and deductive techniques in the form of textual input enhancement (TIE) and explicit rule presentation. TIE is where the target feature in the input is highlighted in some manner to make the structure more salient. Participants were Iranian undergraduates attending an English course and the English simple past tense was used as the target grammar structure. Performance in multiple-choice recognition tasks was measured in two post-tests, one day and two weeks after instruction. They found that TIE proved a useful attention-increasing device, however, TIE combined with explicit rule presentation, i.e. the deductive condition, led to even higher levels of retention of the target form and this group performed significantly better than the control group in both post-tests.

Both AbuSeileek (2009) and Nahavandi and Mukundan (2013) highlight the usefulness of computer-based language learning. E-learning is becoming increasingly sophisticated and has several advantages over classroom teaching in certain respects. Virtual applications are easily tailored to suit individual needs – learners can progress at their own pace and choose to focus on those aspects with which they have the greatest difficulty. Computer-based tools can substitute grammar practice drills in the classroom, giving teachers more time in the classroom to focus on communicative aspects, such as pronunciation. Online language tools are widely accessible to learners and can provide feedback in a form that textbooks cannot. Online language tools are no substitute for face-to-face language teaching but they do provide a useful tool for the learner to practice what they have learnt in the classroom. They enable students to focus on and improve those areas with which they have the greatest difficulty. From both a strong and weak interface perspective, online tools could be invaluable for helping students accelerate and focus their language acquisition.

1.8. Summary of Theoretical Background and Research Questions

In summary, results regarding the effectiveness of inductive vs. deductive strategies remain inconclusive. This is further complicated by the fact that inductive and deductive approaches have been implemented in different ways, making a comparison between studies difficult. Although several of the above studies have found an interaction between inductive vs. deductive techniques, learner characteristics and complexity of the target structure, the practical implications of these are difficult to implement. A one-size-fits-all solution is perhaps unrealistic and devising a scale against which to measure the complexity of grammatical structures and abilities of individual students is hard to do, even if a tailored approach was possible. Therefore, a pragmatic approach is perhaps one that exploits universal tendencies. Despite variation in individual aptitudes, many learners have difficulties with specific grammatical aspects in common.

Furthermore, previous studies have failed to explore how inductive and deductive techniques compare on the dimensions of comprehension and production performance. This is crucial as it may present a way of providing an optimum differentiated approach using both methods. For example, inductive methods may prove more valuable for accurate production, whilst deductive methods result in better grammar comprehension. This presents us with the following research questions:

1. In a present-practice-produce sequence, are deductive and inductive training strategies equally effective in terms of language acquisition?
2. Does the training strategy affect performance in a production task compared with performance in comprehension task? Namely, are some learning strategies more effective for comprehension than for production and vice versa?

Based on the above theoretical framework, inductive learning strategies are expected to be more effective overall because they require more active engagement and a deeper-level of cognitive processing on part of the student. The inductive learning condition prompts the learner to actively search for the pattern in the example sentences and form a linguistic hypothesis. The pattern is therefore more effectively retained in memory. In the deductive approach, the learner simply needs to map the rule presented on to the given examples. The consequence of this is that the deductive learner can quickly and accurately understand the rule during the training phase but, because they have not engaged at a deeper cognitive level by working out the rule for themselves, will struggle to retain and apply this knowledge in the test phase. Therefore, learners in the inductive condition will demonstrate a better level of language acquisition than those in the deductive condition. This paper seeks to answer the above research questions by testing the following hypotheses:

1. Inductive explicit learning strategies are significantly more effective in overall language acquisition than deductive learning strategies when both accuracy and reaction times are taken into account. This will be reflected by:
 - significantly higher overall accuracy in the inductive condition than in the deductive condition.
 - significantly lower overall reaction times in the inductive condition than in the deductive condition.
2. Inductive learning strategies result in significantly higher levels of language acquisition in comprehension and production than deductive learning strategies. This will be reflected by:
 - significantly higher accuracy in production and comprehension in the inductive condition than in the deductive condition.
 - significantly lower reaction times in comprehension and production in the inductive condition than in the deductive condition.

2. Methodology

2.1. Participants

Participants in the study were visitors to an online language tool and ranged from 18 to 66 years of age. Data from a total of 90 participants was used in the analysis. Sixty-four of these were female and 26 were male. The majority of participants were either native English speakers (54 participants) or native Dutch speakers (13 participants), with the rest coming from a variety of linguistic backgrounds shown in Figure 1 below. Some participants were monolinguals whilst others were bi- or poly-lingual, but all had some understanding of English in order to follow the instructions. All participants who were native Polish speakers or who had studied Polish were excluded from the analysis. This was in order to avoid participants having prior knowledge of the target grammar which could act as a confounding variable. One disadvantage of an online study is that the participant characteristics and their reliability cannot be controlled for. Due to this inherent unreliability, the research relied on obtaining a sufficiently large sample size (> 80) in order to be able to draw reliable conclusions from the data that can be applied to a wider population.

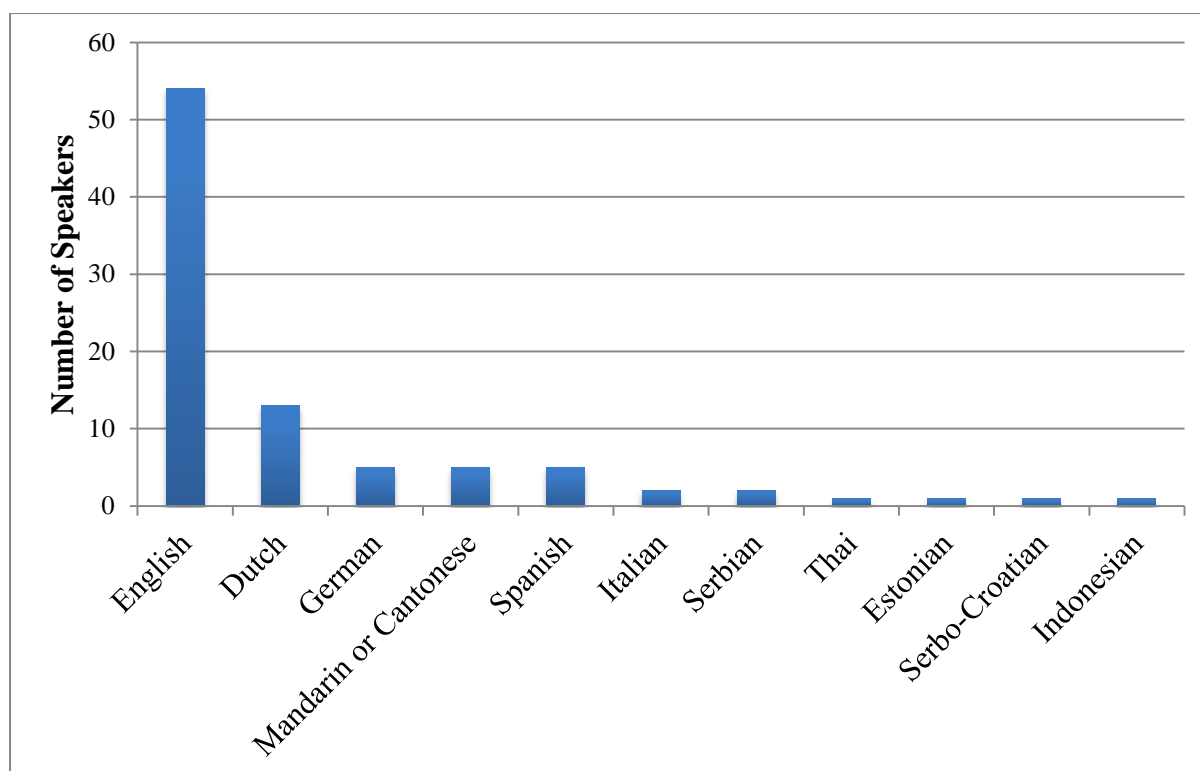


Figure 1. Native Languages of Participants

2.2. Design

The experiment involved a mixed design with a between-subject condition in the learning phase and a within-subject condition in the test phase. In the learning phase, participants were assigned to one of two levels: the inductive or deductive learning condition. In the test phase, participants' responses were measured on both comprehension and production tasks. The order of the training and test slides was randomised to exclude order effects. An overview of the groups is shown in Table 1 below. There was no control group.

Table 1
Training and Test Groups.

Training Condition (between-subject)	Deductive		Inductive	
Test Condition (within-subject)	Comprehension	Production	Comprehension	Production
Group	1		2	

The dependent variables aimed to measure the understanding of the target feature acquired by participants during the training phase and were calculated using the

measurements of performance recorded in the test phase. Level of accuracy, based on the error rate, was chosen as the first dependent variable. Accuracy scores equated to the number of correct responses. A number of past studies have used response times as a general indicator of the cognitive processing load, with longer response times reflecting greater processing difficulty (MacIntyre & Gardner, 1994, Tabullo et al, 2012). Therefore, response times, equal to the total number of seconds spent on the test phase, were included as a second dependent variable. Total response times were also sub-divided into total time spent on comprehension and production tasks.

2.2.1. Target Structure

The target structure was case-marking of animate singular nouns in the Polish accusative case. For regular nouns, this involves a morphological transformation of word endings that marks a change from the nominative to the accusative case. This pattern was chosen because it is precisely the kind of morphological transformation with which L2 students have great difficulty but is necessary for achieving linguistic accuracy in highly-inflected languages. It is also difficult to acquire through meaning-focused instruction or naturalistic exposure in a communicative context alone. Accurate use of this feature involves the learning of a one-to-one correspondence and therefore is also a construct simple enough to be processed by the L2 speaker during real-time communication.

Table 2

Noun endings in the Nominative and Accusative Case for Animate Singular Nouns in Polish.

Noun gender	Animate male	Female	Inanimate masculine/ neuter
Nominative ending	No change	a	No change
Accusative ending	a	ę	No change

Table 2 gives an overview of the change in noun endings. The form of noun declension depends on the grammatical case of the noun; nouns being classed as either masculine, feminine or neuter in Polish. Nouns ending in ‘a’ in the nominative case are

marked in the accusative case by ending ‘ę’. These are typically feminine nouns but also include a few masculine nouns ending in ‘a’. Animate masculine nouns ending in a consonant in the nominative are marked in the accusative case by the addition of an ‘a’. Neuter nouns do not change. To give an example of feminine nominative-accusative case-marking:

Kobieta widzi dziecko (NOM) – The woman sees the child.

Dziecko widzi kobietę (ACC) – The child sees the woman.

‘*Dziecko*’ (child) is a neuter noun which, together with inanimate masculine nouns, are not marked in the accusative case in Polish. In the tool, the changing nouns were colour-coded according to gender to act as a visual aid and assist in pattern recognition. Word accents were omitted for the practical reason that most participants cannot type these, as well as for technical reasons. Admittedly, there are many irregular nouns whose accusative form cannot be explained by a generalised rule but the aim of this study was to identify a method for learning generalised rules for case-marking rather than learning exceptions.

Due to the case-marking system, word orders in Polish are much more flexible than in English and technically any word order is often permissible. However, the tool assumed a SVO word order in order to avoid confusing participants, especially in view of the fact that most participants were L1 speakers of a default SVO word order language, such as English or Dutch. To ensure clarity of meaning, sentences were accompanied by both an English translation and a visual illustration. In addition to providing meaning, these were also necessary for the test of grammaticality as sentences could be grammatically correct in Polish without reflecting the intended meaning.

2.3. Materials

Materials consisted of an online language tool that was accessed remotely by participants. The tool was designed to be user-friendly and excluded technical jargon so that it was suitable for users of any level of language training. A prototype of the tool was created

in PowerPoint and pre-tested on nine persons to assess the appropriate difficulty and quantity of slides. These persons did not participate in the online experiment. The exercise consisted of a series of twelve training and eight test slides in each condition. A small dictionary of the words and their English translation was included so that students could focus on the target structure rather than trying to grasp the sentence meaning.

The training slides included a small dictionary of words, brief instructions, the target sentences in Polish, the English translation and an illustration depicting the sentence meaning. An example of the training slides can be found in Appendix A. Training slides in each condition were identical apart from the instructions above the example sentences. In the deductive condition, a table explaining the pattern in the changing word endings was provided. In the inductive treatment, users were simply asked to look for the pattern in the changing word endings themselves. The target feature was textually enhanced through the use of colour in both training conditions so that the learner could identify the case-marked words and their gender immediately.

Test slides in each condition were identical and had a similar format to the training slides. However, words in the example sentences were not colour-coded so that participants were forced to recall the rules they had learnt in the training phase and apply these to the words in the dictionary when giving their answers. Test slides were evenly split between language comprehension and production tasks. Comprehension test slides involved a grammaticality judgement task where participants had to indicate whether the presented sentence was grammatically correct or incorrect based on the rules they had learnt in the training phase. Production test slides used a fill-in-the-gaps exercise requiring participants to complete an example sentence where the last word was missing.

2.4. Procedure

Data collection on the website took place over a period of three weeks. Participants logged on to first page of the website which gave the context of the study and explained that the language tool was divided into a training and test phase. This page was followed by two instructional pages, which explained for those participants unfamiliar with the concept of case-marking, the fact that in some languages the role of the word in the sentence is marked by a change in the word ending. In order to focus users on the grammar pattern, it was stressed that the aim of the exercise is not to try and remember the words, only the change in word endings.

Having begun the exercise, participants were randomly assigned to either the deductive or inductive learning treatment. They were presented with the target grammar structure on 12 training slides, which they could click through at their own pace. Subsequently, participants began the test phase comprised of four comprehension and four production questions. In the production task participants were asked to fill in the missing word at the end of a sentence. In the comprehension condition, participants had to tick a box indicating grammatical correctness of the sentence displayed (correct-incorrect). After the test, participants were asked to enter a few demographic details including age, gender and linguistic background, before they found out their score. Questions regarding linguistic background asked participants to list their native language, other languages spoken fluently and any other languages they had studied to any level.

2.5. Data Analysis

The data was cleaned using MS Excel so that only results from participants that had completed the entire experiment were retained. Statistical tests were carried out using SPSS version 21.

3. Results

The first MANOVA was used to test the first hypothesis that an inductive learning strategy is significant more effective than a deductive learning strategy when both accuracy and response times are taken into account. The descriptive statistics can be found in Table 3.

Table 1
Mean accuracy scores and response times in deductive and inductive learning conditions.

	Accuracy		Total Time		N
	M	SD	M	SD	
Deductive	5.42	2.50	140.88	46.27	33
Inductive	6.37	2.02	137.33	55.69	57
Total	6.02	2.24	138.63	52.195	90

The results revealed that the mean level of accuracy in the inductive condition ($M=6.37$, $SD=2.02$) was not significantly different from that in the deductive condition ($M=5.42$, $SD=2.50$) and therefore, there was no significant effect of learning condition on accuracy, $F(1, 88)=3.82$, $p=.054$. Similarly, the mean response time in the inductive condition ($M=137.33$, $SD=55.69$) was not significantly lower than in the deductive condition ($M=140.88$, $SD=46.27$), leading us to conclude there is not an effect of learning condition on response times, $F(1,88) = 0.095$, $p=.758$. Roy's largest root confirmed that there was not a significant effect of learning condition on mean accuracy and response times, $\Theta=.045$, $F(1,88)=1.94$, $p=.150$. These results lead us to reject our first hypothesis that inductive learning strategies are more effective than deductive learning strategies when both accuracy and reaction times are considered. The Kolmogorov-Smirnov test was significant for both dependent variables in each condition and z-scores indicated that both response times and accuracy was significantly skewed in the inductive condition. Therefore the assumption of a normal distribution within groups cannot be assumed and the results should be interpreted with caution.

A log transformation performed on total response times was able to correct for the deviation from a normal distribution, based on the Kolmogorov-Smirnov test. An independent t-test confirmed that the difference in mean total response times between the deductive and inductive learning conditions was not significant, $t(88)=0.52, p=.602$.

A further MANOVA analysis was performed on the untransformed data to test the second hypothesis that an inductive learning condition results in significantly lower response times and higher accuracy in comprehension and production tasks than a deductive learning condition. Descriptive statistics are given in Table 4.

Table 2
Mean accuracy scores and response times for comprehension and production tasks in deductive and inductive learning conditions.

		Accuracy		Total Time		
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>N</i>
Production	Deductive	2.52	1.42	77.21	26.88	33
	Inductive	3.00	1.28	78.05	40.37	57
	Total	2.82	1.34	77.74	35.85	90
Comprehension	Deductive	2.91	1.21	63.67	26.00	33
	Inductive	3.37	.94	59.28	25.59	57
	Total	3.20	1.06	60.89	25.68	90

Results showed that the mean response time on production tasks in the inductive condition ($M=78.05, SD=40.37$) did not significantly differ from that in the deductive condition ($M=77.21, SD=26.88$), $F(1,88)= 0.01, p=.915$. Mean response time in the inductive condition ($M=59.28, SD=25.59$) was also not significantly different from that in the deductive condition ($M=63.67, SD=26.00$) on comprehension tasks, $F(1,88)= 0.61, p=.438$.

Mean accuracy in production tasks was not significantly higher in the inductive condition ($M=3.00, SD=1.28$) than in the deductive condition ($M=2.52, SD=1.42$), $F(1,88)=2.77, p=.100$. However, the inductive condition ($M=3.37, SD=0.94$) did result in significantly higher accuracy on comprehension tasks than in the deductive condition

($M=2.91$, $SD=1.21$), $F(1,88)=4.04$, $p=.047$. This is illustrated in Figure 2 below. Using Roy's largest root, there was not a significant effect of learning condition on response times and accuracy in production and comprehension tasks, $\Theta=.06$, $F(1,88)=1.36$, $p=.254$.

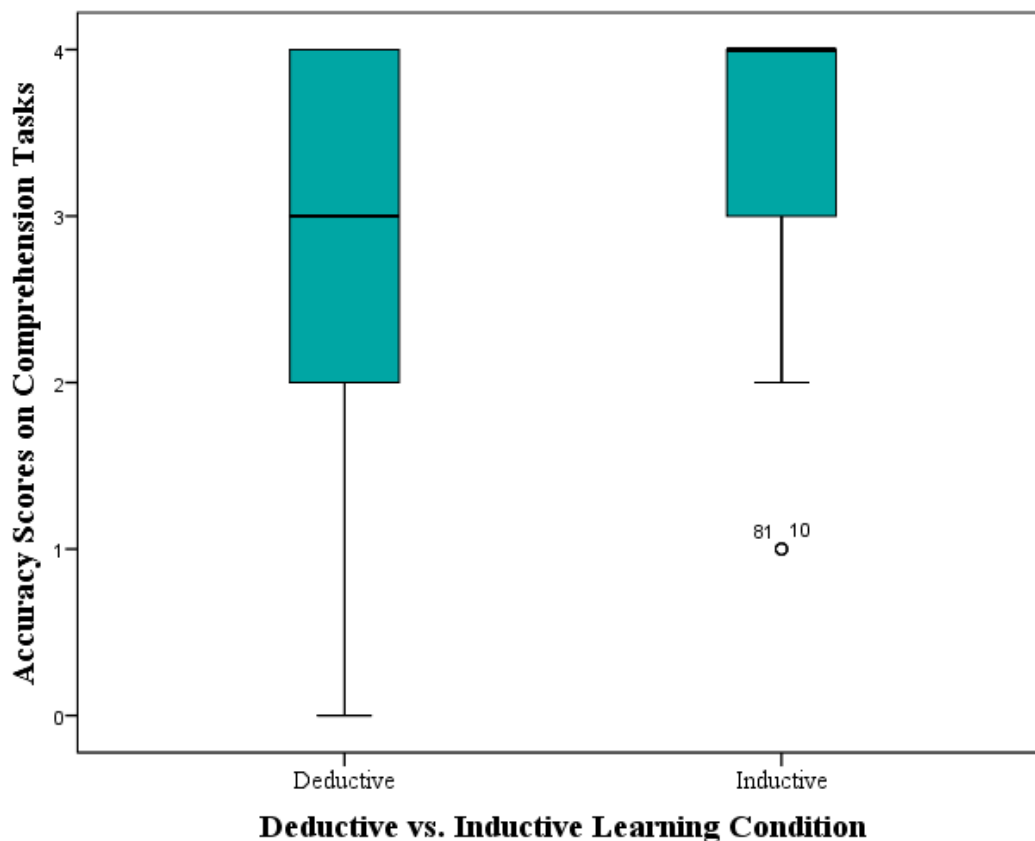


Figure 2. Accuracy on Comprehension Tasks in Inductive and Deductive Learning Conditions

Apart from response times in the deductive condition, the Kolmogorov-Smirnov tests were significant for all dependent variables. Therefore, multivariate normality cannot be assumed and Box's test of equality of covariance matrices was also significant; so these results should be interpreted with caution.

A log transformation performed on response times for comprehension and production tasks was able to correct for the deviation from a normal distribution, judged by the Kolmogorov-Smirnov test. Two independent t-tests confirmed that the difference in response times between the deductive and inductive learning conditions was not significant for comprehension tasks, $t(88)=0.81$, $p=.418$, nor for production tasks, $t(88)=0.20$, $p=.840$.

4. Discussion

In general, an inductive learning strategy does not appear to lead to lower response times in comprehension and production tasks than a deductive strategy. An inductive strategy did also not result in higher accuracy in production tasks than a deductive learning strategy, although it did lead to higher accuracy in comprehension tasks.

The above results suggest that learning strategy does not affect overall language acquisition in the study sample. This also appears true when one considers different measures of language acquisition, such as comprehension and production, although it was shown that learners are significantly more accurate on comprehension tasks in the inductive than deductive condition. These findings substantiate Hwu and Sun's (2012) conclusion that mode of instruction has little impact on learner performance.

5. Effect of the Learner's Linguistic Background

If learning condition has no significant effect on student performance, the question is whether another variable accounts for a significant systematic variation in responses? Hwu and Sun (2012) suggest learner characteristics may interact with instructional approaches and argue further research should seek to find out the sensitivity of different groups of learners to combinations of these. Different learning strategies entail different cognitive workloads and therefore a tailored solution may be best. Hwu and Sun propose measures of linguistic aptitude, such as memory for text, can be used to categorise learners into groups. However, such dimensions are difficult to assess and may not be a practical measure for defining groups in an everyday learning context. It has been shown that the linguistic background of the student can influence their experience of learning an L2. It is intuitive that the difficulty encountered in the study of an inflected language, such as Polish, depends on whether the student speaks or has previously studied a similarly inflected language. Those unfamiliar with noun declension marking case may struggle in the inductive condition to simultaneously grasp the concept of case-marking as well as detect the pattern within a short period of time. Therefore, this group may achieve higher accuracy in the deductive learning condition where the cognitive workload is reduced. In contrast, experienced learners of inflected languages may learn best by engaging in a process of active hypothesis testing (Herron & Tomasello, 1992) because they have an established understanding of a similar case system with which to compare and contrast. Based on the above, the following hypothesis was formulated and tested.

3. A deductive learning strategy will overall be more effective than an inductive one among learners without prior-knowledge of an inflected language. Within this group, the deductive condition will lead to higher rates of accuracy and lower response times. Conversely, learners with a

prior knowledge of inflected languages will perform significantly better in the inductive condition than in the deductive condition. In this group, the inductive condition will result in higher rates of accuracy and lower response times.

It should be noted here that almost all languages show some degree of inflection and therefore, classification of languages into an inflected and non-inflected categories is not clear-cut. This also raises the theoretical question of what exactly constitutes a case. For the purposes of this paper, all languages named by participants were classified as either inflected or non-inflected based on whether they show nominal morphological transformation akin to the kind found in Polish (for an overview see Appendix B). Spencer (2005) defines this ‘prototypical case system’ as one in which ‘nouns bear inflections which subserve various grammatical functions, such as the marking of subjects and objects’ (p.2). Accordingly, all Slavic languages, as well as Latin, Arabic, German, Greek (Ancient and Modern), Hungarian and Irish were categorised as inflected-languages in the analysis. Some languages with inflected forms, such as Hindi, were classified as non-inflected, as these forms arguably act as prepositional markers rather than as case-markers (Spencer, 2005).

5.1. Data Analysis

According to the above criteria, all participants were grouped into one of two classes according to their linguistic background: those with prior knowledge of an inflected language and those without. Both the reported L1 and L2 were used in this categorisation. For instance, if a participant reported being a native speaker or having studied a language such as German or Latin, they were grouped into the ‘inflected’ class; however, if a student neither spoke nor had studied a prototypical inflected language, then they were assigned to the non-inflected class.

6. Results

A MANOVA was used to investigate the main effects of linguistic background and learning condition, as well as the interaction effect. The descriptive statistics can be found in Table 5.

Table 5
Mean accuracy scores and response times for speakers of inflected and non-inflected languages in deductive and inductive learning conditions.

		Accuracy		Total Time		
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>N</i>
Deductive	Non-inflected	4.67	2.85	139.28	41.04	18
	Inflected	6.33	1.676	142.80	53.31	15
	Total	5.42	2.500	140.88	46.27	33
Inductive	Non-inflected	5.50	2.33	135.36	42.58	22
	Inflected	6.91	1.62	138.57	63.12	35
	Total	6.37	2.02	137.33	55.69	57
Total		6.02	2.24	138.63	52.20	90

No significant main effect of linguistic background, $F(1,86)=0.08$, $p=.775$, or learning condition, $F(1,86)=0.12$, $p=.730$, on mean response times was found. No significant main effect of learning condition was found on accuracy, $F(1,86)=2.31$, $p=.132$, although results do show a significant main effect of linguistic background on accuracy, $F(1,86)=10.96$, $p=.001$, illustrated in *Figure 3* below.

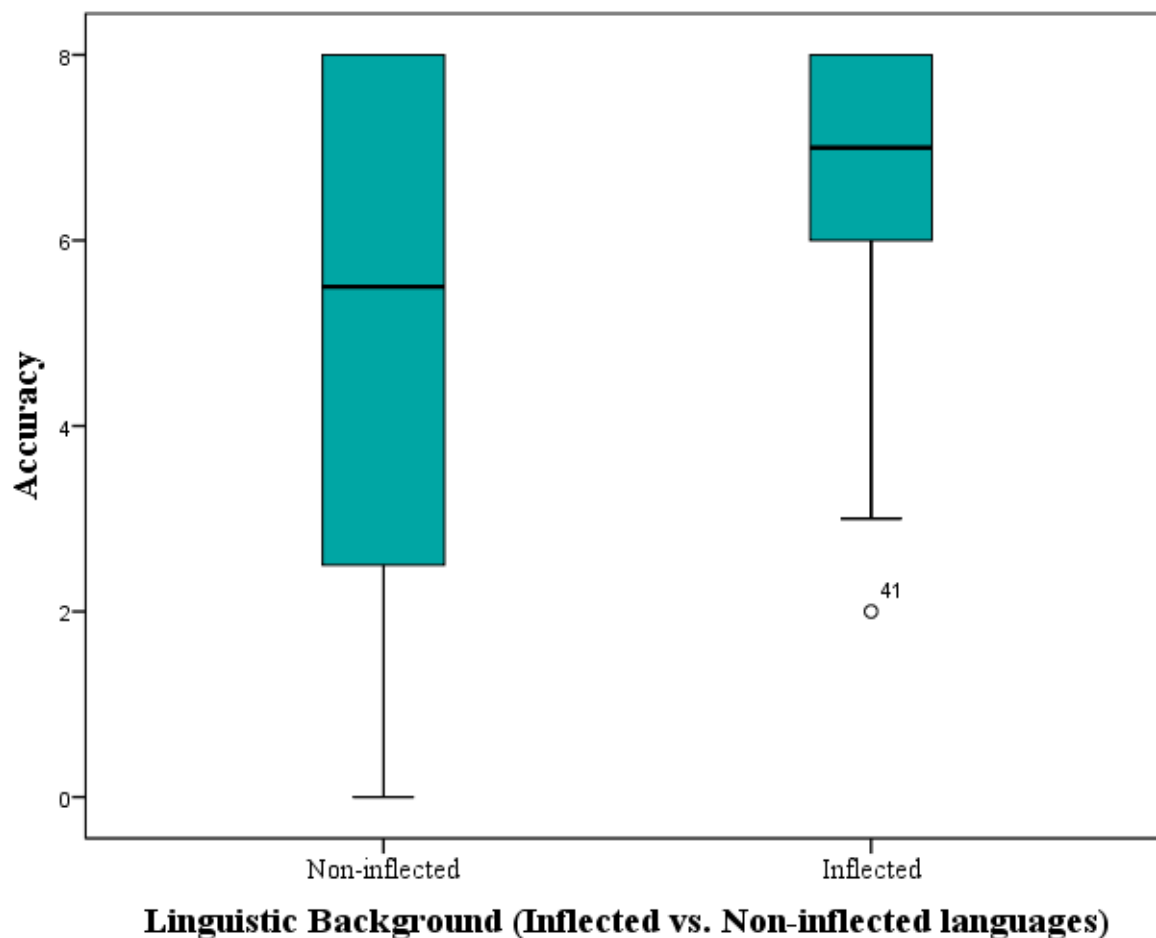


Figure 3. Accuracy among learners with inflected vs. non-inflected linguistic backgrounds

No significant interaction effect was found between linguistic background and learning treatment for mean response times, $F(1,86)=0.00$, $p=.989$, or for accuracy, $F(1,86)=0.07$, $p=.787$. The mean accuracy score was higher and the mean response time lower in the inductive condition, shown in *Figure 4* below. The Kolmogorov-Smirnov tests were significant for all dependent variables and Levene's test was significant for accuracy, therefore multivariate normality and homogeneity of variance cannot be assumed and the above results should be interpreted with caution.

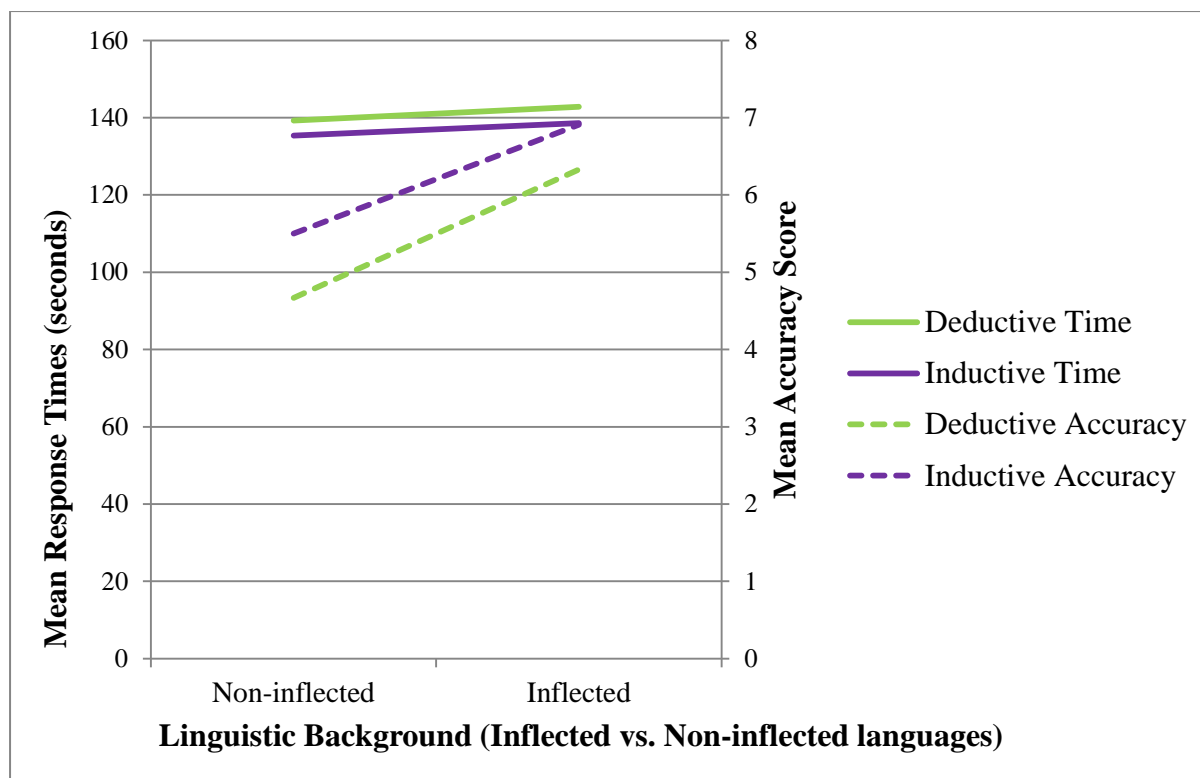


Figure 4. Mean Accuracy and Response Times among Participants of Different Linguistic Backgrounds

Two further MANOVAs confirmed that learning condition does not have a significant effect within groups of participants with similar linguistic backgrounds. Among speakers of non-inflected languages, there was no significant difference in mean accuracy, $F(1,38)=1.04$, $p=.315$, or mean response times, $F(1,38)=0.09$, $p=.770$, between those in the two learning treatments. Likewise, among speakers of inflected-languages, no significant effect was found on mean accuracy, $F(1,48)=1.33$, $p=.255$, nor on mean response times, $F(1,48)=0.05$, $p=.822$. The Kolmogorov-Smirnov test was significant for one or both dependent variables among both groups of speakers, therefore multivariate normality cannot be assumed and these results should be interpreted with caution.

To further investigate the significant effect of linguistic background on accuracy, one final MANOVA was performed comparing the effect of linguistic background on accuracy in production and comprehension tasks. This confirmed that linguistic background has a significant effect on both types of accuracy, although it appeared to have a stronger effect on

production tasks, $F(1,88)=9.87$, $p=.002$, than on comprehension tasks, $F(1,88)=12.21$, $p=.001$. Box's test was significant ($p=.026$) and according to the Kolmogorov-Smirnov test the assumption of multivariate normality was not met for both dependent variables, therefore the results should be interpreted with caution.

7. Discussion and Conclusion

The purpose of this study was to investigate the effectiveness of inductive and deductive explicit learning conditions on language retention in an online language tool. The advantages and disadvantages of deductive and inductive techniques have been widely discussed in the existing literature but findings of previous studies regarding the effectiveness of one over the other have been inconclusive. Previous research has also failed to distinguish between different measures of performance. This paper sought to clarify the effect of the two learning strategies on accuracy and response times in comprehension and production tasks. The case-marking of animate nouns in the Polish nominative and accusative case was used as the target structure in the tool, an example of the type of transformational morphological with which L2 learners of all abilities persistently struggle with.

The first two hypotheses predicted that inductive learning treatment would result in significantly better performance overall, as well as specifically comprehension and production tasks, than the deductive treatment. No support for these hypotheses was found, although significantly higher rates of accuracy on comprehension tasks was found in the inductive condition. A third hypothesis was formulated predicting that learners with a non-inflected linguistic background would perform better in the deductive than in inductive condition, whereas learners with prior knowledge of a similarly inflected language as Polish, would perform better with an inductive learning strategy than with a deductive one. No evidence was found to support this hypothesis as the results showed that both learning strategies were equally effective.

On the whole the results indicate that, learning strategy has little to no effect on accuracy or response times. This finding is consistent with that of the study by Hwu and Sun (2012), which found that learning performance was unaffected by learning condition. There also appears to be no interaction between the linguistic background of the learner, in this case

prior knowledge of an inflected-language, and learning treatment. No significant difference was found between those in different instructional conditions within the groups of inflected and non-inflected languages. Perhaps predictably, further analysis revealed that linguistic background has a significant effect on accuracy in both production and comprehension tasks. Response times differed little between-groups, even when accuracy scores differed significantly. This suggests that response times do not accurately reflect language difficulty and are perhaps a poor measure of language retention.

These findings conflict with those of Herron and Tomasello (1992) somewhat, who found significantly better performance among learners in the inductive condition. Reasons for the discrepancy may be the differences in target grammar and implementation of the learning strategies as well as teaching procedure (one was an online study, the other classroom-based). For example, Herron and Tomasello (1992) used 10 different grammar constructs in French, whereas this study was limited to case-marking in Polish. Nevertheless, in our results accuracy in the inductive condition was generally better than in the deductive condition, even if this difference was not significant. Response times were also lower in the inductive condition, suggesting either greater hesitation in the minds of learners in the deductive condition or greater clarity of understanding among those in the inductive treatment. It may be that some participants struggled to decode the rule table in the deductive treatment. In the pre-test, some participants expressed difficulty in understanding this and it was subsequently revised, however, if participants struggled to understand the table in training, they may have had difficulties recalling the rules in the test phase.

Potential confounding variables could be the uneven sample size in the two learning conditions and uncontrolled-for linguistic knowledge of participants. The participant pool was not gender-balanced, with far more female participants, and the sample was possibly non-random, as those with an interest for languages were far more inclined to participate.

Therefore, it is questionable whether the findings can be generalised to the wider population without further research that controls for these factors. This highlights one disadvantage of online studies – lack of control over the participant pool. The tool was designed for use by adults of all ages but some systematic variation between groups of adults of different ages may exist. Future online studies should aim to collect a large enough sample size so that results can be sub-divided into age groups and effects between age groups identified. The present study also only examined one type of grammar structure so different results may be found for other types of grammatical features. A further weakness of the present study was the fact that length of exposure of learners to the training material was very limited and only measures of short-term acquisition were taken. Perhaps a longitudinal study where training and testing takes place over an extended period of time could provide a more accurate assessment of language acquisition and long-term retention. The present study's findings also put the validity of response times as an indicator of language retention into doubt. This is particularly true of production tasks, where latency may be influenced by other factors such as typing speed, rather than language retention alone. Finally, there is the question of whether the learning conditions could be more effectively implemented. For example, whether participants in the deductive condition in the present study actually used the rule table or chose to ignore these is unclear.

The findings of this study have a number of theoretical as well as practical implications. It has been argued that explicit learning strategies are useful for achieving linguistic competence in communication, in particular with regards to grammatical accuracy. The distinction between inductive and deductive explicit approaches has traditionally been made in theoretical discussion by scholars. However, the present study's findings suggest that this distinction is of little significance and in practice teachers should be free to use both. Nevertheless, based on the present findings it can be argued that if a choice must be made

between the two, an inductive learning approach should be taken. The inductive training led to higher accuracy and lower response times overall, even if the discrepancy was not significant. It is unclear why inductive training should result in significantly better accuracy in comprehension than deductive training. One reason may be that learners find it easier to retain rules that they have inferred themselves rather than rules presented to them. This implies that an examples-to-rules approach may be more effective than a rules-to-examples approach for acquiring comprehension skills in an L2, although it is unclear why this was not the case in the production task. This study confirms the importance of taking the linguistic background of the learner into account when designing instructional strategy. Even if no interaction between learning strategy and linguistic background was found, the findings suggest that learners exploit their existing knowledge in acquiring an L2, possibly through a process of linguistic hypotheses testing. In the present study, participants with knowledge of a similarly-inflected language did this to achieve higher accuracy in rule-learning. The practical implications of this finding are difficult to apply in a classroom environment where the abilities and backgrounds of students are mixed. However, computer-based methods can easily be designed to assess learners' prior knowledge of grammatical features. For example, a computer-based tool can ask students to enter the languages they have studied, and adjust the training accordingly.

A further advantage of e-learning tools is that they provide the learner with immediate feedback. Ellis (2010) stresses the importance of corrective feedback in learning and Herron and Tomasello (1992) also underline the contribution of immediate feedback to the learning process. Therefore, future research would do well to examine the role of feedback in grammar learning. It could do so, for example, by incorporating an element of feedback into the testing procedure and assessing its effect on short and long-term language acquisition.

Feedback may play a crucial role in the process of linguistic hypothesis building; therefore, greater understanding of types of feedback may be very fruitful for language learning.

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Appendix A – Example Training Slides in the Inductive and Deductive Learning

Conditions

Dictionary

zaba	the frog
malpa	the monkey
swinia	the pig
krowa	the cow
kot	the cat
krolik	the rabbit
wielbad	the camel
pajak	the spider
dziecko	the child
kurzce	the chicken
piskle	the chick
kaczatko	the duckling
widzi	sees
kocha	loves

Try to identify the pattern in how the red (feminine), blue (masculine) and green (neutral) word endings change. These depend on whether the word is doing the action or the action is being done to it.



Kaczatko kocha krowę.

The duckling loves the cow.



Krowa kocha kaczatko.

The cow loves the duckling.

Next


Figure 5. Example of training slide in the inductive condition

Dictionary


- zaba *the frog*
- malpa *the monkey*
- swinia *the pig*
- krowa *the cow*
- kot *the cat*
- krolik *the rabbit*
- wielbad *the camel*
- pajak *the spider*
- dziecko *the child*
- kurzce *the chicken*
- piskle *the chick*
- kaczatko *the duckling*
- widzi *sees*
- kocha *loves*

Instructions: Read the sentences below. The table below explains how the endings of **masculine**, **feminine** and **neutral** words change. Try to remember this pattern.

Word Ending	Word Gender		
	Masculine	Feminine	Neutral
When the word is doing the action	No change	- a	No change
When the action is being done to the word	- a	- e	No change




Kurcze




krolika

The chicken loves the rabbit.



Krolik



kurcze

The rabbit loves the chicken.

Next

Figure 6. Example of training slide in the deductive condition

**Appendix B – Classification of Languages Spoken by Participants into Inflected
and Non-Inflected Categories**

Table 6

Classification of Languages listed by participants into inflected and non-inflected categories.

Ancient Greek	Inflected
Arabic	Inflected
ASL	Non-inflected
Chinese	Non-inflected
Dutch	Non-inflected
English	Non-inflected
Estonian	Inflected
Farsi	Non-inflected
Finnish	-
French	Non-inflected
Galician	-
German	Inflected
Ancient Greek	Inflected
Greek	Inflected
Hebrew	Non-inflected
Hindi	Non-inflected
Hungarian	Inflected
Indonesian	Non-inflected
Irish	Inflected
Italian	Non-inflected
Japanese	Non-inflected
Korean	-
Latin	Inflected
Old-Norse	Inflected
Persian	Non-inflected
Portuguese	Non-inflected
Russian	Inflected
Serbian	Inflected
Serbo-Croatian	Inflected
Spanish	Non-inflected
Swedish	-
Thai	Non-inflected
Turkish	-

Note. Languages with empty values were not used for classification of participants because speakers of these languages already spoke another inflected language and were therefore automatically categorised as inflected speakers.