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Gesture-based language learning – Can more learners learn more?

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Preface

Imagine walking into a school in an old brick building. As you walk through the hall your eyes are drawn to colourful artwork and inspiring quotes about the virtues of learning. This was my experience in Berlin in 2015 as I visited a class in preparation for teaching the following week. After finding the correct door and silently waving to the teacher, I slipped into a chair in the classroom where I met Hassan.[1] At first I didn't notice him. The classroom was calm. Children took turns reading aloud from their books about how female subway drivers in London like their jobs. Settling into observation, I noticed three children off to the side of the room sitting quietly with tired, blank expressions. Because they were on their own, I—undoubtedly influenced by my own experiences from primary school—assumed these children were being punished. Later, I discreetly asked the teacher why these three had not participated in reading. She explained that they had all come to Germany in the past two or three months and had never had English. In contrast, most children in her class had already had English instruction for several years, so it was hardly possible to teach everyone together. And the new children could probably use the extra break anyway.

The teacher also mentioned that one of the boys, Hassan, spoke very poorly and needed professional help beyond what the school could provide. Perhaps his family was still overwhelmed by their flight from Syria? In any case, the parents never followed through with any suggestions of help for their son. School would be over in a few weeks, after which the boy would be somewhere else anyway. I looked at her. Perhaps detecting my concern, she leaned forward and said: 'You wanted to teach using only gestures and English. If we notice that things don't work, I can always find another classroom for these children to be in.' In that moment, I don't think this teacher meant to challenge me, but as she spoke, she piqued my curiosity about what would happen.

1 All names in this thesis have been changed to protect the identity of the children and teachers.

Contents

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Abstract

Regardless of our birthplace, culture or language, the body plays a central role in our experiences. In order to understand language learning, it is thus crucial to consider not only aspects of language, but also to understand the interconnections between the brain, body and social interaction. Despite the fundamental role of gestures in human communication and classroom instruction, their impact on second language learning is poorly understood and has rarely been studied in naturalistic instructional settings like schools. Drawing on methods from psycholinguistics, English language teaching and ethnography, this thesis examines the social and cognitive processes that underlie gesture-based L2 learning.

In particular, the present work focuses on codified gestures as a teaching tool to support L2 fluency as well as spatial term and grammatical morpheme learning in diverse classrooms. It grapples with the following questions: (1) Can differences in L2 fluency development be observed when employing different teaching methodologies to teach the text of a play—specifically when using methods that employ a gesture for every morpheme of the text without learner access to the written text (CG), and methods that employ gestures for key sentences with learner access to the written text (SL)? (2) Can differences in L2 spatial term development be observed when employing different teaching methodologies to learn the text of a play—specifically when using methods that pair gestures with morphemes (CG), and when using those that pair gestures for key sentences (SL)? (3) When learning English morphosyntactic structures, do different gestures for the third person possessive {-s} and the plural marker {-s} systematically differ from gestures that do not show the specific {-s} meaning? The general methodological approach taken here is to teach learners the same text but to alter the learning process by combining the linguistic units of the text with different gestures. In this way, the effect of different gestures on the learning process can be examined independently of the linguistic forms used to facilitate it.

In the first study, L2 oral fluency development was investigated in the context of learning and performing a play. Subjects participated in a picture description task before and after taking part in a theatre project which involved learning the text of a play in a gesture per morpheme

(CG) or gesture per sentence (SL) condition. The aim was to compare changes in fluency development between learners. The results show that learning the same text with different instructional methods is associated with a different development in oral fluency. When instructional gestures differ in linguistic units, the initial fluency level of learners is predictive of which learning condition benefits fluency the most. In particular, learners with a lower initial speech rate benefited more from teaching using gestures that are paired with morphemes (CG), whereas the children with a higher initial speech rate benefited more from the condition with gestures at the sentence level (SL).

The second study also took place in the context of a theatre project but examined L2 spatial term learning. Subjects participated in a spatial term test before and after learning the text of a play in a CG or SL condition. The finding from experiment one—that learners with a lower initial ability benefited more from gestures that show morphemes (CG), and learners with a higher initial ability benefited more from gestures at the sentence level (SL)—was not replicated. Rather, in experiment two, learners exposed to the one gesture per morpheme condition (CG) showed a more rapid increase in spatial term comprehension and ability.

In a third study, subjects were asked to complete word fragments in phrases containing the plural and possessive {-s} in gesture form. The plural and possessive {-s} gestures were presented in both a two-gesture condition with distinct gestures for plural and possessive {-s} and a one gesture condition with a single general {-s} gesture to assess the differences between them. Compared with the single-gesture condition, fragment completion response time after training was found to be faster in the condition with two distinct gestures for plural and possessive {-s}. Notably, the gestures in the two gesture condition in study three were the same as those used in the CG condition in study one and two.

In summary, it could be shown that: (i) when instructional gestures differ in linguistic units, the initial fluency level of learners is predictive of which gesture type benefits fluency the most, and children with a lower initial speech rate benefit more from gestures that show morphemes; (ii) gains in understanding and using spatial terms are more immediate for learners exposed to one gesture per morpheme; (iii) seeing different grammatical morphemes for the plural and possessive {-s} in gesture form results in measurable differences in response time when compared to gestures without this distinction; and (iv) contrasting the same and different gestures for the plural and possessive {-s} grammatical morphemes revealed a decrease in response time after instruction for gestures that visually distinguish between grammatical morphemes which differ in meaning but sound the same. Overall, it was demonstrated that learners in this age group benefit from instructional gestures, where one gesture represents a sentence, word, or morpheme,

because they can support oral fluency. In the case of gestures at the level of morphology, gestures also help learners to internalize and apply L2 grammar. As a learning tool, gestures bring together our social, physical, and mental experiences. These findings add to the growing literature examining teaching gestures in naturalistic contexts and provide plausible reasons for greater inclusion of codified gestures in L2 instruction in diverse teaching settings.

Zusammenfassung

Unabhängig von unserem Geburtsort, unserer Kultur oder Sprache erfahren wir die Welt über unseren Körper. Um zu verstehen, wie Menschen Sprachen erlernen ist es wichtig, die Zusammenhänge zwischen Gehirn, Körper und sozialer Interaktion mit einzubeziehen. Obwohl Gesten in der menschlichen Kommunikation und im Unterricht eine grundlegende Rolle spielen, ist ihr Einfluss auf das Erlernen von Zweitsprachen nur wenig bekannt und wird nur selten in relevanten Unterrichtssituationen wie Schulen erforscht. Mit Hilfe von Methoden aus Psycholinguistik, Englischdidaktik und Ethnographie werden in dieser Arbeit die sozialen und kognitiven Prozesse untersucht, die dem gestenbasierten L2-Lernen zugrunde liegen.

Die vorliegende Arbeit konzentriert sich insbesondere auf kodifizierte Gesten als Methode, um den Redefluss zu verbessern und das Verständnis von räumlichen Begriffen und grammatikalischen Morphemen in heterogenen Klassen zu unterstützen. Folgende Fragen sollen beantwortet werden: (1) Können Unterschiede in der Verbesserung des Redeflusses beobachtet werden, wenn verschiedene gestenbasierte Methoden zum Erlernen eines Textes eingesetzt werden? Was passiert, bei der Verwendung einer Geste für jedes Morphem eines Textes ohne Zugang der Lernenden zum geschriebenen Text (codified gesture condition CG) im Gegensatz zu der Verwendung von Gesten für Schlüsselsätze mit Zugang der Lernenden zum geschriebenen Text (scenic learning condition SL)? (2) Lassen sich bei den oben genannten Methoden (CG und SL) Unterschiede in der Entwicklung räumlicher Begriffe in der L2 beobachten? (3) Unterscheiden sich beim Erlernen englischer morphosyntaktischer Strukturen syntaktisch spezifische Gesten (unterschiedliche Gesten für das Possessiv der dritten Person {-s} und den Pluralmarker {-s}) systematisch von syntaktisch allgemeinen Gesten (eine Geste für beide {-s})? Der allgemeine methodische Ansatz besteht darin, den Lernenden denselben Text beizubringen, aber den Lernprozess zu verändern, indem die sprachlichen Einheiten des Textes mit verschiedenen Gesten kombiniert werden. Auf diese Weise kann die Auswirkung der verschiedenen Gesten auf den Lernprozess unabhängig von den dafür verwendeten sprachlichen Formen untersucht werden.

In der ersten Studie wurde das Lernen und Aufführen eines Theaterstücks genutzt, um die Entwicklung der mündlichen Sprachkompetenz in der L2 zu untersuchen. Die Probanden bekamen

die Aufgabe ein Bild zu beschreiben, bevor und nachdem sie an einem Theaterprojekt teilnahmen, bei dem der Text des Stücks unter verschiedenen Bedingungen (CG oder SL) gelernt wurde. Ziel war es, zu vergleichen, wie sich die Sprechfertigkeit der Lernenden verändert. Wir fanden heraus, dass das Lernen desselben Textes mit unterschiedlichen Unterrichtsmethoden mit einer unterschiedlichen Entwicklung der Sprechfertigkeit verbunden ist. Bei den hier genutzten Gesten, ist das anfängliche Sprachniveau der Lernenden ausschlaggebend dafür, welcher Gesten-Typ den größten Nutzen hat. Insbesondere Lernende mit einer niedrigeren anfänglichen Sprechgeschwindigkeit profitierten mehr vom Unterricht mit Gesten auf Morphem Ebene (CG), während Kinder mit einer höheren anfänglichen Sprechgeschwindigkeit mehr von Gesten auf der Satzebene (SL) profitierten.

Die zweite Studie fand ebenfalls im Rahmen eines Theaterprojekts statt und untersuchte das Lernen von räumlichen Begriffen. Das Ergebnis des ersten Versuchs, bei dem das anfängliche Sprachniveau der Lernenden ausschlaggebend für den Nutzen des Gesten-Typs war, konnte nicht repliziert werden. Alle Lernenden aus der CG Gruppe (eine Geste pro Morphem) haben unmittelbar an räumlichem Begriffsverständnis und -kompetenz gewonnen.

In einer dritten Studie wurden die Probanden gebeten, Wortfragmente in Phrasen zu vervollständigen, die den Plural und das Possessivum {-s} in Gestenform enthielten. Die Plural- und Possessivgesten wurden sowohl mit unterschiedlichen Gesten für Plural und Possessiv {-s} als auch mit einer einzigen allgemeinen {-s}-Geste dargeboten, um die Unterschiede zwischen den beiden Bedingungen zu bewerten. Wenn zwei verschiedene Gesten für Plural und Possessivum {-s} benutzt wurden, war die Reaktionszeit für die Vervollständigung von Fragmenten im Test kürzer, als wenn eine allgemeine Geste gezeigt wurde. Bemerkenswert ist, dass hier dieselben Gesten Verwendung fanden, wie in den CG Gruppen von Studie 1 und 2.

Zusammenfassend konnte folgendes gezeigt werden: (i) Wenn Lehrgesten unterschiedliche sprachliche Einheiten repräsentieren, dann ist das anfängliche Sprachniveau der Lernenden ein Indikator dafür, welcher Gesten-Typ den größten Nutzen für den Redefluss hat. Kinder mit einer niedrigeren anfänglichen Sprechgeschwindigkeit profitieren mehr von einer Geste pro Morphem. (ii) Die Lernenden, die eine Geste pro Morphem zu sehen bekommen, lernen schneller, räumliche Begriffe zu verstehen und zu verwenden. (iii) Es gab Hinweise darauf, dass das Sehen verschiedener Gesten für grammatikalische Morpheme (Plural und das Possessivum {-s}) zu messbaren Unterschieden in der Reaktionszeit im Vergleich zu Gesten ohne diese Unterscheidung führt. (iv) Bei Gesten für grammatische Morpheme mit unterschiedlicher Bedeutung, aber gleichem Klang führte eine Unterscheidung der Gesten für Plural und Possessivum {-s} im Gegensatz zu einer einheitlichen Geste zu einer Verringerung der Reaktionszeit im Test nach der

Lehrintervention. Insgesamt konnte gezeigt werden, dass Lernende in dieser Altersgruppe von Gesten profitieren können, bei denen eine Geste einen Satz, ein Wort oder ein Morphem repräsentiert, da sie den Redefluss unterstützen. Im Falle von Gesten auf der Ebene der Morphologie helfen Gesten den Lernenden auch dabei, die Grammatik zu verinnerlichen und anzuwenden. Als Lernwerkzeug bringen Gesten unsere sozialen, körperlichen und geistigen Erfahrungen zusammen. Diese Ergebnisse ergänzen die wachsende Anzahl von Fachpublikationen die sich mit dem Unterrichten mit Gesten in realen Kontexten beschäftigen, und bringen plausible Gründen für eine stärkere Einbeziehung kodifizierter Gesten in den L2-Unterricht in vielfältigen Unterrichtssituationen vor.

List of Publications

Parts of this thesis have been published in peer-reviewed journals:

1) **Janzen Ulbricht, N.** (2018). An experiment on gesture and fluency in two German schools. ELT Journal, 72(3), 309–318.
DOI: https://doi.org/10.1093/elt/ccx059
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2) **Janzen Ulbricht, N.** (2020). The embodied teaching of spatial terms: Gestures mapped to morphemes improve learning. Frontiers in Education, 5(109), 1–13.
DOI: https://doi.org/10.3389/feduc.2020.00109
The published version of this chapter is reproduced in Chapter 2.2 of the thesis.

3) **Janzen Ulbricht, N.** (2023). Can grammatical morphemes be taught? Evidence of gestures influencing second language procedural learning in middle childhood. PLOS ONE, 18(2), e0280543.
DOI: https://doi.org/10.1371/journal.pone.0280543
The published version of this chapter is reproduced in Chapter 2.3 of the thesis.

Other selected additional articles published in peer-reviewed journals, as chapters in edited books, or in peer-reviewed academic blogs based on the doctoral thesis topic:

4) Biswas, T., & **Janzen Ulbricht, N.** (2020, December 20). The narrative in-between spaces of pedagogical research. The Critical Childhoods and Youth Studies Collective (CCYSC) Blog [Academic Blog]. DOI: https://www.theccysc.com/post/the-narrative-in-between-spaces-of-pedagogical-research

5) **Janzen Ulbricht, N.** (2018). The Role of Music and Theater as Classroom Glue: An experienced teacher navigates chaos and group cohesion. In M. Sambanis & H. Böttger (Eds.), Focus on Evidence II Netzwerke zwischen Fremdsprachendidaktik und Neurowissenschaften (pp. 199–205). Narr Francke Attempto.

6) **Janzen Ulbricht, N.** (2020a). Learning a play through codified gestures: Cat and Dog write a letter. Grundschulmagazin Englisch, 3, 11–14.

7) **Janzen Ulbricht, N.** (2022a). Ein Theaterexperiment oder ein Experiment im Theater? In Göksel, Eva [Hrsg.] & Giebert, Stefanie [Hrsg.] (Eds.), Drama in Education Days 2020 (pp. 118–133). pedocs. DOI: https://doi.org/10.25656/01:25295

8) **Janzen Ulbricht, N.** (2022b). Teaching tool codified gestures - Can more people learn more? Experiences with the Earth Speakr app from digital teacher training. Scenario: A Journal of Performative Teaching, Learning, Research, 21–40. DOI: https://doi.org/10.33178/scenario.16.2.2

9) **Janzen Ulbricht, N.** (2020b, December 3). Boasblog - Observing the narrative in-between space of research in schools during lockdown. Boasblog Fieldwork Meets Crisis. DOI: https://boasblogs.org/fieldworkmeetscrisis/schools-during-lockdown/

10) **Janzen Ulbricht, N.**, & Kruger, M. (2023). A theatre experiment: A research paradigm with applications for second language learning? Cogent Arts & Humanities, 10(1), 2204625. DOI: https://doi.org/10.1080/23311983.2023.2204625

11) **Janzen Ulbricht, N.**, & Michalak, M. (2019). Codified Gestures, Curiosity and Group Cohesion in the Foreign Language Classroom. In C. Haase & N. Orlova (Eds.), English Language Teaching Through the Lens of Experience (pp. 207–222). Cambridge Scholars Publishing.

12) **Janzen Ulbricht, N.**, & Spindler, B. (2022). A dentist to the rescue. In M. Sambanis & C. Ludwig (Eds.), English and beyond: Impulse zur Förderung von Mehrsprachigkeit im Englischunterricht (pp. 41–45). Brigg Verlag. DOI: http://dx.doi.org/10.17169/refubium-39474

13) **Janzen Ulbricht, N.**, & Uhl, O. (2020). Ein Theaterexperiment mit Gesten und Musik: Gemeinsam Englisch lernen in der sechsten Klasse. In C. Andrä & M. Macedonia (Eds.), Bewegtes Lernen—Ein Handbuch für Forschung und Praxis (Vol. 9, pp. 41–54). Lehmanns Media Berlin.

Abbreviations and Terminology

ADHD ..... attention deficit hyperactivity disorder
ANOVA ..... analysis of variance
CEFR ..... Common European Framework of Reference for Languages
CG ..... condition codified gesture condition or group
DGS ..... Deutsche Gebärdensprache/German sign language
DP ..... declarative/procedural model
ELT .....English language teaching
ERP ..... event related potential
ESL ..... English as a second language
fMRI ..... functional magnetic resonance imaging
GEL ..... grounded and embodied learning paradigm
GfCH ..... gesture-for-conceptualization hypothesis
GSF ..... gesture speeded fragment task
L1 ..... first language
L2 ..... second language
LBG.....lautsprachbegleitenden Gebärden
M ..... mean
MRC ..... mental representation of what is being communicated
OECD .....Organisation for Economic Co-operation and Development
RT ..... response time
SD ..... standard deviation
SEE .....Signing Exact English
SL .....scenic learning experimental condition or group
SL ..... sign language
SLA ..... second language acquisition

Terminology *précis*

The terms ‘first’, ‘second’, and ‘foreign language’ are used in applied linguistic and language teaching research. Following Stern (1983) ‘One could assume that as a language-conscious profession we had our own house in good order…. The ironic fact is that the terminology we need in language pedagogy is often ambiguous and sometimes downright confusing’ (p. 9). Some literature distinguishes between second and foreign language learning contexts (Bechler, 2014) while others combine them (Köylü & Tracy-Ventura, 2022). Beginning with the observation that the first signed or spoken language(s) learned can differ from languages learned later in life, Stern (1983) makes the following distinction:

L1	L2
first language	second language
native language	non-native language
mother tongue	foreign language
primary language	secondary language
stronger language	weaker language (p. 9)

In essence, the concept of a second language (L2) implies the prior availability of a first language (L1), which influences learning. The concept of an L2 does not specify if this additional language was learned informally at home, through private study or in a school classroom, but rather indicates that one language is acquired after another. This thesis recognises that an individual growing up in a multilingual environment can have multiple ‘first’ as well as ‘second languages’. In addition, referring to learning a ‘second language’ implies no value judgement about the language itself.

Reimer (2017) notes that the term L2 is used as a neutral term to refer to both ‘foreign language’ and ‘second language’ learning. However, she also explains that in German-speaking countries, the umbrella term ‘Fremdsprache’ (meaning ‘foreign language’) is frequently used for both meanings (p. 317). Some researchers prefer the term ‘development’ instead of ‘language acquisition’ or ‘language learning’ to clarify that language skills, can grow and decline and that language attrition is an equally relevant outcome of developmental processes (de Bot & Larsen-Freeman, 2011 p. 5-8). While this thesis values the above positions, especially given the context of migration and multilingualism, ‘second language learning’ will be used.

Chapter 1

General Introduction

Regardless of our birthplace, culture, or language, our bodies move as we participate in everyday life. While communicating with others, we move our hands, or gesture (Kendon, 2004; McNeill, 1992) and it is through the coordinated efforts of our movements and perceptions that we actively participate within our cultural and learning communities (Martin, 2021). Because this is so, and in order to understand language and language learning, it is crucial to not only understand structural aspects of language, but to also understand how the brain, body, and social interaction work together. Wulf (2023a) writes that modern life 'creates a need for new ways of examining different cultures' (p. 337) which include semiotic resources involved in cultures of learning (Wulf, 2011). Nevertheless, although gesture is a fundamental part of human communication and classroom instruction (Sambanis, 2013), the impact of gestures on L2 learning is rarely studied in naturalistic instructional settings (Wilks-Smith, 2022), and results seldom influence L2 teaching practice (Macedonia, 1999; Macedonia, 2020, p. 25).

The purpose of this dissertation is to contribute to understanding the social and cognitive processes underlying gesture-based L2 learning (Cook et al., 2008) with a focus on how teacher gestures may potentially influence oral fluency, spatial term, and grammatical morpheme learning. Teaching gestures may be useful when instructing linguistically diverse groups of students, because instructional gestures are not dependent on any particular L1. To this end, three experiments were conducted in order to investigate three research questions using two new experimental techniques. Accompanying these experiments ethnographic methods were used to provide additional context and depth to the findings.

The Introduction (Chapter 1) describes the object of study and the state of the art in gesture research relevant to English language teaching (ELT) from an interdisciplinary perspective. First, in

Section 1.1, I address the question of why gestures in the L2 classroom should be studied. This is followed, in Section 1.2, by a presentation of core concepts, definitions, and positions related to gesture-based L2 learning. This characterization at the theoretical and linguistic level enables us to understand and make predictions about the underpinnings of the phenomena in naturalistic settings such as the English language classroom. In Section 1.3 I explore existing literature and key findings related to L2 teaching gestures in naturalistic settings and demonstrate how the different academic disciplines of psycholinguistics, ELT, and ethnography can complement each other and contribute insight to the phenomenon of interest. Finally, in Section 1.4, I briefly outline the methodology to be applied in each study and more narrowly define the goals of this dissertation. The introductory chapter will be followed by Chapters 2, 3, and 4, each reporting individual studies on the effects of L2 gestures on learning.

This dissertation continues with a general discussion in Chapter 5. Section 5.1 summarizes the outcomes of each of the three studies, while Section 5.2 details their contributions to our understanding of L2 classroom learning and research. This section is followed by a discussion of the perspectives offered by this work and the limitations of the approach taken, culminating in the final conclusion in Section 5.3.

1.1 Why research gestures in the second language classroom?

Spontaneous gestures embody emotions, intentions, and thoughts, and are used across cultures to support communication and understanding (Ebert, 2024; Kendon, 2004; Liszkowski et al., 2012; McNeill, 1992; Tomasello, 1999). Gesture development predates language development and young children typically communicate using gestures before they are able to speak (Iverson & Goldin-Meadow, 2005; Rohlfing et al., 2017). Brain regions involved in semantic and syntactic processing are also relevant for gestures (Gunter & Weinbrenner, 2017; Holle et al., 2012; Wu & Coulson, 2007), and in instructional settings like the foreign or L2 classroom, gestures play an important role in learning (Kaschak & Glenberg, 2000; Nathan, 2021; Sambanis, 2013). However, in addition to using spontaneous gestures as a part of regular human communication, teachers can also intentionally plan and practice gesture use as a teaching tool (Alibali et al., 2013; Scrivener & Thornbury, 2012; Wilks-Smith, 2021; Yousefzadeh & Aghajanzadeh, 2017). This makes it possible for teachers to pair symbolic gestures with different units of language, such as sentences, words, or grammatical morphemes (Gullberg, 2013). Importantly, it is the potential of these deliberate gestures that are paired with L2 linguistic units for the purpose of learning a text that is the central focus of this thesis.

Although studied for their role in supporting verbal communication since ancient Roman times (Lapaire, 2019, p. 29), the empirical evidence demonstrating that gestures facilitate L2 learning lack specificity, particularly regarding how teachers should integrate gestures into their L2 teaching. Linguistic levels interact in complex ways. Hence, a considerable amount of the information used to determine meaning is not associated with any one individual lexical item (Knoeferle et al., 2010; Tomasello, 2023). It follows that the benefits of seeing instructional gestures may depend on the sentences, words or morphemes being used (Gullberg, 2013, p. 1872). Furthermore, how learners mentally represent conceptual information changes over the course of their lives (Pulvermüller, 2013), raising the question of whether experimental results from early childhood still apply later in life (Dick et al., 2012; Kelly, 2017). While at the word level there is widespread agreement that gestures support L2 word learning (Cook, 2018; Macedonia, 1999), on the whole, there is a dearth of research on the use of gestures as an L2 teaching tool in naturalistic instructional settings, despite the fact that they are widely employed (Eskildsen & Wagner, 2015; Wilks-Smith, 2022). In summary, in addition to a lack of research concerning the effect of gestures on syntax, there exists a noticeable gap on gestures studied 'in the wild' of the L2 classroom.

The acquisition of L2 grammatical knowledge is a fundamental part of formal education since without grammar, spoken or written words lose much of their ability to convey meaning. While content words, such as *baby* or *sleep*, express object and relation categories, grammatical morphemes represent a restricted set of conceptual distinctions that apply to most object and relation categories. Grammatical morphemes work in conjunction with content words in order to convey situations. Therefore, language users must understand these distinctions, which help organise objects and actions (Morrow, 1986, p. 424). As will be further explained in Section 1.3.2, over time, various methods for teaching grammar have been implemented, including some performative teaching methods (Bryant & Rummel, 2015; Even, 2011). In the words of Rod Ellis (2006), 'The zero grammar approach was flirted with but never really took hold, as is evident in both current textbook materials … and in current theories of L2 acquisition' (pp. 101-102). Despite ongoing debates about the methods of teaching grammar in school (Lightbown & Spada, 2010; Long, 1996; Struckmeier, 2020), its mastery remains crucial, demanding effective transmission by teachers.

Although essential for L2 learning, grammar is frequently perceived as a challenging and monotonous subject (Witt, 2018) that causes apprehension among students and 'unfortunately, sometimes among teachers as well[2]' (Keßler & Plesser, 2011, p. 13). This perception may be rooted in a pedagogical approach that involves repetitive drills of correct grammar for specific situations,

2 This and all subsequent translations from German to English are my own.

similar to rote memorization (Nikolov & Timpe-Laughlin, 2021) which has been criticized for its tedious nature (Ellis, 1984). While repetition is an integral part of language learning, this method tends to produce limited outcomes, fostering repetition rather than transfer, and results in a lack of comprehensive understanding applicable across diverse contexts (Ellis, 2006). Another possible reason for unease with grammar instruction on the part of teachers in particular may have to do with students not necessarily noticing that it is even taking place. In a study involving participant stimulated recall, Mackey, Gass, and McDonough (2000) investigated how learners of English and Italian perceived the feedback they received during a picture-matching task that involved problem-solving from an L1 interlocutor. After watching a video of their own conversations, students appeared to be most conscious of feedback concerning phonological, lexical, and semantic issues. Feedback containing L2 morphosyntactic information was described as 'generally not perceived as such' (p. 471). Although stated in neutral academic language and leaving the exact differences between student and teacher morphosyntactic perception unspecified, this finding is clearly not good news, and the situation begs the question of whether there is a better way.

While empirical data can shed light on processes of classroom learning, teacher and learner experiences are crucial for understanding gesture-based L2 instruction. Therefore, inquiry into the social realities of the learning process equally hold importance. Given that the best tool isn't useful until someone uses it, it is important to understand the learners and teachers who use such methods. The question must be asked: How do learners and teachers who use such methods feel? Can interviews and focus groups offer insight into the classroom as a space where languages, teaching methods, cultures, and identities intersect and sometimes collide? Or are teaching gestures so 'under the radar' of consciousness, that their investigation requires other methods? In Germany, where approximately one-third of children and adolescents experience schooling in a language that is not their first (L1) or only first language (Bryant & Rinker, 2021), the need for effective language learning processes in diverse multilingual settings is undeniable (Gogolin et al., 2020). In Berlin alone, the presence of 11,000 pupils in 'Wilkommensklassen', with an additional 1,100 new students awaiting school placements[3] (Gargarina et al., 2023), underscore this urgency. These circumstances emphasise the importance of establishing effective language learning processes in multilingual societies (De Wilde & Hüning, 2024). However, previous studies on gesture and L2 acquisition have rarely addressed the crucial role that gesture plays as a teaching and learning tool, instead concentrating more on the relationship between gesture and cognition (Janzen Ulbricht, 2018a, 2020a).

3 Often translated as Welcome Class, the term 'Willkommensklasse' is commonly used in Berlin and refers to a special class within a school for non-native speaking children, who initially have little or no knowledge of German (Janzen Ulbricht, 2018b, p. 200).

An important goal of formal education is to provide learning through experiences that are meaningful to students. This is essential because ideas and representations that remain abstract and disconnected from lived experience are frequently inaccessible, incomprehensible, and easily consigned to oblivion (Adams et al., 2019; Bergner, 2006; Glenberg, 2011; Macedonia & Knösche, 2011). In language classrooms, promoting language support and inclusion is crucially needed (European Commission, 2023, p. 15). This dissertation will consider the significant implications for English language teaching presented by gesture research and the challenges brought about by globalisation, migration, and diversity in classrooms. In various aspects of life, inclusion is not yet a matter of course, and many people are still unfamiliar with interacting with people with disabilities or with whom they do not share a common language. This underscores the importance of adopting inclusive teaching practices in schools. Through experiences that use body-based teaching methods like gestures, teaching can increase the likelihood that learners feel engaged and understood, which in turn, enables them to learn more (Nathan, 2021). In summary, it has been argued that 'when students do not learn, they do not need *more*, they need *different*' (Hattie, 2012, p. 93). It is my firm belief the experiments presented here represent an exploration of what this 'different' could be.

In addition to understanding the social reality of diverse teacher and learner experiences in the classroom, briefly examining learning itself is helpful. Andrä and Macedonia (2020) and others (Borovsky et al., 2010; Constant et al., 2023; Kahneman, 2012; Sambanis & Walter, 2020), have observed that learning takes place over many different timescales. In his influential book *Thinking, Fast and Slow*, Kahneman (2012, p. 20) introduces two modes of thinking.[4] System 1 operates automatically and effortlessly, with no sense of voluntary control. System 1 is responsible for phenomena such as registering anger or happiness when seeing an angry or happy face, driving a car on an empty road, if driving is a skill one has sufficiently practiced, as well as innate skills humans share with animals such as perceiving our environment or orienting our attention (2012, p. 21). In contrast, System 2 is responsible for mental activities associated with a subjective sense of agency, choice, and concentration such as telling someone your phone number. Nathan, in his book Foundations of Embodied Learning (2021), builds on Kahneman's framework by introducing a third type of cognitive processing that is culturally mediated. In Nathan's model, Type 1 processing aligns with Kahneman's System 1, and operates fast and unconsciously. Type 2 processing is slow and involves (mostly) conscious awareness. Lastly, Type 3 processing operates conscious of social

4 In *Thinking Fast and Slow*, Kahneman uses the terms System 1 and System 2 which were originally proposed by Stanovich and West (2000). The book's overarching premise is that, although humans are intuitive thinkers, their intuition is fallible, which means that decisions and judgments, presumably including decisions and judgements about methods of teaching and learning, are prone to cognitive biases. Kahneman won the Nobel Prize for his work in behavioural economics and decision-making in 2002.

norms and structures and can be energizing, involving effort or being effortless (2021, pp. 120–123).

Building on this observation, the educational psychologist and gesture researcher Nathan (2021) has proposed Grounded and Embodied Learning (GEL). This paradigm for education acknowledges that body-based processes, which refer to direct physical, social, and environmental interactions, constantly mediate intellectual performance, sensory stimulation, communication abilities, and other conditions of learning. The five learning processes included in GEL (biological, cognitive, rational etc.) can be seen in Figure 1.

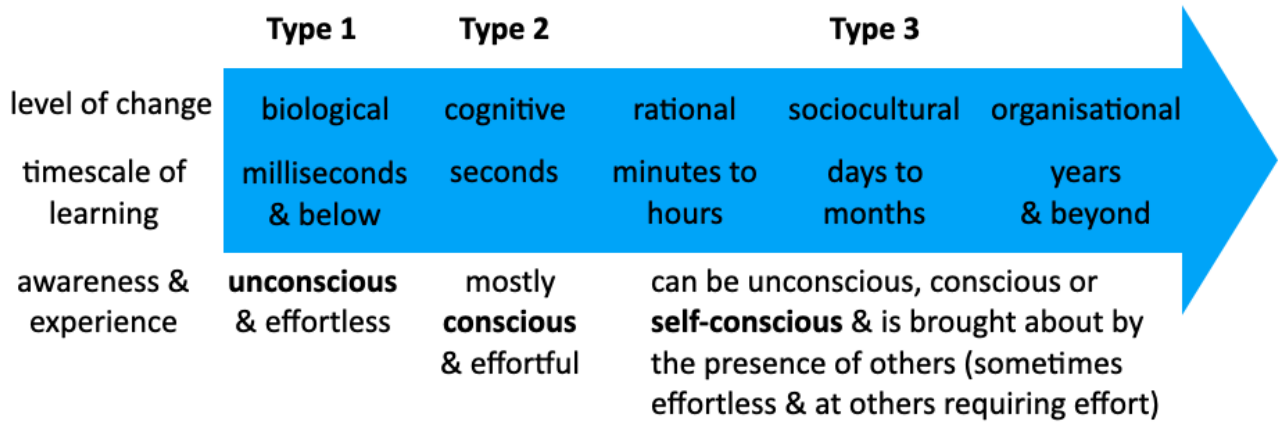

Figure 1. Modified schematic visualisation of the grounded and embodied learning (GEL) paradigm as proposed by Nathan (2021) and others (e.g. Kahneman, 2012) and its relationship to awareness and experience (Nathan, 2021, p. 120-23).

Although no academic discipline need wait for an overarching framework to justify its existence, the different processes of the GEL timescale can help explain why academic disciplines with their different research methods and traditions can complement each other in understanding instructional gestures 'in the wild' of the L2 classroom. In the context of this thesis, biological and cognitive learning, which take place on the order of milliseconds and seconds, are the domain of psycholinguistic research (Kaiser, 2014). Rational and knowledge-based learning, which unfold over minutes to days, are the domain of ELT. Sociocultural and organisational learning, which take place on the order of days to months and extend into years, are of particular interest to ethnography.

Ethnographic research methods, such as participant observation, have a distinctive ability to capture complex aspects of social interaction within instructional settings that are relevant for

learning. Ethnography is particularly useful in situations where there is limited prior knowledge about the situation under investigation (Mackey & Gass, 2005). This holds true for gesture-based learning in schools, where ethnography serves as a valuable lens for documenting and understanding how gesture-based learning occurs and has meaning in these settings.[5] While the GEL divisions in timeframe are usefully made, it is also worth noting that although interaction can be ordinary and situated within a certain context, this does not mean it is not a part of smaller-scale or larger-scale processes. Having established the significance of different research methods for different timescales of learning, it is essential to now shift our focus to examine the current research on L2 embodied learning, particularly in its relevance to understanding gesture-based learning in school settings. This thesis emphasises hand movements that are paired with specific linguistic units, such as sentences, words and grammatical morphemes, as will be detailed in the experiments in Chapters 2, 3, and 4. However, while unique in some respects, as will be seen, this thesis does not assert that only these gestures facilitate learning. Therefore, there is valuable insight to be gained about gestures paired with linguistic units by considering them within the broader framework of embodied learning.

Gesture-based L2 instruction: Exploring literature relevant to classroom implementation

Embodied learning is an approach to education that emphasizes the integration of the body and physical experiences into the learning process for enhanced understanding and retention. It is seen among ELT practitioners and professionals, as relevant for those who plan to become English language teachers. Embodied knowledge has been characterised as implicit ‘personen- oder körpergebundes Wissen’ (Viebrock, 2017, p. 376). Embodied learning can be understood to refer to pedagogical approaches that take the crucial role of the body in language (Glenberg & Kaschak, 2002), sensorimotor networks in the brain representing memory (Kiefer & Pulvermüller, 2012), perception (Cichy & Teng, 2017) and emotion (Dreyer & Pulvermüller, 2018) into account. Embodied learning can also be seen as aligned with fostering ‘non-cognitive skills’ in education (Paniagua & Istance, 2018). This approach contrasts with more traditional forms of learning that focus primarily on intellectual and cognitive aspects to enhance understanding and retention (Perry et al., 2021). There are a number of recent texts on embodied learning of which Andrä and

5 Anthropological approaches that focus on everyday practices and situate the researcher in relation to her research subjects can ‘unsettle the boundary between self and other’ and have been called ‘ethnographies of the particular’ (Abu-Lughod, 1991, p. 51). Related thoughts that culture can enforce separations that engender discrimination and inequality and should be mitigated are also relevant to L2 teaching and learning (Cummins, 2000) and education more broadly (European Education and Culture Executive Agency of the European Commission, 2023).

Macedonia's book (2020) *Bewegtes Lernen* is a valuable example. This work provides theoretical background as well as practical teaching activities across many subjects, some of which focus on gestures as a tool for teaching languages. *Foundations of Embodied Learning: A Paradigm for Education* (Nathan, 2021) also presents principles of grounded and embodied learning with implications for curriculum design and classroom instruction.

Nevertheless, despite noted researchers proposing that 'gesticulation assists your mental processes entirely positively' (Hattie & Yates, 2013, p. 142), to my knowledge, there are no instructional books specifically aimed at providing teachers with guidance on how to incorporate gestures for cuing speech into the instruction of foreign or second languages.[6] It is not the case that recent L2 school textbooks ignore hand movements as a teaching resource. Some textbooks include suggestions for learners to use their hands in certain ways. For example, Niebisch (2019) encourages learners to trace the prosody of their speech by moving a hand up and down while speaking (p. 18) and to spread out their arms when saying long vowels (p. 22). According to the gesture taxonomy developed by Müller (2013) and further refined by Ortega and Özyürek (2020) the first gesture implements the *representing* strategy, because the change in configuration of the hand in space represents the change in prosody. The second gesture, which is accompanied by a depiction of an accordion, belongs to the *acting* mode of representation because the body represents itself and depicts how an accordion is played. A systematic overview of the instructional gestures in current L2 language literature, such as those suggested to silently facilitate classroom management (eg. Harmer, 2015; Scrivener, 2012), is beyond the scope of this dissertation but would be worthwhile for future research.

Playful 'talking hands' books that show individual Deutsche Gebärden Sprache (DGS) signs are available for young children, their parents, and preschool teachers (Möller & Mohn, 2023), as are some relevant books on linguistic supportive signing, such as *Schau doch meine Hände an* (Drescher, 2017; 2023) and Mayer's *Lautsprachunterstützendes Gebärden* (2007); however, these and similar books are primarily intended to support L1 and not L2 language development. The multi-book series *Body – Language – Communication* edited by Müller et al. (2013) investigates how multimodal communication relates to embodiment and language. This extensive reference work includes, for example, sections on gestures in the classroom as a medium for L2 acquisition (Gullberg, 2013, pp. 1871–1872), as well as historical references to the use of sign language in the

6 Although one can agree with the sentiment that gestures are generally supportive of learning, as research (Gunter & Weinbrenner, 2017; Kelly & Lee, 2012) and the analysis of the experimental data in this thesis show, this is not true in every case. For example, as described under limitations in Section 3.4.3, there may be reasons why individual gestures (e.g. the 'dark' gesture chosen in the scenic learning condition) may have been confusing and may not have supported learning.

classroom (Copple, 2013, pp. 378-392). A final work which must be mentioned is Kaufmann's *Bericht über das LBG-Projekt Zürich: Erfahrungen mit lautsprachbegleitenden Gebärden* (1995). This book stands out for its documentation of the development of a codified gesture system designed to facilitate communication for deaf learners within a German-speaking environment. The focus of this account is on how LBG changed education at the school. However, in one section it also details how learning these new gestures aided hearing parents with an L1 other than German not only in communicating with their deaf children, but also in learning German as an L2.[7] Notably, the book also describes the experiences and viewpoints of children, parents, school staff, and teachers (Kaufmann, 1995).

Last but not least, a Web of Science search with the keywords 'gesture', 'classroom', 'English language teaching', and 'hand' from the past five years (2018–2023) resulted in 11 hits, the majority of which were for learners in early childhood or at university (see also Hauge, 2000). This does not suggest that research on gestures and L2 learning is not available to teachers (see Schilitz, 2018; 2021), but rather that this information remains difficult to access for teachers of children in middle childhood, the age when many students begin formal L2 instruction.[8] Studies on gesture-based teaching methods done in the context of the classroom are few and far between (Andrä & Macedonia, 2020, p. 13; Nathan, 2021, pp. 28–29), which is especially true for linguistic units beyond words such as grammatical morphemes.

This dissertation differs from the important sources detailed above in that it focuses on experimental work from the classroom to investigate the effects of gesture-based instruction on L2 language learning from the perspectives of different academic disciplines. It considers the matter from a psycholinguistic as well as from an ELT and an ethnographic viewpoint. In this naturalistic context, it argues that teachers can learn to use novel L2 gestures, and that even if employed only for a short time, this foray into using gestures benefits their students.[9]

7 Background information provided by Kaufmann's report indicates that in the early 1990s there was a scarcity of instructors for German sign language (DGS). Consequently, many hearing parents with young deaf children lacked good resources to learn sign language. This challenge was also faced by parents who moved to Switzerland from other countries and did not have German as their L1. The situation has evolved since then. Presently, hearing parents of deaf children, whether born in Switzerland and Germany, as well as those who move to these countries from elsewhere, have, in comparison, much improved access to instruction. This includes Swiss French sign language (langue des signes française), Swiss German sign language (Deutschschweizer Gebärdensprache), and Swiss Italian sign language (Lingua dei Segni Italiana) in Switzerland and DGS in Germany (C. Becker, personal communication, December 2, 2015).

8 In 2008 Marion Tellier published a study on the effect of gestures on L2 memorisation by young children remarking that until her study there had been 'no work on the effect of gestures on memorisation in children, whether in first or second languages, on short or on long term memorisation' (2008, p. 221).

9 Empirical evidence for learning, or a lack thereof, is important information for decision-making at all levels in education (Hattie, 2008, 2012). This thesis also acknowledges that individual learning resulting from participation in group aesthetic experiences can be valuable even when not accompanied by a long-

A common belief supported by academics, publishers, professional organisations, and language schools—regardless of the methods and approaches to teaching they currently use—is that improving language learning depends on changing and improving methods (Pinter, 2017; Richards & Rodgers, 2014).[10] In foreign language didactics research in Germany, gestures are seldom implemented as a teaching method in the classroom, even though the approach is known (Arndt & Sambanis, 2017). Taking these considerations into account, the present study focuses on beginning learners of English in classrooms where teachers employ a teaching method that has not yet gained much attention in ELT in Germany.

To understand why language in the L2 classroom may be deeply rooted in the body, it is useful to contemplate the context in which language came into being. It is widely accepted that modern language emerged as part of a more distributed bodily communication system. Researchers have posited that hand gestures, in particular, may have been the potential starting point for human language (e.g. Corballis, 2002; Hewes, 1973; McNeill, 1992; Tomasello, 2008). By studying sign language and gestures from different cultures, Wilhelm Wundt (1921/2018) convincingly elucidated the complex and interwoven semiotic processes initiated when communicators move from perceived to imagined objects and their symbolic gestural representation. Wundt's gesture classification represents an important contribution to gesture studies and laid the basis for many gesture classification systems to come (Bressem, 2013; see also Efron 1941/1972; Ekman & Friesen, 1969; Müller, 2013; Ortega & Özyürek, 2020). An analysis of the development of gesture and sign languages thus offers an opportunity to study the psychological and sign-making processes involved in language development. It provides information about the nature of language and shows how even arbitrary signs can evolve from simple iconic relationships through abstract processes of concept formation, reflecting the characteristics of innate linguistic capacities in collaboration with others (Philipsen & Trasmundi, 2019). If language and gesture have a deep evolutionary relationship to cognition, it makes sense to explore the remnants and potential of this link in present-day language and learning.

term measurable increase in achievement (Greene, 1984; Morrin, 2023).

10 In ELT literature distinctions between an approach to teaching and a teaching method are made, but often the terms are used indistinguishably (Mitchell et al., 2019). Richards and Rodgers (2014) list three assumptions that are common to most approaches and methods: they refer to theoretically coherent teaching procedures; following them leads to effective language teaching; and that teacher training should prepare teachers to understand and apply the best available language teaching methods. This understanding of 'using gestures' to teach English as a method was also mirrored when classroom teachers reflected on their experiences during the experiments.

1.2 Gesture-based second language learning – Core concepts, definitions and positions

Several core concepts, definitions and positions are relevant for the discussion of gesture-based L2 instruction in schools: embodied cognition, grounding, usage-based language acquisition, iconicity, gesture, and sign language.

Because learning is fundamental to the human experience, we acquire a vast amount of knowledge and skills throughout our lives—regardless of our cultural identity. The practice of education is thus in a large part about creating learning experiences (Hattie & Yates, 2013). Despite the crucial role that education plays in society, educational institutions are frequently accused of lacking a coherent, evidence-based framework to guide educational design and decision making, leaving teachers to make choices based on their own ideas about how learning occurs and how to best gather evidence that their students are learning (Nathan, 2021, p. 6). As a result, the link between these practices and theory is often tenuous and insufficient to help adjust learning experiences to the needs of students and teachers (Ur, 2019). All too often, students are left to participate in inefficient exercises without knowledge of how to direct their own learning efforts, how to engage in effective self-study, or how to engage in meaningful and helpful interactions with their peers (Kos, 2021).

One reason for this state of affairs in Western school instruction has been found in pedagogy with its mind-body separation or dualism which can be traced to Descartes (1596–1650) (see also Kelz, 2023). Scholars have raised concerns that society does not value embodied forms of knowing and that learning activities are rarely organized around the everyday, practical experiences of students. ‘Rather, educators seem to prefer that students sit at their desks in front of computers and textbooks … reading and manipulating arbitrary symbols and abstract terminology to *acquire* and *show* their knowledge’ (Nathan, 2021, p. 6, emphasis in original). This type of ‘mentalistic education’ (Macedonia, 2019) is frequently promoted in curricula and can be contrasted with meaning and sense-making through personally grounded ways of knowing (Sambanis & Walter, 2020). For instance, actively constructing knowledge by engaging in hands-on experiences, such as learners physically moving objects to demonstrate the content of what they are reading (Glenberg, 2011).

If our natural ways of learning, thinking, and teaching are based on the body, and we need the body to connect new ideas to previous experiences (Lakoff & Johnson, 2008), then limiting our access to movement inhibits our ability to think and learn just as it risks significantly underestimating people’s knowledge and commitment to learning (Glenberg, 2011). Emphasizing

the role of sensory-motor experiences, *Embodied Cognition* is a theoretical framework that suggests that cognitive processes, such as language comprehension, memory, and use, are deeply influenced by the body and its interactions with the environment (Kaschak & Glenberg, 2000). Although questions about the nature of processes involved in language comprehension remain, a wide range of behavioural and neuroscientific studies show that systems used for perception and action are involved in the interpretation of language (for overviews see Dargue et al., 2019; Dove, 2023 and Pelkey, 2023)

Grounding in the context of language learning refers to the process of anchoring abstract concepts—such as new L2 words or ideas—to concrete, perceptual experiences (Macedonia, 1999, 2019). It involves linking linguistic utterances to sensory motor experiences, enabling learners to understand and produce language. The term *common ground*, on the other hand, is defined as 'the sum of [two or more people's] mutual, common, or joint knowledge, beliefs, or suppositions' (Clark, 1996, p. 93), meaning that common ground is not information a person has for themselves, but information they assume their conversation partner has as well. The g*rounding problem*, or the problem of how abstract symbols can be anchored in the real world (Harnad, 1990), cannot be solved by mentalistic or symbolic approaches. As supported by neuroscientific studies (Grisoni et al., 2017; Miller et al., 2018), this implies that mind and body are intertwined and that theories of mind, which neglect the interplay between cognitive, emotional, social and embodied dimensions, are insufficient as a reference for education. Cognition is closely tied to bodily experience and the brain embodies syntax and grammar (Pulvermüller, 2010). In the context of L2 acquisition, gestures and other physical movements can help learners in understanding and internalising language by employing our tendency to categorise in certain ways based on our bodily experiences (Lakoff & Johnson, 1999).

Emphasizing the significance of social interaction for linguistic development, Tomasello (2009; 2015) proposes a *usage-based approach to language acquisition.* Tomasello asserts that children possess two sets of cognitive abilities when they come to the process of language acquisition, each of which evolved for different, more general functions before linguistic communication emerged in humans (phylogenesis): intention reading and pattern finding (see also Sambanis, 2013, pp. 106-108).

Children use 'intention reading' in order to identify the goals or intentions of mature speakers when they employ linguistic conventions to achieve social ends. According to the so-called social-pragmatic approach to language acquisition, the central cognitive construct is intention reading, which includes the skill of joint attention. Taking an example from Moll and Tomasello (2007), if an 18-month-old girl and an adult are cleaning up toys together and the adult points to a

toy, the girl will get the toy, based on the assumption that the adult's pointing is relevant to their shared activity of cleaning up. However, if another person enters the room during the same task and points to the toy in a comparable way, the child understands the situation differently, not as relevant to the activity of cleaning up, but rather as an invitation to share attention by noticing the toy or as an opportunity to give the toy to the new adult (p. 645).

Relevant for L1 and L2 learning, for children to move beyond the individual utterances they hear people using around them, they must create abstract linguistic schemas or constructions (ontogenesis). This process is known as 'pattern finding'. Pattern-finding is a term that summarizes concepts like categorization, analogy and distributional analysis, and is the central cognitive construct in the so-called usage-based approach to grammar acquisition (Tomasello, 2009, pp. 69–70). Multiple studies on language acquisition have used the well-known 'Wug Test' developed by the psycholinguist Berko Gleason to investigate language development in children (Massari, 2021). Utilizing pseudowords, such as 'wug', the test examines how children acquire morphological concepts, such as adding the plural 's' English. Presented with images of small Wug creatures, children are prompted to complete sentences. Findings from such experiments indicate that children do not memorize and repeat what they hear, but rather they discern patterns in the input in their environment, deduce rules from these patterns and demonstrate the capacity to generalize these rules to novel stimuli (Marian, 2023, p. 183). Pattern-finding thus allows learners to extrapolate from individual instances to new ones.

Perhaps slightly less well known, the related *simulation theory of language comprehension* suggests that we understand language not only through reading intentions and finding patterns, but that the neural and bodily systems used for perception, action and emotion are used to do so. In other words, we understand language similarly to how situations are understood: in terms of the actions made possible by the situations described (Glenberg, 2011). This connects to one of Nathan's GEL guiding principles, which states that in order for a notion or skill to become abstract and generalizable, the experience must first be concrete and relatable (2021, p. 53).

Iconicity refers to a type of correspondence between a form and its meaning and is a characteristic of both spoken and signed human communication (Ortega, 2017; Perniss & Vigliocco, 2014). In spoken languages, there are instances of sound symbolism like 'bouncy', which has a rhythm that resembles the up and down nature of a bounce, and 'buzz' where a word imitates the sounds it describes. Studies exploring the bouba/kiki effect, where 'bouba' is associated with a round shape and 'kiki' with a spiky shape, demonstrate that sound symbolism is robust across diverse cultures and writing systems. This research offers compelling evidence that this phenomenon is rooted in cross-modal correspondence between aspects of the voice and visual

shapes (Ćwiek et al., 2022). While different kinds of correspondence are available (Müller, 2013), there is high potential for iconicity in the visuo-manual modality (Ortega & Özyürek, 2020). Cross-linguistic and cross-cultural research from gesture and sign language studies show that while there is considerable similarity in gestures within and across cultures and between gestures and signs, iconicity has more potential for representing concrete concepts, whereas abstract concepts are more likely to be represented by different strategies both within and across languages (Schiefner et al., 2022). This might have important consequences for teaching.

The origins of gestural communication predate oral and written language (Corballis, 2002; Tomasello, 1999). In the words of Wulf (2023), 'From a historical point of view there is no doubt gesture contributed considerably to the creation of spoken language' (p. 1431). At a very basic level, a *gesture* is a symbolic movement that conveys meaning. Taking the palm-up form, for instance, this gesture can signify an absence of knowledge (Cooperrider et al., 2018). Movements can be performed with the hands, arms, fingers, facial features, or even the entire body. It is also possible to separate gestures into more specific categories. McNeill (1992, 2000) is credited with creating a widely adopted typology for gestures to better understand their wide range of linguistic values. Because McNeill derived this typology from Adam Kendon's research and discussion of gesture's variable conventionalisation, semiotic character, and relationship to speech (Kendon, 2004) he called it 'Kendon's Continuum' (McNeill, 1992, 2000). On this continuum, behaviour types are arranged from those that are rarely produced in the absence of speech to movements independent of speech. Progressing from *gesticulation* to *language-like gestures* to *pantomime* to *emblems* to *sign languages*, the communicative burden that speech carries declines as the language-like properties of behaviours increase. This continuum emerged as an important point of reference for researchers, shaping the understanding of gesture in cognitive science, second language acquisition and sign language linguistics (Harrison & Ladewig, 2021, pp. 158–159).

Beyond Kendon's Continuum, gestures have been grouped and named according to many classifications, sometimes being categorised together under large umbrella terms with fine distinctions being made between different types in others. For this reason, it is important to understand how the term is used by different researchers (Wakefield, 2013, p. 5). The term 'codified gesture' simply refers to a gesture that has a 'dictionary meaning' stored as a stable link in long-term memory which is shared within a certain group (Poggi, 2013). For example, the codified 'bear' gesture (see Section 3.2.3) involved mimicking the appearance of bear paws by placing both hands slightly above shoulder height with their fingers spread. This gesture is similar to the Turkish sign for 'bear' (Lydell, 2018), with the difference that in Turkish sign language the hands are more in front of the face, whereas the hands in the codified bear gesture leave the face in plain sight,

important for speaking in the classroom. (More examples are provided in Sections 2.1.2, 3.1.2 and 4.1.5.) According to the foreground-background gesture framework, gestures can differ in their intention, awareness and design. Some gestures are *background gestures*, meaning that while they are executed, they are in the background of the speaker's and listener's mind, whereas other gestures, which are perhaps seen as helpful in communicating a critical aspect of meaning are *foreground gestures*, in the foreground of speaker's and 'listener's awareness, and in the foreground of the interaction' (Cooperrider et al., 2018, p. 181). Codified gestures are foreground gestures and are comparable to an entry in the mental lexicon that assigns a stable meaning to constant hand shapes and movements. This dissertation will focus on codified gestures that involve a one-to-one form meaning mapping between a gesture and sentences, words or morphemes.

Hand movements are an inherent part of human communication. It follows that no matter where we were born or what languages we speak or sign, we all have extensive practice and experience at combining speech, gesture, and meaning. This holds significance because learning something new—such as German, because we have moved to Germany, or English in a foreign language classroom—becomes easier when we can pair something new with existing knowledge. This basic didactic principle which we intuitively use when we explain something new, is unrelated to classroom-based language learning per se, however, it prompts the questions of whether using gestures in this way as part of classroom instruction makes sense. This is the question that motivates the experiments presented in this thesis.

A *sign language* (SL) is a linguistic system that typically utilizes hand, facial, and bodily movements to convey meaning visually, rather than relying on sounds produced by the vocal tract (Farnell & Davies Brenier, 2023). SLs operate in three-dimensional space, with signers employing visible articulators, such as the hands, eye brows and mouth shapes to form lexical elements and grammatical structures. In the case of the deafblind, such as those who use pro-tactile American SL or pro-tactile Swedish SL, SLs can also operate exclusively through touch (Edwards, 2014). Although typically used among members of different deaf communities, SLs can be used alongside spoken languages, as is the case with Yolngu SL in Australia, which is used by a small number of deaf individuals, but is mainly used by hearing individuals (Bauer, 2014). Despite countries sharing a spoken language, such as the Republic of Ireland, the UK and the USA sharing English, these countries have mutually unintelligible signed languages (Farnell & Davies Brenier, 2023). Related to SL and L2 classroom learning, it is known that hearing non-signers use their previous experience with gestures to predict iconic form-meaning mappings when they are first exposed to signs (Ortega et al., 2019). Additionally, while both deaf children and adults appreciate iconicity for vocabulary learning, they prefer different kinds of iconicity (Ortega et al., 2017).

The role that SL can and should play in formal L2 education is complex and not the direct focus of this thesis, however feedback from students and teachers across all experiments shows general curiosity and interest in the potential of SL for L2 learning. Considering that culture-specific symbols, such as counting gestures, can prime aspects of identity, such as self-esteem, and that out-group gestures can diminish self-esteem (Nicoladis et al., 2020), it follows that, under similar circumstances, gestures borrowed from a specific context could positively impact self-esteem and consequently, learning. Even if we have never formally learned a sign language, if we have witnessed a conversation, we know it is possible for hand movements to completely embody language in a way that is complex, engaging and remarkably fast. In short, language can be packaged into speaking without hand movements, in oral speech with hand movements and also entirely into sign language, even in the form of touch.

Since human communication combines speech and gesture, this raises the question as to whether certain forms of combining speech and linguistic information in the form of gesture are more productive ways to scaffold or support L2 learning than others. Another way to ask this question is, 'Can more learners learn more if teachers use codified gestures while teaching?' Further, if codified teaching gestures can help, what should these gestures represent? Language can be divided into linguistic units, such as sentences, which more or less contain one thought; words, which are perhaps the most basic unit of language; and morphemes, which are the most basic linguistic unit of meaning. For instance, taking the word *cat* in English or *Katze* in German, these sounds will summon up a mental image which, as long as we know the language, is an image we all share to some extent. The question my research addresses is not if teaching the word *cat* is better done with or without gestures. There is wide consensus across many disciplines that this is the case (Cook, 2018; Kiefer et al., 2007; Macedonia, 1999; Sambanis, 2013). Rather, the question is whether using gestures at the level of morphology—if distinguishing between *cat* and *cats* through deploying distinct gestures—makes a meaningful difference in long-term learning outcomes. This is a question that can and should be approached from many different perspectives.

Currently, research on gesture is being conducted within many fields: psycholinguistics and psychology, education, linguistics, and semiotics, cognitive linguistics, conversation analysis, primatology and anthropology, as well as the field of artificial intelligence. This illustrates that research on the body and language is a 'wanderer between disciplines' and is first and foremost characterised by its interdisciplinary nature (Müller, 2018). However, before continuing this exploration, drawing together the main points discussed, I will now offer some provisional conclusions based on existing findings.

Interim summary 1

Integrating gestures and embodied teaching methods into classroom-based instruction holds significant potential for ELT. Research from different traditions underscores the complex nature of studying the relationship between the body and language. Recognizing language as multimodal and language learning as a social endeavour highlights the importance of incorporating gesture and physical movement into individual and group instruction in order to enhance understanding. While there is growing support for gesture-based L2 learning, further research is needed to explore its effectiveness, limitations, and to develop best practices for integrating it productively into language classrooms. We begin now with a subchapter detailing what psycholinguistics is and how research from this discipline can contribute to understanding L2 gestures.

1.3 Research Overview

1.3.1 A psycholinguistic approach to gesture-based learning

What is psycholinguistics?

Psycholinguistics is a diverse interdisciplinary field, influenced by both linguistics and psychology, as well as cognitive science (Traxler, 2012). Whereas linguistics analyses language in order to ascertain ‘how it works’ as a shared system of meaning, psycholinguistics examines the relationship between linguistic behavior and mental processes involved in acquiring, comprehending, producing, and ultimately, in losing language (Crystal, 2009; Marian, 2023). Basic research in psycholinguistics thus addresses fundamental questions such as the nature of mental representation that language users have, as well as how speakers process linguistic elements across languages in real-time (Bardel, 2019). In this field speech comprehension and production are understood to include all aspects of processing an incoming or outgoing linguistic signal with its diverse phonological, lexical, syntactic, semantic, and pragmatic aspects (Boux, 2023). Common research methods in psycholinguistics include neurophysiological measures, such as ERP and fMRI techniques, as well as behavioural measures, such as eye-tracking and measuring response time in experiments (Roberts, 2012), as is implemented in Study 3. Many psycholinguistic experiments require that participant responses be captured while visual and or auditory stimuli are presented. In order to enable a clear interpretation of the results, the context in which the words are presented is often simplified in order to control for variation present in more naturalistic settings. Despite the fact that this approach does not correspond to the conditions in which most human communication

takes place, it is assumed that the same underlying processes occur when participants recognise words presented individually or in a reduced context (Sonnenstuhl-Henning, 2003).

An important area of psycholinguistics involves the study of cross-modal processing or examining how information from different modalities, such as speech and sound, speech and smell (Vanek et al., 2021), or speech and gesture (Goldin-Meadow, 2005) interact.[11] Research and experience suggest that cross-modal associations, which combine different sensory modalities, such as those found when speech and gesture are paired, improve the quality and efficiency of learning (Gilakjani et al., 2011; Gullberg, 2006; Hostetter & Alibali, 2019). The term cross-modal association is commonly used in psycholinguistics, as well as the fields of psychology, cognitive science and neuroscience. Relevant to Section 1.3.2, in ELT, and in education more broadly, the terms multimodal or multisensory are more frequently used to reference this same concept (DePriest, 2021).

Many arguments have been put forward to explain why gestures are beneficial, such as the notion that they capture attention, provide helpful redundancy, or engage the senses (Gullberg, 2006; Hostetter & Alibali, 2019). A more detailed explanation for the facilitative effect of gesture has to do with categorization, that is how, similar to real-world labels, novel gestures facilitate L2 category learning by making the pertinent perceptual dimensions (dog vs. cat) more concrete and, consequently, easier to recall as learning proceeds. This helps simplify between-category distinctions. Stated differently, labels influence mental models of categories by drawing attention to important common characteristics across objects. This improves the ability to successfully store category-defining visual features in memory and retrieve them when needed (Miller et al., 2018).

Despite this understanding, there is still a considerable gap in knowledge regarding how cross-modal associations, such as speech and gesture can best support pupils in educational settings. When meaningful interactions with learning materials fall short and are replaced by verbal descriptions alone, learners may be forced to rely on verbal associations that are less durable than cross-modal associations which may eventually lead to learning loss. Language learning is an incremental process (Marslen-Wilson & Komisarjevsky Tyler, 1980). Gesture experiments, such as those presented in this thesis, can give crucial insights into how this learning process unfolds within classroom environments.

Exploring the efficacy of different practices is crucial in understanding how to enhance L2 learning. Cross-modal associations appear to increase powers of discrimination. This is likely due to enhanced cell assembly formations which decrease the overlapping activation in similar stimuli by

11 For a review of the role modality-preferential areas play in understanding abstract language see Dreyer and Pulvermüller (2018). For a review on verbal units and manual activity see García & Ibáñez (2016).

connecting them to unique, widely differing verbal labels (Miller et al., 2018; Pulvermüller, 2013; Pulvermüller et al., 2014). At the same time, a large number of empirical studies show that iconic gestures—meaning those that convey the sensorimotor attributes of a referent—significantly contribute to language acquisition, perception, and processing (Goldin-Meadow, 2014; Holle et al., 2012; Kelly et al., 2009; Kita et al., 2017; Sambanis, 2013). However, there are fewer studies dealing with how cross-modal associations increase discrimination capabilities by connecting them to different visual labels in the form of gestures potentially useful for grammar instruction (Matsumoto & Dobs, 2017; Yousefzadeh & Aghajanzadeh, 2017). Given that gestures are anchored in human development (Tomasello, 2008) and even shared between species (Kersken et al., 2019), it is perplexing that only limited resources have been devoted to research on the use of gestures in L2 didactic contexts. A comprehensive investigation of these phenomena is necessary to advance our understanding of the potential and constraints of gesture-based language instruction for L2 learners.

Gestures facilitate mental representation and learning

The Gesture-for-Conceptualization Hypothesis, recently put forth by researchers, holds that gestures schematize information and are conceptually linked not only to speaking, but also to mental processes more generally (Kita et al., 2017). Relevant for L2 learning, linguistic units, such as a new L2 word like *baby* or *book* can be paired with iconic gestures. In Experiment 3, for example, the *book* gesture began with both palms together in front of the body and then tipped the hands open twice representing a closed book being opened followed by a page being turned. This relationship can decrease the need for semantic aspects of language comprehension, freeing up cognitive resources for additional information processing which in turn may lead to more robust learning and better retention—as will be explained in more detail in Sections 3.1.1 and 4.1.4. According to Zwaan & Radvansky (1998), words and words and sentences can be understood as instructions for creating a representation or mental model of the situation being described. Along similar lines, but based on more recent neurobiological research, Brouwer et al. (2012) have proposed the theory-neutral term ‘mental representation of what is being communicated’ (MRC) to refer to the internal representation that a listener or reader constructs while comprehending a story, sentence or scene. They contend that inferences drawn from logical, causal, or pragmatic world knowledge based on experience are also included in MRCs, not only linguistic input (2012). Thus, if gestures, in addition to patterns already available in speech, enable listeners to form an accurate MRC, this enhances mental processing. If meaningful gestures facilitate learners to update their MRC with

more ease and clarity, it follows that learning would be less dependent on contextual familiarity and more prone to consolidation and flexible use.

While an important focus of this thesis is on how to ground L2 learning in meaningful experiences in order to 'help more learners learn more', it should be mentioned that in linguistics and neuroscience there is still ongoing debate regarding the nature of how language is represented. Specifically, there is contention between proponents of an amodal symbolic system or a system with a strong overlap between language areas and sensory-motor regions. While neurobiologically motivated models, such as the MRC or GfCH frameworks, integrate concepts of semantic grounding or embodiment, classical amodal symbolic system approaches (Anderson, 1996; Ellis & Young, 1988), maintain that it is only when producing (physically speaking) or perceiving language (hearing speech sounds) that the body is involved. This traditional perspective, focused on symbolic and amodal representations, potentially overlooks important aspects and may not fully account for human behavior (Boux, 2023; A. Clark, 2013; Cook, 2018; Dreyer & Pulvermüller, 2018; Glenberg, 2011; Pouw et al., 2014). This may result in pedagogical implementation based more on the strength of an underlying theory than because strategies have been reliably tested in everyday classroom environments (Perry et al., 2021, p. 8). However, while it is generally agreed that gestures can schematize information and conceptually link hand movements to speaking and thinking (Kita et al., 2017), for the purpose of predicting which gestures should be used to support teaching certain content, such as the development of fluency, the learning of abstract words like spatial terms or the teaching of grammatical morphemes, for example, most experiments are underspecified. This lack of a principled account of why certain gestures help learners frequently results in researchers relying on intuition when implementing gestures in research (Rodríguez-Cuadrado et al., 2022).

Although there is consensus on the benefits of gesture for learning (Arndt & Sambanis, 2017; Hattie & Yates, 2013; Macedonia & von Kriegstein, 2012), the mechanisms by which gestures support learning are not fully understood. Neuroscientific research shows that perceptual and lexical-semantic spatial information have a parallel organization in the brain (Göksun et al., 2013) and that simple gestures can make meaningful differences in understanding (Holle et al., 2012). However, the relationship between speech, gesture, and language is complex. Research suggests that under certain circumstances—for example, when cognitive demands are high or skill level is low—gestures may actually impair comprehension (Kelly, 2017; McNeill, 2000). Gesture theory, as described in the GfCH, makes predictions about the enhancing effects of gestures for learning, but how to best use gestures in L2 classrooms is still under-researched, leaving many questions unanswered. While many studies have focused on the role that gestures play in L2 word

learning, relatively few have focused on fluency and abstract words, like spatial terms, and even fewer studies have focused on the learning of morphemes. While the relationship between gesture and L2 learning has been examined, few studies have operationalized this learning in classroom settings, and even fewer with beginning learners. This research gap is unfortunate because although fluency, spatial terms, and the use of grammatical morphemes are clearly important, as is described in more detail in Section 1.3.2, they are frequently perceived as challenging to teach (Harmer, 2005).

How can we measure L2 language learning?

The neurocognitive systems engaged in acquiring, representing, and using relevant knowledge are referred to as the declarative and procedural memory systems (Ullman, 2016). While declarative knowledge can be quickly learned, it is slower to use, requires more cognitive resources than procedural knowledge, and is also more easily forgotten (Ferman et al., 2009). During proceduralisation a skill, such as pronouncing a difficult L2 word, which took conscious effort in the beginning becomes more automatic, putting less of a burden on working memory and resulting in more fluent speech (de Jong & Perfetti, 2011). Much L2 linguistic research has focused on short-term effects, paying less attention to long-term developments. Planning and repetition can help a speaker to benefit from priming, but proceduralisation might be necessary for longer-term effects (de Jong & Perfetti 2011). In learning in instructional settings, it is seldom the case that children have no prior knowledge of a concept to be learned and are completely open to the teacher's explanations. More frequently listeners have their own ideas (prior knowledge), and it is not so easy to change these preconceptions.

Gesture theories, such as the GfCH, posit that gestures can schematize information and conceptually link hand movements to speaking and thinking. However, for the purpose of predicting which gestures should be used to support e.g. the development of L2 fluency, spatial terms or grammatical morpheme learning, they are lacking.

Brain dynamics in learning with verbal labels for tactile patterns

Patterns of brain activation reveal features of word meaning. For example, understanding language semantically related to actions or objects activates the motor cortex in areas linked to those actions or the handling of those objects. This can be explained because when words are used to speak of actions and objects, this leads to associations between neurons in core language areas of the left-perisylvian cortex and additional neurons in areas processing information about the word's referents

in extra-perisylvian space, in brain areas dedicated to perceiving object features or planning and executing physical movements (Shebani et al., 2022). This is implied by the correlation learning principle (Hebb, 1949) and the cortex's long-range connections between sensory-motor, linguistic, and intermediary cortical systems. If the referent is an object usually perceived through the visual modality, neurons in temporal-occipital areas will be combined into a cell assembly[12] connected to perisylvian language areas activated by the word. This has also been demonstrated, for example, in the way that temporal visual cortex areas are activated specifically upon reading or hearing visually-related symbols, such as, for example, colour and form words (Pulvermüller & Hauk, 2006; Simmons et al., 2007). In addition, somatosensory areas have also been identified in recent EEG data as grounding novel tools into specialised action systems when these novel tools are labelled (Foerster et al., 2020).

When learners encounter an unknown word in an L2, they often rely on context or prior experience to make educated guesses about the word's meaning. In a recent learning experiment, participants were exposed to unknown complex tactile patterns (Miller et al., 2018). The results demonstrate that associating a specific tactile pattern with a verbal label such as *fromp,* while simultaneously associating a similar tactile pattern to a different verbal label, such as *schpepf*, communicated to the participant that, while these tactile patterns share commonalities, they are distinct. Presenting percepts over several days with a 70% probability of agreement using unique labels for the unique tactile percepts showed that tactile perception improves when the tactile precepts are named and paired with a label (Miller et al., 2018). This demonstrates that when activated, regions become strongly linked, and operational cell assemblies are formed which can be fully activated later on by only partial ignition due to strong internal connection. Relevant for the experiments in Chapters 2, 3, and 4, this means that once a word-gesture pair is learned, an incoming verbal or nonverbal stimulus, such as a word or gesture, can automatically activate its corresponding representation, thanks to robust internal connections.

In summary, researchers have investigated the role of gesture in L2 didactic settings for several decades (Hauge, 2000; Tellier, 2008; Macedonia, 2019). However, since limited resources have been devoted to L2 gesture research in authentic didactic contexts, we have an incomplete picture of the empirical data that supports the role of gesture in L2 learning. Syntactic links between meaningful units of language have been proposed to be neuro-biologically grounded in discrete combinatorial neuronal assemblies (Pulvermüller, 2010, 2013). By associating these syntactic links with meaningful gestures, the neuronal assemblies which result include far-reaching links

12 A cell assembly has been proposed as the fundamental unit of neural information processing at the interface of physiology and psychology that combines representations, memory, and the organization of complex behavior (Wennekers, 2007).

connecting different cortical areas and may not only facilitate learning, but lead to better long-term retention of syntactical features. Critical questions remain on how fluency, abstract words and abstract syntactic processing units such as grammatical morphemes operating on classes of L2 lexical items can best be taught.

The following quote by the psycholinguist Viorica Marian (2023) presents much of the foregoing in terms of the relationship between language, cognition, and neural processes in the multilingual brain:

> Our perception of reality is tied not only to the words we know but also to the patterns of activation in our brains, and these patterns vary across people based on individual experiences. What we perceive as reality is essentially brain activity. Because our perceptions and thoughts are bound by patterns of neural activation, and because different languages activate different neural networks, those who speak multiple languages can cross these mental boundaries…. What we see or hear is influenced by which neurons are most likely to fire, and which neurons are more likely to fire depends on which prior neurons were activated by recent experiences. When bilinguals switch languages, their networks of neural activation change as well and, with them, so do their perception and interpretation of reality, allowing them to move across multiple planes of neural co-activation – and hence, arguably, across multiple planes of existence (p. 19).

While psycholinguistics is not commonly recognized as an essential component of teacher education, it is an academic discipline that explains how cognitive and neural evidence can be mutually informative and helpful in understanding language performance (Grimaldi, 2012). Its insights can significantly contribute to understanding the potential of gesture-based instruction and L2 learning in schools.

Interim summary 2

Psycholinguistic research methods can provide systematic and objective approaches to creating experiments relevant to studying gesture-based learning in the classroom. Using these methods can contribute to a deeper understanding of how learners integrate gestures during language learning tasks in naturalistic settings allowing researchers to draw more robust conclusions about the effectiveness, limitations, and potential benefits of using gestures in L2 classrooms.

Although exploring the intricate psycholinguistic processes involved in gesture-based instruction and L2 learning is important, understanding the history of the language being taught is also important, as we shall see in the next section.

1.3.2 An ELT approach to gesture-based learning

What is English language teaching?

Essential to understanding ELT is knowing where the English language came from and how it has evolved through time. The Britons, who were the initial inhabitants of the Isle of Britain, spoke Celtic languages. However, their culture was transformed when Anglo-Saxon raiders began invading England around 500 A.D., introducing their own Germanic language. Although coming as warriors, they soon became farmers and pastoral people, adding Anglo-Saxon words such as *sheep, earth, plow, dog, wood,* and *field* to the language of Britain (McCrum, 2011). In 1066, another invasion by the Norman French introduced French and Latin influences to Middle and Early Modern English. Eventually, English became the global lingua franca of the 21st century (Crystal, 2009). A knowledge of the history and evolution of the English language is essential to understanding ELT. This is true for two reasons when teaching in multilingual classrooms. Given the many historical linguistic influences on English, this knowledge enhances teaching English as a living entity subject to change. Additionally, it fosters a deeper appreciation for the linguistic diversity teachers find in their own classrooms.

This rich historical context shapes the field of ELT teaching and the global landscape in which English is taught and learned, also has a long history in its own right. This history, in turn, influences how English as a language is understood and taught within teacher education. (For an overview of the past 250 years of ELT in Europe and Britain see Howatt & Smith, 2014.) The development of ELT as a field is driven by connecting the everyday concerns of practitioners to insights gained from ELT, as well as related academic disciplines such as applied linguistics, education, psychology, and sociology. Examples of how research in ELT follows practice and range from studying how individuals learn English phonemes (Yilmaz, 2014), like the ‘th’ sounds in *mother* and *thumb,* to analysing the influence of anxiety, enjoyment, and boredom on English learning in rural China (Li & Wei, 2022) to grappling with the role of laser pointers to direct students’ attention (Rumme et al., 2008).

Given that theory in ELT follows practice and is inspired by many different disciplines, theoretical perspectives can be very heterogeneous, leading to different kinds of theories that can be difficult to follow and discuss (Bardel, 2019), especially for practitioners with a heavy teaching load (Lightbown & Spada, 2010). Nevertheless, the majority of English teachers would say they teach communicatively, and many important methods, including task-based learning, exist because of the communicative revolution of the 1970’s and 80s (Harmer, 2015, p. 57). However, defining communicative teaching is challenging. Nunan (2004) has compared the communicative approach

to an extended family of teaching approaches where ‘not all members live harmoniously together all of the time. There are squabbles and disagreements … [h]owever, no one is willing to assert that they do not belong to the family’ (p. 7). Going back in time to the 1880s in France a concise declaration of L2 teaching principles was featured in every issue of the IPA review *Le Maître Phonétique* (Stern, 1983, pp. 88–89). Although not necessarily well known, the six articles of the International Phonetic Association, or the IPA articles, can provide an antidote to what has been called the ‘method wars’ (see also Haß, 2006, pp. 16-20).

Relevant to the instructional materials used in the experiments in Chapters 2, 3, and 4, the first IPA principle emphasizes that foreign language study should prioritize the spoken language of everyday life. Especially appropriate to Chapter 4 on grammatical morphemes, principle 4 asserts that in the beginning stages of language learning, grammar should use an inductive approach, with more systematic grammar study being postponed until a later stage. Almost addressing the subject of gesture itself, principle 5 states that as much as possible, expressions in the L2 should be directly connected to ideas and other expressions in the L2 itself, and not to the native language of the students. The teacher should take every opportunity to replace translation with references to tangible objects or images or by explanations given in the language to be learned.

In his exploration of historical worldwide developments regarding L2 teaching, Stern observes that while both theorists and practitioners share the common goal of enhancing language learning, ‘they must decide for themselves what to do about it’ (1983, p. 2). He further asserts, ‘The [relevant] question is whether the decisions made … are well thought out, informed, based on sound theoretical foundations, and are as effective as they can be expected to be, or whether they are patently naive, uninformed, ill-founded, and inconsistent’ (1983, p. 2). Writing about teaching methods, such as L2 instruction using gestures, in a manner that oversimplifies or ignores historical context can contribute to the latter.

An important area of ELT relevant to this thesis relates to the performative teaching approach employed in the experiments. According to the Common European Framework of Reference (CEFR), L2 instruction should be action-oriented and allow learners to draw upon and further develop all of their linguistic and cultural repertoires (CEFR, 2021). This expectation is met in performative teaching as it provides both teachers and learners the opportunity to create realistic and communicative situations for language learning (Bryant, 2023; Crutchfield & Schewe, 2017; Sambanis & Walter, 2020; Schewe, 2013, 2017) which crucially frequently involve emotions (Crutchfield, 2015). As neuroscientific research has demonstrated, emotions have a special capacity to facilitate learning abstract concepts (Pulvermüller, 2013), and ethnographic studies have shown that emotional reactions enable knowledge construction more generally (Stodulka et al., 2019).

Promoting equality in L2 instruction

Although not specific to teaching English, first paragraph of the Berlin School Act states that it is the responsibility of schools to nurture the abilities that every student brings to their fullest potential (*Schulgesetz für das Land Berlin*, 2021). Especially in the area of L2 learning, it is impossible for teachers to cover every aspect of what their students will need to know. Therefore, laying a firm foundation on which pupils can later build is of utmost importance. This includes motivation to learn languages, joy in communicating, interest in literature, an openness to cultural differences as well as knowledge of learning strategies that make them successful (Andrä & Macedonia, 2020; Bitmann & Brüning, 2012; see also Sambanis & Ludwig, 2024, p. 88-89). Hattie and Yates (2013) address educational inequality, underscoring the challenges schools encounter.

> It would be nice to have eager, well-groomed invested students …, but our neighbourhood schools must take all who walk through the gates. We could ask that students … come to school well fed, having been supported at home to do their homework … [but] we should not discriminate against students whose parents may not know how to help them to do so (p. 169).

Relevant to learning in school, the Organisation for Economic Co-operation and Development (OECD) collects data related to students' socio-economic backgrounds and educational outcomes.[13] The OECD can identify patterns and trends related to educational inequality within and across countries and use these findings to make policy recommendations aimed at reducing inequality and improving overall education (OECD, 2018). In the words of Andreas Schleicher, the OECD Director for Education and Skills, 'Teachers see that students come from different backgrounds, that they have different needs, that the heterogeneity which is actually the potential of really good education becomes a major challenge for teachers' (2023).

A phenomenon related to educational inequality in the ELT classroom is the Matthew Effect, whereby instruction creates rich-get-richer and poor-get-poorer patterns of educational achievement (Stanovich, 2009). While educational inequality creates differences in long-term economic outcomes for learners and society, it also creates frustration for students resulting in challenges in classroom management for teachers. Of course, not all frustration in the classroom is caused by educational inequality or needs to be avoided, because overcoming challenges is a part of learning (Moll & Tomasello, 2007; Vygotsky, 1978). However, in speaking about the inequality divide in education, Sesan reminds us that 'Young men and women who don't get set on the path of equal opportunities become frustrated. And we may not like the choices they make in their attempt to get what they think they rightly deserve' (2020). Although perhaps not mentioning it by name, without

13 The OECD was established in 1961 and has 38 member countries (OECD, 2024), including Germany. The OECD's mission is to promote policies that improve economic and social well-being.

exception, all teachers involved in the projects resulting in Chapters 2, 3, and 4 commented on their commitment to reducing inequality and improving outcomes for their leaners.

Conditions contributing to L2 learning

For L2 learners, word learning is comparable to how cells are fundamental to biology. Webb and Nation (2017) are frequently referenced when it comes to explaining the process of word learning. Instead of viewing vocabulary knowledge as ‘an all-or-nothing construct’, there is widespread agreement that vocabulary knowledge entails multiple dimensions for each lexical item such as a word’s spelling, morphological forms, multiple meanings dependent on context, in addition to the other words with which it can collocate (Brezina et al., 2015; González-Fernández, 2022; Kötter, 2022; Verhallen & Schoonen, 1993). These insights can be extended to various aspects of language learning, including fluency, spatial terms, and the acquisition of grammatical morphemes, any practical use of which will involve integrating them with words. According to Webb and Nation (2017), vocabulary learning occurs under certain conditions that facilitate learning. These conditions include repetition, noticing, retrieval, varied encounters and varied use, and elaboration. These learning conditions are influenced by two factors: the frequency of encounters with each word and the quality of attention at each encounter (p. 61). Essentially, the more encounters a learner has with a word and the higher the quality of the encounters, the more likely learning is to take place. While both repetition and quality of attention are important (Sambanis & Walter, 2020, p. 15-16), the latter has a more significant impact on learning outcomes (Webb & Nation, 2017, p. 61).

Webb and Nation (2017) further assert that the quality of attention significantly relies on whether the learner gives incidental attention or deliberate attention when encountering a word. Incidental attention occurs when the learners’s focus is on aspects of communication other than individual words and phrases, whereas deliberate attention involves the learner consciously focusing on a word or phrase. According to this account, deliberate attention during an activity is more conducive to learning compared to incidental attention. This being said, ‘in a well-balanced vocabulary learning program, the opportunities for learning from incidental attention should be much greater than those for learning from deliberate attention’ (p. 62). It should also be noted that the learning conditions associated with quality of attention—noticing, retrieval, varied encounters and varied use, and elaboration—tend to build on one another. For instance, retrieval encompasses noticing, and varied use involves retrieval and noticing. Elaboration involves noticing and may involve retrieval if the elaborated words were previously encountered. Moreover, deliberate

elaboration can also involve varied use (Nation, 2015). These observations align with recent neuroscientific research which shows that speech comprehension and production are tightly linked (Boux, 2023). Related to L2 learning in school, Kötter (2022) suggests that speaking and writing new words should be presented in various forms, and that it is beneficial to practise them in both context-independent and context-bound ways (p. 130). These insights into vocabulary learning offer valuable context for understanding the challenges associated with fluency, spatial terms, and teaching grammatical morphemes. Because these are addressed in their respective chapters, they will not be discussed in depth here. However, given that the scientific articles in Chapters 2, 3, and 4 have gesture and L2 learning as their focus, it makes sense to highlight a few specific ELT issues related to these areas of instruction. Fluency, spatial terms, and grammatical morpheme teaching will briefly be addressed in turn.

Insights into fluency instruction in the ELT classroom

According to de Jong and Perfetti (2011), ‘The ultimate goal of many second-language learners is to be fluent in the target language’, which means expressing ideas with ease and being able to articulate ideas with more attention to meaning than form in any given situation (p. 535). In L2 instruction a distinction is frequently made between accuracy and fluency and teachers often struggle with finding the balance between expecting accuracy, as in the study of a grammar point, a pronunciation exercise, or vocabulary work, and fostering fluency. Depending on past educational experience, learners may expect correction, meaning they can be disappointed if teachers are hesitant to correct or do not correct during speaking. This can be at odds with teacher experience that immediate and constant correction of errors is not necessarily an effective way to help participants improve their speaking skills, and has prompted gesture research into error correction (Nakatsukasa, 2016). The prevailing belief suggests that teachers should not interrupt students mid-flow to point out errors, since doing so interrupts communication and ‘drags an activity back to the study of language form or precise meaning’ (Harmer, 2001, p. 105). Rather, students should negotiate for meaning by making use of the resources they have (Long, 1996). However, this is only possible when learners possess sufficient linguistic resources to navigate such situations (Foster & Ohta, 2005). When feedback interventions are excessive and distract learners, or negotiation for meaning is unsuccessful, this elevates stress levels, thus impeding learning processes. Thus, such circumstances which are expected and intended to improve learning can ‘stop the acquisition process in its tracks’ (Harmer, 2001, p. 105).

Investigation into foreign language anxiety has had a prominent focus in L2 studies for decades and has produced special issues, such as Mackey (2023) meta-analyses, or Zhang's (2019) investigation into the relationship between L2 anxiety and performance, even producing studies within the context of L2 drama pedagogy (Surkamp & Wirag, 2021). Despite this scholarly activity, consensus among educators regarding effective strategies for alleviating anxiety while improving L2 learning remain elusive (Nakatsukasa, 2016). However, relevant to the training phases described in Chapters 2, 3 and 4, research consistently shows that speaking a foreign language within a group setting can reduce anxiety compared to speaking alone in front of a group (Ölmezer Öztürk & Öztürk, 2021). Instructors and their training play a pivotal role in creating a supportive environment thus reducing this anxiety (Young, 1990), but what this specifically entails for individual learners is not always known (Pinter, 2021). One approach proposed by this thesis to address both fluency and accuracy in language teaching involves cueing groups of learners to speak, offering a sense of safety in numbers and minimizing the pressure associated with producing errors for segments of instruction, thus potentially reducing foreign language anxiety. Fluency comes from speaking. Most students want and expect feedback from their teacher on their speaking, but how this should happen is seen as challenging and highly personal. Good teachers should be able to correct without offending, meaning judging how to correct and 'deciding if and when to intervene at all' (Harmer, 2001, p. 106). In summary, teaching for fluency presents a challenge in L2 instruction and using L2 gestures may help educators balance needs for accuracy and fluency while considering learners' anxiety, creating more room for learning.

Insights into preposition instruction in the ELT classroom

During an informal conversation with a teacher before Experiment 2, I asked what teachers typically do to teach prepositions she replied, **'**If there is anything that teachers teach in an embodied way, it is prepositions'. Many teachers enjoy teaching spatial terms and are convinced that physical demonstration and interactive activities help, as is evident in the abundance of songs, dances, and instructional games dedicated to L2 prepositions (Leff, 2008; Thomas, 1997). Cuisenaire rods, consisting of coloured wooden blocks of varying lengths, for example, serve as an effective tool. Educators can demonstrate sentence structures using these blocks, such as 'The yellow one is on top of the blue one beside the red one. The orange one is under the brown one and behind the green one.' By manipulating the blocks into various positions, teachers can prompt students to describe their spatial relationships. Furthermore, students can take turns positioning the blocks for their peers to describe, allowing for progressively more intricate arrangements (Harmer,

2001, p. 141). Incorporating tangible objects into lessons on prepositions is often well-received by students due to their visual and multisensory characteristics (Budden, 2011). If lessons on spatial terms are frequently taught using real objects and enjoyable, it may seem contradictory to suggest using gestures as a teaching method. To reconcile this approach, it is necessary to better understand what exactly is challenging about teaching L2 spatial terms.

Alongside L2 fluency, spatial terms, commonly taught as prepositions or directions in ELT, also present unique challenges. The process of learning these terms is typically difficult and gradual. Due to their brevity, words of this class are often short and they tend not to be stressed when spoken, leading to unclear articulation. When encountered in written form, they may be glossed over, resulting in comprehension difficulties (Adams et al., 2019; Glenberg, 2011). Moreover, English prepositions are often conceptually different from those in other languages, creating more potential for error (Brala, 2002). For instance, while in English one ‘walks in the rain’, in French one ‘walks under the rain’ (marcher sous la pluie), illustrating that direct translations can easily result in ungrammatical sentences (Hendricks, 2010). Further complicating matters, this conceptual disparity extends from spatial to abstract domains as well (Lakoff and Johnson, 1999; Tyler and Evans, 2003). Additionally, discrepancies in choice of prepositions exist between varieties of English, such as between British and American English, not to mention regional variation. For example, in British English it is common to ‘live *in* Seward Street’, whereas one ‘lives *on* Seward Street’ in American English. These examples show that there are systematic reasons why uncertainty about prepositions in the ELT classroom exist. While research indicates the value of understanding the bodily experiences that underpin abstract concepts for teaching and learning usage patterns for prepositions (Johansson Falck, 2018), how to exactly teach this knowledge is unknown.

Insights into grammar instruction in the ELT classroom

Grammar can be defined as ‘the ways in which words can change their form and can be combined into sentences in that language’ (Harmer, 2001 p. 12). Grammatical morphemes are the smallest units of language that carry grammatical information. These morphemes typically include affixes such as prefixes, suffixes, and infixes, as well as free morphemes that modify the meaning of words. Grammatical morphemes play a crucial role in indicating grammatical relationships within a sentence, including tense, aspect, mood, number, gender and case. Unlike lexical morphemes, such as {cat}, which carry lexical meaning because they are a word or contribute to the semantics of a word, grammatical morphemes, such as the plural {-s}, serve to convey grammatical relationships

and do not typically have independent meaning outside of this relationship. For learners, understanding that grammatical morphemes are important components of grammar is essential, and these rules are known, at some level, by all competent speakers. In pedagogical terms this implicit knowledge is frequently called competence, whereas its realisation, as in speaking a sentence such as *What is happening?* from Experiment 1 and *It is dark out there!* from Experiment 2 is described as performance (Chomsky, 1965; see also Anderson, 2023). The wide-ranging question 'whether grammar should be taught and if so what grammar, when, and how' posed by Ellis (2006 p. 83) suggests that how grammar should be taught is contested. In the field of applied construction grammar, for example, a recent work was criticized because the shift in the study of communication as a multimodal phenomenon was insufficiently reflected and 'it is a pity … [because] ... gestures might boost both successful production and comprehension of L2 learners' (Lehečková, 2019 p. 94). Many linguists and teachers agree that, the topic of grammar remains a highly disputed issue in L2 didactics.

In Germany, a contributing factor to the challenge of reaching consensus lies in the distinct educational standards between the different German federal states. This diversity extends to the testing of L2 grammar, with Baden-Württemberg conducting grammar assessments in a separate section, whereas in Lower Saxony grammar testing is integrated. Consequently, instructional approaches vary. Furthermore, according to Bastkowski and Summer (2020), there has been limited innovation in instructional methods for grammar teaching over the past two decades in Germany. This situation has resulted in the continued emphasis on Detlef and Margaret von Ziegésar's acquisition-orientated method from the 1990s, which remains the subject of teacher training. It consists of a system with five distinct phases: (1) perception, comprehension and reaction, (2) cognition I (conscious or unconscious use of structures), (3) cognition II (contrasting with the native language, visualisation and/or grammar rules to be memorised), (4) language use, and (5) independent use of structures in more complex contexts. This model of grammar instruction is useful as a comparison to the instruction children received during Experiment 1, 2, and 3.

Interim summary 3

Understanding the historical evolution of the English language is crucial in ELT because it shapes teaching practices. In L2 instruction, striking a balance between accuracy and fluency remains a challenge for teachers, because feedback interventions, which are necessary, can elevate stress levels and impede learning. Gesture-based teaching offers promise because it may be able to offer a sense of safety and minimize anxiety while enhancing both fluency and accuracy. In addition,

gestures may alleviate teacher insecurity by providing a non-verbal means of conveying abstract concepts, allowing them to better 'stick with' learners. Despite challenges like educational inequality, efforts to reduce disparities are crucial. Incorporating gestures into ELT may hold potential for improving educational outcomes in oral fluency, understanding spatial terms, and addressing challenges associated with teaching L2 grammar.

In the next section, drawing on fieldwork during my time in schools, I explore socially and culturally embedded activity to better understand gesture-based language learning in context. In important ways, understanding biological and cognitive learning at the individual level is necessary to comprehend how the human mind operates on its own. At the same time, mental processes such as thinking and learning are situated, highly contextualised, and physically extended (Pouw et al., 2014). In exploring the nature of cognition, Lave (1988) suggests that '[T]here is reason to suspect that what we call cognition is in fact a complex social phenomenon' (p. 1). If observed cognition in everyday practice is distributed across mind, body, and activity, and includes other individuals (Lave, 1988), ethnographic research becomes a valuable complement to individual-focused L2 experimentation by allowing us to observe how people think and learn together. For this reason, ethnographic research in educational settings is useful for understanding how classroom practices like gesture-based instruction function and can be further developed. We turn now to three different vignettes which illustrate Type 3 learning as introduced in Section 1.1.

1.3.3 An ethnographic approach to gesture-based learning

> When students simultaneously see a picture of a cat and observe their teacher modelling a corresponding L2 speech and gesture pair, the meaning of this gesture becomes *taken-as-shared* for classroom instruction. This rapid process establishes the common ground needed to construct agreement among class members for what the sound and gesture mean and enables teachers to build on this shared understanding in further instruction.

> During a conference workshop, teachers form a community of learners with the shared aim of enhancing their ability to use embodied teaching methods. To achieve these objectives, they develop appropriate group *norms of interaction*. This fosters a safe and helpful environment where they can freely experiment and analyse, supporting their professional learning.

> Students who have worked together *collaborate* on a group assessment project. The project documents how they can apply their learning to a new activity while demonstrating their collective skills. Measures of evaluation include how effectively group members work together as a team as well as certain aspects of their artistic performance.

These three episodes represent the many instances I witnessed where instructional gestures made taken-as-shared meaning, as well as norms of interaction and collaboration visible, all of which

influence learning. To more fully grasp such phenomena, it becomes imperative to better understand ethnographic research and the role it can play in embedding such incidents into a broader context.

What is ethnography in the context of language learning?

When discussing ethnographic methods, Howell (2018) observes that 'while anthropologists are endlessly debating … they mostly agree that anthropology has nothing to offer the world without ethnographic fieldwork' (p. 1). This involves methods such as participant observation, where researchers act as both observers and participants. In addition, other standard ethnographic methods include face-to-face interviewing, researcher reflection or journaling, and the analysis of archival records (Eisenhart, 2001, p. 18). Aside from investigating archival records, all of the above methods played a role in my research. In the past, participant observation could be defined as an 'open-ended inductive long-term living with and among the people to be studied, the sole purpose of which is to achieve an understanding of local knowledge, values, and practices' (Howell, 2018, p. 2). It is unfortunately beyond the scope of this section to give a detailed description of what fieldwork is (see Senft, 2012).

In recent years, and increasingly with the beginning of the Covid-19 pandemic, ethnographers have been forced to reconsider face-to-face participant observation (Jakil, 2020), which has influenced work in schools (Janzen Ulbricht, 2020b) and education more broadly (Baumann, 2020). In another development, multi-sited ethnography has emerged and been utilized as a means to investigate educational events and processes that extend beyond the classroom and relate to the broader community (Pierides, 2010; Schieffelin, 2005; Thorne, 1993), which has helped researchers overcome some limitations of previous work (Eisenhart, 2001, p. 17).

Using ethnographic methods in the context of an experiment can be seen as unconventional, and in his essay 'That's enough about ethnography!' anthropology theorist Tim Ingold (2014) writes that the term ethnography has become overused in anthropology and related fields, degrading its meaning and necessitating clarification.

> Such a procedure, in which ethnographic appears to be a modish substitute for qualitative, offends every principle of proper, rigorous anthropological inquiry—including long-term and open-ended commitment, generous attentiveness, relational depth, and sensitivity to context—and we are right to protest against it (p. 384).

One page later, Ingold broadly defines ethnography as 'writing about the people' (p. 385). McGranahan (2018) emphasises that ethnography rests on fostering an awareness of lived expectations and contradictions, being present in order to document how people organise, feel, and 'give their world meaning' (p. 5). Howell (2018) additionally explains that the term ethnography

not only applies to writing but is ‘used for both the actual fieldwork … and the subsequent text—an ethnography’ (p. 2). In summary, included in Ingold’s previously mentioned comments are characteristics of ethnographic research, which have been used elsewhere to define what ethnography is (McGranahan, 2012; Stodulka et al., 2019).

Understanding the defining features of ethnographic research leads to the question of what justifies calling my approach to research in schools ethnographic and asks what this particular way of looking at gestures in the classroom affords. Relevant to this thesis, my ethnographic research focuses on gesture-based L2 learning in diverse classrooms in Germany and Poland. Although the coexistence of different languages and ability levels in individuals and society is a worldwide normality, this reality is often met with scepticism and uncertainty by educational institutions and even multilingual teachers and learners themselves. The context of the language classroom is complex and brings together people from a range of backgrounds with their own sets of linguistic resources ‘[the] words and their pronunciations, [and the] rules for combining them into meaningful utterances, … that have accumulated over time and are available … with varying degrees of reliability’ (Stevenson, 2016, p. 7). The experiences shared in this chapter took place at various times over a period of 5 years between trialing the teaching and testing procedures for Experiment 1 in 2016 and implementing the final learning interventions for Experiment 3 in 2021. In a sense, this introduction argues that my involvement as a researcher with teachers, students, and parents before and after the language experiments was long-term and open-ended enough (including a sufficient number of school lunches, parent meetings, emergency subbing for teachers who were ill, breaking up classroom fights, convincing adults who had become foster-parents mid-experiment that me testing their children would not hinder their child’s education, etc.) for my involvement to count as substantial and my fieldwork to count as ethnographic.

Methodological approaches in ethnographic research

In my work, the field is constituted by physical location and social space. My formal role is often as a researcher, but this can place me in situations in which I talk with parents and school administrators or listen to teachers discuss how education has changed and the struggles they see in the families of the children in their classes. The idea of open-ended learning and listening which is essential to ethnographic work is important here. Drawing on Caine’s (2007) concept of *narrative in-between space*, narration can be defined as a psychological space that lies between researchers and participants (see also Quinn, 2005).

I find the *narrative in-between space* a useful concept because it goes beyond physical proximity. It recognizes that the research process establishes a unique space where knowledge is constructed through relationships among teachers, janitors, and students in the school, but also extends to others such as parents, guardians, and translators beyond the school. In other words, research is not a process of directly transferring information from a child or teacher to a researcher, but rather, that knowledge is jointly constructed in encounters between individuals (Kinnunen & Puroila, 2016). This is important because I have noticed differences between the data formally collected (e.g. interviews with teachers or focus groups with children where exact phrasing is required for ethics applications) and the more spontaneous exchanges presented here from field notes, for example, in their ability to reveal dynamic teaching and learning situations.

In his ethnography *Tangled Up in School*, Nespor (1997) distinguishes his approach from those that view schools as isolated entities unaffected by society. Rather, he posits that schools should be seen as dynamic intersections within society where different factors influence curriculum, teaching methods, and the experiences of students and teachers (1997, p. xiii).

> Instead of treating the school as a container filled with teacher cultures, student subgroups, classroom instruction, and administrative micropolitics, I look at one school … as an intersection in social space, a knot in a web of practices … beginning and ending outside the school …. I look at them as extensive in space and time, fluid in form and content; as intersections of multiple networks shaping cities, communities, schools, pedagogies, and teacher and student practices.… I want to give school its due, but not on its own terms—to treat it not as the focus of study but as a point of entry … to the study of economic, cultural, and political relations shaping curriculum, teaching and kids' experiences.

Given that schools are tasked with helping each student to develop to their fullest potential while utilizing their unique talents and viewpoints, it is critical to recognise how these processes are deeply situated, contextualized, and culturally embedded. Also important to the *narrative in-between space* concept is acknowledgement of research as a practice, where researchers, and possibly others involved, are endowed with symbolic capital, which includes authority and legitimacy in the realm of knowledge production and dissemination. Bourdieu (2017) argues that dominant groups within society possess cultural capital, which encompasses forms of knowledge, skills, and credentials that are valued and recognized as legitimate by broader society. This factor also may have played a role in the way I was trusted as an outsider, but, as Hammersley and Atkinson (2019) report, having status as an authority of some kind does not necessarily make the process of research easier.

Understanding social interaction in language classrooms

If the process of learning involves generating new ways to actively participate in social settings (Cummins, 2016; Kuhlen & Abdel Rahman, 2023; Nathan, 2021), then when closely observing learners in their physical environment, we should be able to observe new socially oriented activities. In addition, since socially patterned activities are organized in reference to community norms and values, any changes in these norms should also be observable. Linguistic accounts of all kinds are a feature of everyday life where people discuss what happened and evaluate each other's intentions, attitudes, responses, and abilities (Hammersley & Atkinson, 2019). One way to make these observations is by attending to what is said. In ethnographic writing, as in many disciplines (medicine, business, law, etc.), vignettes are frequently named to help readers anticipate the subject matter and better understand its relevance within the broader study. The following vignettes (e.g. *You are in my group and we have to speak in English* and *What is 'small' in English?*) provide readers with an opportunity to better understand the experiments described in Chapters 2, 3, and 4 of this thesis by introducing some of the people and events which took place concurrently.

You are in my group and we have to speak in English.

> On the second day of the week-long learning intervention for a school in Experiment 1, a Grade 6 boy who had missed school the previous day came into the English classroom. The boy, who we will call Thomas, was met by his classmate Raik. Raik explained that on the previous day, the class had been divided into small groups, that Thomas and Raik were in the same group, and that lessons were such that Thomas would have to speak English. Overhearing this brief conversation, I was surprised that speaking English in English class seemed noteworthy, and was also reminded that in the previous week, Thomas had been the boy who had responded to my question 'What's your name?' with 'I don't speak English.' This conversation and my recollection caused me to wonder how the subsequent gesture training phases would go. With the entire class in front of me, it was easy to keep Thomas in sight. The instructions were simple. Something along the lines of, 'The words we are learning will repeat. If you recognise a hand movement you can say the word. If you can speak and move your hands, you may join in.' Standing in the middle of his row, Thomas remained silent and still for about approximately three minutes. Eventually, the synchronous motions of the speech-gesture pairs surrounding him seemed to draw him in and he soon spoke and gestured the words alongside his classmates.

The Gesture-for-Conceptualizing Hypothesis (see Section 1.3.1 under 'Gestures play an important role in learning and teaching') posits that gestures schematise information and suggests that since Thomas and Raik joined in the training phase, they were most likely learning something about the

specific items they practiced as well as something about the language as an abstract system (Cappelle et al., 2010; Koelsch et al., 2016). Having only visited this particular English class once before the learning intervention began, it is impossible to say what the classroom norms for speaking English were like, but this incident illustrates that participant observation and ethnographic writing can describe *norms of interaction* as well as processes of how these norms can be altered, even if only for a time, in a group of students.

What is 'small' in English?

In this account, also from Experiment 1, we shift our focus to an exchange that occurred in the first-aid room that I was allowed to use as a testing room. Before examining the details of the exchange, between Asif (13) and myself, it is helpful to provide a description of Asif sourced from my field notes in order to contextualise the interaction.

> I had come to understand Asif as the unofficial leader of the four other unaccompanied boys also from Afghanistan. He was the one who could explain what the teacher wanted, could calm heated situations, and knew enough Arabic to know when an insult from a class member of a different ethnicity had to be punished and that the ensuing fight that erupted was 'justified'. Fighting broke the classroom rules Asif usually helped others to uphold, but sometimes, when a whispered insult went too far, breaking the rules seemed to be, as his teacher explained to me, a matter of honour.

In the exchange below, Asif had accompanied a younger boy, Jammas, to my testing room to help him find the way and translate instructions if needed. After the younger boy had completed the test and left, a question about English vocabulary prompted Asif to share a story about the after-school English lessons he had attended in his village back home.

	Original transcription	English translation
Student A:	What in English 'klein'?	What is 'small' in English?
Researcher:	'Kleid?'	'Dress?'
Student A:	'klein'	'small'
Researcher:	'klein' small	'small' [means] small.
Student A:	Ich vergesse …	I forget...
Student A:	… das ist nicht Schule. Das ist von einer Stunde und wir gehen dann English.	… [The place we went to] was not [a regular] school. [There] we [had special lessons in this special school] for an hour [every day] and then we were [knew] English.
Student A:	Englisch ich fertig.	I was finished [with learning] English. [I

		was fluent.]
Student A:	Englisch und wir kommen [nach Deutschland] und vergessen.	[We knew] English and we came [to Germany] and [we] forgot [everything we had ever learned].

The situation above was interesting for a number of reasons. Participating in classroom activities, I had witnessed joy as well as frustration, but this short exchange about loss was the first of its kind in that class. Glancing at a simple picture in the testing room and not knowing a word seemed to open up a field of awareness not usually mentioned. A technical error on my part meant that I had mistakenly recorded the above exchange, as opposed to the fluency test I had intended to capture.

This excerpt also illustrates the principle of reflexivity important in ethnography because it acknowledges 'the extent to which researchers shape the phenomena that they study' (Hammersley & Atkinson, 2019, p 191). Explaining the connection between the phrase *English ich fertig* and its understood meaning is difficult to explain in any other way. This interpretation cannot be separated from the pride in accomplishment conveyed by Asif's voice, as well as passing comments by the teacher indicating that she had initially communicated solely in English with Asif when he first arrived.

The project is good.

We now turn to another exchange recorded during a focus group session in a 'Willkommensklasse', from another school where learners reflect on the group theater project they had completed as a part of Experiment 1 with another grade 6 class.[14] The class teacher, researcher, and all the 'Willkommensklasse' class members are present.

	Original transcription	English translation
Student A:	Projekt ist gut.	[The] project is good.
	(lachen)	*(laughter)*
	Theater etwas anderes.	The play [was] something different.
Researcher:	Und die Bewegungen die wir gemacht haben ... haben die euch geholfen oder war das doof?	And the movements we made … did they help you [to learn the text] or were they stupid?
Student A:	War das...	That was...
Teacher:	Habt ihr das gern gemacht?	Did you like that?
Researcher:	Hat es geholfen? Ja, aber warum?	Did it help? Yes, but why?
Student A:	[ja ja]	[Yes, yes]

14 A theater experiment is a conceptual framework which embeds non-quantitative data collection within an experimental design. These ideas are presented and explored in Janzen Ulbricht and Kruger (2023).

	Ja, gestern, gestern [meint er Gesten?][15]	Yes, yesterday, yesterday [meaning gesture?]
Researcher:	A. kannst du sagen was du darüber denkst?	A. Can you tell what you think about it?
Student A:	Weiß ich nicht.	I don't know.
Researcher:	Schwer nä?	Hard, isn't it?
Teacher:	Das erfordert eine gewisse Reflexion und dazu sind sie nicht in der Lage.	This requires a certain amount of reflection that they are unable to do.
Researcher	Ja, ja.	Yes, ok.
Student B:	Wir haben das alles in Schule gemacht, und dann habe ich das alleine nach Hause.	We did it all [the play] at school, and then I [showed it at] home on my own.
Teacher:	Das ist doch schon toll. Das ist super. Hast du's deine Mama gezeigt? Das ist doch schon super!	That's already great. That's super. Did you show your mommy? That's really great!
Researcher:	Ok, also das [Theaterstück] konntest du zu Hause auch machen.	Okay, so you could do [the play] at home, too.
Student B:	Ah! *(nicken)*	Ah! *(nodding)*

Beliefs are formed in various ways. One way is certainly through the culture we live in, but beliefs can also be formed through repetitive experiences. Because the teacher reformulates the researcher's questions, we can infer that while she appreciates the benefits of reflective group discussions, she has experienced difficulties in similar situations. This also explains her almost overwhelming enthusiasm, not well captured in the written transcription, when Student B describes presenting the play learned during the theatre project at school to her family at home.

This leads to a second observation, that when children need to tell stories or express opinions, and time is available, the language is there. This stands in contrast to the teacher rather bluntly stating that the children are not able to reflect on their personal opinions 'dazu sind sie nicht in der Lage.' / 'they are unable to do this.' Of course, listening to a transcript is different than responding in the moment, but I would like to suggest that children in this second language classroom do express their opinions.

Student A says, '[The] project is good.' expressing positive emotions, and a few lines later is also able to express not having or wanting to say anything with, 'Weiß ich nicht.' / 'I don't know.' When Student B relates her experience of 'taking home' the play, based on the teacher's reaction, we can infer that this experience is something special, that the experience has left an emotional

15 This transcription includes a line highlighting the similarity in sound between the German word for 'gesture' (Geste) and 'yesterday' (gestern). This observation prompts the question if translation should involve 'second-guessing' by anticipating challenges faced by L2 learners.

imprint on both the student recounting what she did and on her listeners. This enthusiasm, ‘Das ist doch schon super!’ aligns with Nespor’s view of seeing schools as dynamic intersections within society where connections between home and school life have an important influence on students and teachers.

Watching students in a physical environment can offer tangible proof of their learning, but closely listening to what learners say is another way and plays an important role in ethnographic work. Linguistic and cultural anthropologists concur that narratives go beyond mere accounts of what happened, when and where and to whom, and ‘that they somehow make public the covert underlying presuppositions that organize the worlds in which speakers live’ (Hill, 2005, p. 157). Following this line of thought, we can examine a few additional quotes from the ‘narrative in-between space’ provided by three Polish children. These quotes represent those who were in Experiment 2 on spatial term learning which took place in both Poland and Germany.[16] They offer reflections on their individual experiences portraying a bear and an owl onstage after the theater project they participated in had ended.

> Od początku chciałem być misiem. Fajnie jest być na łóżku z kolegami z klasy mając na sobie uszy misia i piżamę.
>
> I wanted to be a bear from the very beginning. It’s really exciting to share a bed with your classmates wearing bear ears and pyjamas. (Szymon, age 10)

This example shows the importance of taken-as-shared meaning and group collaboration. Szymon’s statement underscores the importance of social engagement with peers during learning activities (cf. Böttger & Sambanis, 2017), alongside the joy of immersing oneself in an atmosphere outside everyday experience. This sentiment finds resonance in the next quote:

> Sowa jest najlepsza! Nie musisz pamiętać żadnego tekstu i możesz skakać i wydawać dziwne dźwięki!
>
> Being an owl is the best! You don’t have to remember any text, and you are allowed to jump, and make strange noises! (Alicja, age 11)

This example shows the importance of aesthetic experiences and group collaboration. While some students may have grappled with shyness or felt slighted that they were not assigned their favourite role, Alicja eagerly embraced what she considers ‘the best’ role, exploring her

16 These three quotes have been previously published in Janzen Ulbricht & Michalak (2019). Results from the experiment these learners participated in are detailed in this thesis (see Experiment 2 in section 3.2). Participant observation was a part of the original ethics application and proposed experimental design, but this information was not included in the published experimental results (Janzen Ulbricht, 2020a).

experience through physical movement and sound. As will be explained in more depth elsewhere (see Sections 2.1.4 and 3.2.4), in the theatre project every child, regardless of the role they eventually played on stage, learned every speaking part. Alicja not needing to 'remember any text' should be understood within this context, a situation also shared by Lena, as mentioned in the subsequent quote.

> Nie przeszkadza mi, że trzymam te gałęzie. Niby tylko siedzimy, ale misie potrzebują nas, żeby móc przejść wokół jeziora.
>
> I don't mind holding these branches. We are just sitting [here], but the bears need us in order to be able to walk around the lake. (Lena, age 9)

This example shows the importance of taken-as-shared meaning and group collaboration. Despite having a limited speaking role, Lena expressed her appreciation for her part in the play and demonstrated flexibility in her interpretation of what it meant to be needed. Her use of the word 'we' suggests that she spoke not only for herself but also on behalf of others, indicating an emotional connection to her classmates through her role. This statement underscores the sense of unity resulting from collaborative effort within the group. Lena acknowledged the significance not only of her role, but also that of her peers who were holding branches. Their role was crucial in marking the boundaries of the lake as 'trees', enabling the audience to make sense of the bears' movements. Without this delineation, the bears' actions would have been visible but difficult to comprehend for the audience.

Let us now consider a final classroom example that shares similarities with the three initial classroom examples from this section. In this concluding interaction, we observe how codified gestures, representing a multimodal form of taken-as-shared knowledge, are used in a novel way within norms of interaction that are creative and supportive. This results in a collaborative effort, leading to the creation of a simple group artistic performance which provides evidence of an understanding of the meaning of the English plural 's' in context.

I know—the cars crash

> On the final day of the week-long learning intervention in Experiment 3, students have learned the gestures needed to cue phrases like 'the dog's tail' or 'the frogs jump'. Three girls receive a card representing the phrase 'the cars crash' with the instructions to go out into the hall and together 'create a GIF', meaning a short scene with a beginning, middle, and end that they can perform for their class. After practicing on their own, the three return to the class and take their turn presenting. When a classmate shows the car gesture, the performers realise that the one car in their performance (crashing into a tree being watched by an onlooker) won't elicit the 'cars

gesture' required by their cue card. The girl who had been a tree quickly takes on the role of a second car (two cars drive into each other as the onlooker looks dismayed), repeating their actions more and more smoothly until a classmate says, 'I know—the cars crash.' guessing the intended phrase.

Advancing the understanding of gesture-based language learning

Ethnographic methods have the potential to uncover complexities of social interaction in language classrooms and make visible the role of emotions in learning. This section highlights something rather remarkable: Through participant observation in authentic learning settings like schools, it is possible to see how teachers and students embody the practices, norms, and values of their cultures and that ways of thinking, teaching, and learning in the L2 classroom can be grounded and embodied through gesture. This is added evidence that people use their physical bodies to create meaning and establish connections between new concepts and prior experiences. Although not the focus of the events reported here, teachers also mentioned evidence indicating that educational systems can limit access to these natural, embodied resources, suggesting that doing so impedes the abilities of students to think and learn. As a consequence, we may significantly underestimate not only what students know but also what they want to know.

Interim summary 4

Adopting an ethnographic approach is useful for understanding the use of teaching gestures in the English language classroom. Ethnography allows researchers to use the in-between space of research to study the contextual factors that shape learning including the exploration of social interaction and the meanings attributed to these interactions by students and teachers. By capturing student and teacher perspectives of language learning, ethnography provides insights into the complexities and diverse perspectives involved. Incorporating an ethnographic lens in experimental research on gesture-based teaching methods enhances our understanding of how gestures are utilized, interpreted, and experienced within specific educational contexts, thus contributing to a more in-depth understanding of embodied teaching practices.

1.4 Focus and aim of the present work

Theories or theoretical models can be used to make predictions about expected outcomes from experimental work. In this regard, different theories can be compared with one another based on their ability to predict experimental outcomes. However, experimental work can also be used to

enrich a given theory, by providing more detailed information about contextual influences on outcomes, supporting when findings can be generalised (and when not), and anticipating how future phenomena might unfold (Kislov, 2019). The present work takes an enriching theories approach to investigate the social and cognitive processes underlying gesture-based L2 learning. In order to gain more insight into how codified teacher gestures may influence L2 fluency, spatial term, and grammatical morpheme learning, three experiments were conducted along three research questions using two new experimental techniques.

As has been outlined, academic disciplines differ in their theoretical backgrounds and thus their perspectives on gesture-based L2 learning. Language classrooms are complex, and no single discipline can fully explain what occurs within them. However, recent findings of gesture research demonstrate that information relevant for learning can sneak in 'under the radar' of consciousness (Cook, 2018), 'widening' the time window in which children can integrate speech (Carrazza et al., 2021), and aiding the comprehension of abstract systems (Novack et al., 2014). In addition, teachers who are taught to integrate gestures into their lessons teach in ways that benefit the learning of their students (Alibali et al., 2013). Given that instructional gestures can function independent of any specific L1, teaching gestures may be particularly beneficial when instructing linguistically diverse groups of students, as is often the case in Germany and in many other countries, underscoring the urgency to learn more about L2 learning strategies (Janzen Ulbricht, 2018a, 2020a, 2023). Language is symbolic and social. Gestures, as an abstract embodied form of linguistic information, might be able to support learning in such a way.

Therefore, the first question of the present work is whether and how L2 oral fluency might change when learners in a naturalistic setting receive gesture-based instruction. The study reported in Chapter 2 (Janzen Ulbricht, 2018a) implements two teaching methodologies—one with teacher gestures at the level of morphology and one with gestures at the sentence level—and compares fluency measurements before and after instruction. The experiment detailed here builds on the work of Hille et al. (2010), which also compared two L2 teaching methods under naturalistic teaching conditions. In the study reported in Chapter 2, participants were randomly assigned to one of the two gesture learning conditions and over four days received instruction on the text of a simple play. To control for teacher effects, teachers taught in both groups balanced for time. The experimental task used in Chapter 2 to measure L2 oral fluency was a picture description task where the picture was unrelated to the play used during the learning intervention.

Building on results from the first empirical study on oral fluency (Chapter 2), the second question of the present work focused on whether and how spatial term ability might change over time. Unlike fluency measures that weigh all syllables or morphemes equally, spatial terms,

although frequently short in word length, pose a unique challenge for L2 learners due to their abstract nature. Therefore, the investigation reported in Chapter 3 (Janzen Ulbricht, 2020a) compared changes in L2 spatial term ability following instruction in the same two teaching methodologies presented in Chapter 2. The experimental task used in Chapter 3 to measure L2 spatial term ability is the Bear, Ball, Box Spatial Term Test which was also unrelated to the play used during the learning intervention and was specifically developed for the investigation.

The third question of the present work was to evaluate the role that gestures can play in learning L2 morphosyntactic structures. This experiment extends the general concept that cognitive representations are grounded or embodied through perception and action to an important aspect of L2 syntax. It specifically focuses on the teaching of two significant L2 grammatical morphemes through gestures for the plural {-s} and 3rd person possessive {-s} in English. In a within-subjects pilot experiment with pretest and post-test design, children were tested with syntactically specific (gestures vary depending on the meaning of the {-s}) and syntactically general gestures (gestures do not show the specific meaning of the {-s}). This experiment exploits the fact that the English possessive ‘s’ (e.g. The {dog} + {-s} leash is over there.) and the plural ‘s’ (e.g. The two {dog} + {-s} ran away.) are homophone ‘s’ morphemes that have different meanings (but sound the same).[17] In the study described in Chapter 4 (Janzen Ulbricht, 2023), before and after teaching participants were asked to complete word fragments preceded by video footage presenting gestures that were either syntactically general or syntactically specific. This task is the Gesture Speeded Fragment Completion Task and was specifically developed for this experiment.

In Section 1.1, grounded and embodied experiences were suggested as a possible explanation for discerning when learners feel connected to or disconnected from learning. Meaningful experiences can also explain why some learners have long-term access to concepts, while for others these same concepts slip away. To truly understand how to support learners, in addition to teaching experience and careful observation, empirical L2 classroom experiments also prove invaluable. Experiments can help educators gain a more nuanced understanding of the complex dynamics at play during L2 learning, providing evidence beyond what can be personally observed, and enabling educators to more easily adapt their teaching strategies to foster inclusive and lasting educational experiences for all. As mentioned at the beginning of this chapter, we now move on to the details of such experiments in Chapters 2, 3, and 4. Chapter 5 then summarizes the outcomes of the three studies and discusses their contributions to understanding gesture-based learning.

17 The third-person singular verb ending ‘s’ (e.g. The {dog} run {-s}.) is also homophonic, and important for beginning learners of English but was not included in the experiment.

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Chapter 2

An Experiment on Gesture and Fluency in two German Schools

This chapter is based on: **Janzen Ulbricht, N.** (2018). An experiment on gesture and fluency in two German schools. *ELT Journal*, 72(3), 309–318. https://doi.org/10.1093/elt/ccx059

Abstract

Effective language learning processes are key in multilingual societies, but past research on gesture and second language acquisition has often focused on the relationship between gesture and cognition, but seldom on gesture as a teaching and learning tool. Although it is well established that gestures facilitate second language learning, there is reason to think that different gestures may benefit children differentially. In the context of learning and performing a play, the experiment discussed in this article implements two English language teaching methodologies, one with teacher gestures at the level of morphology and one with gestures at the sentence level. This experiment, with a diverse group of primary school age children, takes a naturalistic setting and shows that among the high and low performers there was a difference in long-term fluency development between the two experimental conditions. The data suggests that the fluency level of learners is predictive of which gesture type benefits fluency the most. Children who had a lower initial speech rate benefitted more from teaching using gestures which are morphologically complex, whereas the children who had a higher initial speech rate benefitted more from gestures at the sentence level.

2.1 Introduction

Creating a symbolic gesture in the classroom brings something concrete into being which affects ongoing thinking. Just as glancing at a written note helps one to remember, gestures provide a stable physical reference that can embody aspects of cognitive tasks. Previous gesture studies suggest their value for teaching abstract systems like language (Macedonia and Klimesch 2014) and maths (Novack, Congdon, Hemani-Lopez and Goldin-Meadow 2014), but research also shows that gestures are not helpful with all types of learning. In distinguishing between L2 word pairs, for example, gestures did not help when the contrast was difficult to perceive phonetically (Kelly, Hirata, Manansala and Huang 2014). The classroom-based study outlined in this article considers gestures as a foreign language teaching tool by implementing two language teaching methodologies, one with gestures at the level of morphology, and one with gestures at the sentence level. While learning gestures in addition to speech increases initial cognitive demands on learners, knowing meaningful gestures tied to a word or sentence has been shown to enhance learning (Macedonia and Klimesch 2014). Here we do not ask if gestures per se 'help'. For this, the interested reader is referred to a review by Macedonia and von Kriegstein (2012). Rather, we ask whether memorising the same play with the aid of different movement-based teaching methodologies impacts the long-term oral fluency of beginning learners in measurably different ways.[18]

In two urban schools in Germany, matched English codified gesture (CG) and scenic learning (SL) units were designed for a one week English language theatre project for mixed groups of recent refugee and grade six learners. Children were placed in two experimental groups where they learnt and memorized the same text. In the CG group, the teacher provided gestures for all the words of the play, meaning words and gestures were learnt simultaneously. Consistent with SL methodology, the teacher taught the children the play supported by gestures for the most important sentences.

2.1.1 Fluency and language learning

Fluency refers to the level of oral proficiency at which a speaker is easily able to express their thoughts. Fluency has been considered in different ways. Lennon (1990) differentiates between fluency in the broad sense, meaning the ability to produce accurate and complex speech, and fluency in the narrow sense, as measured by the length and number of pauses in a given speech

18 See Appendix B for a sample text illustrating the original play's language and style.

sample. Segalowitz (2000) observes that fluency reflects ‘cognitive fluency’, meaning the cognitive mechanisms which support performance, as well as ‘performance fluency’, which is how this ability is actually expressed. According to Ullman (2016), meanwhile, the declarative and procedural memory systems refer to the neurocognitive systems involved in learning, representing and applying relevant knowledge. Applied to language learning, declarative knowledge includes knowledge of morphology, as well as grammar and pronunciation rules. Declarative knowledge can be quickly learnt, but is slower to use, necessitates more cognitive resources than procedural knowledge and is also more easily forgotten. Procedural knowledge requires practice but is processed fast and in parallel with other processes, putting less of a burden on working memory and so is more suitable for fluent speech (de Jong and Perfetti 2011).

The number and length of pauses influences perceptions of fluency, but alone are not reliable indicators of the proceduralization of speech, because they vary depending on task demands and planning opportunities. However, used in combination with a measure of speech, as in speech rate, pause data can provide a robust measure of proceduralization. Fluency is perceived by many as difficult to acquire and assess, but by using speech rate data (counted in syllables per time unit) researchers are able to reliably compare fluency between tasks, individuals and over time (de Jong and Wempe 2007). Since fluency is an important goal of foreign language education, measuring fluency, as suggested by de Jong and Perfetti (op.cit.), can help to evaluate teaching techniques and methods.

Most fluency research has focused on short-term effects, not on long-term developments. While planning and repetition may enable the speaker to benefit from priming, longer term effects may require proceduralization (de Jong & Perfetti op.cit.). In this research, since the same text was learned in both experimental conditions, if teaching gestures in one domain (learning the text of a play about animals) transfer to fluency changes in another (describing a picture of a family) and these fluency changes are sustained over time, this could indicate that the gestures contributed to proceduralization.

2.1.2 Gesture and language learning

Most teachers and learners agree on the importance of spoken fluency. While many teachers perceive their gestures as being relevant to learning, the role of gesture in teacher training has received much less emphasis than has fluency. Based on advances in neuroimaging, however, many studies have shown the supportive cognitive effects of gesture on language learning (Macedonia and von Kriegstein op. cit.), as has long been argued by proponents of Asher's Total Physical

Response method (1977). Neuroscientific research methods may be new, but as Mackey's ELT Journal article from as far back as 1955 points out: 'Objects alone are not sufficient to teach meaning. Much has to be taught through gestures like pointing and touching...'. Gestures, or hand, face and body movements made while speaking, are an important feature of human communication, and teachers using gestures in a purposeful or even scripted way is not a recent pedagogical innovation.

As previously stated, gestures can support comprehension, memory and recall. When there is something about the hand shape or movement which suggests what is meant, gestures have a clear meaning. When a teacher creates a new gesture, they must produce a symbolic movement with a semantic relationship to what is meant or the gesture will not be immediately understood and must be learnt. Codified gestures refer to gestures which have a 'dictionary meaning' shared within a certain group (Poggi 2013). This group can be very large, as in the group of people in the world who understand the 'thumbs up' gesture, or as small as the students of one teacher. Codified gestures may be iconic, such as meaning 'cat' by showing whiskers on the side of the mouth but may also be rather arbitrary, as when moving a closed fist back and forth to represent the word 'why' in German sign language. Movements indicated by the term gesture are distinct from hand movements which are a part of sign language. While sign languages can be a rich source of useful teaching gestures, the hand movements used in sign language are called signs and they follow grammar which is different from spoken speech. Codified gestures may be part of a system that shows language (such as Signing Exact English (SEE) to show spoken English) but are not a language in their own right. In this experiment, because the teacher gestures referred to fixed morphemes ('run' + 's' in the CG condition) and fixed sentences ('Let's go out the window!' in the SL condition), technically both groups of children used codified gestures to support their learning.

2.1.3 Codified gesture condition

In both experimental groups, the children had text learning phases in which they separately learnt the same text. For the CG condition, the teachers taught a set of codified gestures, one for every morpheme in the play. In this condition, most words such as 'window' had a single gesture, but some words such as 'animals' had two gestures, one for 'animal' and one to show the plural 's'. During the text learning phases, the children sat in a semi-circle facing the teacher. When reading the text, the teacher initially spoke and slowly cued the play, meaning that words and gestures were learnt simultaneously. The children were instructed to speak together as soon as they recognised a

gesture, but were not instructed to gesture. Once the children could recognise and speak the words, of their own accord, they began to imitate the accompanying gestures.

2.1.4 Scenic learning condition

Scenic Learning is a drama-based approach to language learning which combines choral repetition and movement to learn vocabulary words, phrases or sentences (Sambanis 2013). In this condition, the children were initially told to relax, close their eyes and listen to the teacher reading through the play. During the second reading the children were to relax, listen to the teacher read and listen for words they knew. After listening, the teachers were instructed to work through the text and help the children in ways they had had success with in the past. Techniques used included following in the text with a finger while the teacher reads, the teacher stopping unexpectedly and the children calling out the last word heard; reading the play in parts; and reading in small groups.

The focus of the first six text learning phases for the SL group was on understanding and fluently reading the play. For sessions seven to twelve, the emphasis was on using gestures at the sentence level to memorise the parts of all actors and practise speaking together. Following the SL approach, the most important and most frequent sentences of the play were practised accompanied by a simple movement. The gesture for the sentence ‘But we can't sleep!’, for example, was enacted in the SL group by everyone simultaneously raising their open hands to shoulder height and speaking in an exasperated manner. While in the CG condition, all of the words were accompanied by gestures, in the SL condition, excluding the narrator parts, 63 per cent of the words were in sentences accompanied by gestures.

For all children, it was made clear that the goal was to memorise every speaking part independent of the role they would play in the actual performance. In the SL group the children had access to the printed text but only during the text learning phases, after which the texts were collected for safe keeping. It was emphasized that the goal for the performance was speaking and acting together in character groups, and it was not possible to practise this independently. After the text learning phases finished, both groups (i.e., the CG and SL groups) were combined, roles were assigned and a narrator from each group was chosen. For the final five hours of teaching time, the focus moved from learning the text to presenting it on stage in an artistic way. At both schools, two children took turns reading the narrator's part. All other children were assigned the parts of the other characters. At one school, during the final rehearsal, several children decided they did not want to perform on stage and sat for the performance in the audience. Because of the nature of the play,

with several children speaking chorally for one part, this did not result in significant changes in the performance.

Research question

In this study, the following research question was addressed: When learning the same text, does the use of different movement-based teaching methodologies, using a gesture for every word without the written text (CG) or using a gesture for the most important sentences with access to the written text (SL), create a measurable difference in learners' long-term oral fluency?

2.2 Materials and Methods

It is well established that gestures facilitate L2 learning. This study contributes to the field of classroom-based research by testing the effects of gestures on fluency outcomes through a preliminary study using a randomized experimental design. Matched codified gesture and scenic learning units for beginning English learners were developed and their effects on oral fluency were tested. Following a repeated measures experimental design, which measures changes over time, pre-, post- and delayed post-test recording analyses of oral fluency measures were carried out (including the number of syllables and morphemes and the number and length of silent pauses). The same transcriptions were also used to test for grammatical accuracy but these tests are not reported in this article.

2.2.1 Participants

Fifty-four learners from two primary schools in urban Germany (37 per cent female; ages 10-13; M = 11.65, SD = 0.78) participated in our study. At both locations, the experiment was part of a joint theatre project between members of a grade six class and a class of refugee children from the same school. At the first school, there were 20 grade six and eight refugee learners. Of the grade six children, 16 (80 per cent) listed an L1 other than German as their primary home language. At the second school there were 16 grade six and 10 refugee learners. Of the grade six children, all listed German as their primary home language. All the refugee children at both schools listed an L1 other than German as their home language. The time the refugee children had spent in Germany at the time of the study at school one was between 6 and 18 months. In the second school, three children had arrived between 6 and 12 months earlier, but seven had been in Germany for less than half a year. All of the children in all classes reported having previously learnt English in Germany or in

their home country (grade six learners M = 3.94 years, SD = 0.79; refugee learners M = 2.94 years, SD 1.98). Signed parental consent was obtained and all learners in the study agreed to participate.

2.2.2 Procedure

At the outset of the study, a fluency test using a set of family pictures not required during subsequent teaching was administered to all initial participants. Students were individually recorded, and in each test they used the same single picture which they themselves had selected. The fluency tests consisted of a planning phase, where the child looked at the picture until he or she was ready to speak, followed by a one-minute recorded monologue prompted by the sentences: 'Tell me what you see and what you think. Start when you are ready.' The one-minute timer began when the child said his or her first English word. If, after beginning, children became silent and had not spoken for ten seconds, the researcher pointed to the picture encouraging the child to speak about it. This testing format was chosen for several reasons:

- Describing pictures is a common task familiar to most learners.
- From teacher interviews, it was known that some of the refugee children had been at English speaking schools, so the test needed to be appropriate for children of widely differing abilities.
- As a result of their migration, many children had experienced a break in their education and a non-threatening test was a prerequisite for permission to run the study.

Typical speaking strategies used were naming items (baby, t-shirt), or constructing a story based on the family members (e.g., 'This is the mother and the father. They love their daughter very much and she is very funny...'). All students completed a pre-test in week one, before their gesture training, and the post-test in the week after the training, followed by the delayed post-test in week seven at the project's end. All training and test sessions took place during regular class hours. Taking class of origin and sex into account, learners were then randomly assigned to either the codified gesture (CG) or scenic learning (SL) groups.

In week two, the children received 14 hours of English instruction as part of a special week-long project. The main focus of the project week was a simple play. There were a total of 12 sessions, each 15 minutes in length, which focused on learning the text of the play. These phases took place in separate CG and SL groups and made up three of the total 14 hours of teaching time. These separate training sessions were embedded in activities which happened in the larger group.

Beginning and ending the day, sport activities and creative activities, such as singing and designing costumes and props, as well as the final production, all took place in the large group with both teachers in each school present. In the text learning sessions of the CG group, the teacher gestured the play and the students learnt the text by hearing and 'reading' the gestures. In the SL group, after becoming familiar with the text, the students acted out the scenes of the play using gestures at the sentence level to support their learning. During their text learning phases, the SL learners had access to the written text, which was not the case for the CG group. To control for an influence of teacher effects, both teachers in each school taught both groups balanced for time. It is of significance that the content of the theatre piece (animals) and the family pictures (people) were not the same. For slightly more than 60 per cent of the text learning sessions, fidelity-of-implementation observers were present in each classroom to ensure that the children were taught as intended in terms of timing, content and activities.

In week three (post-test) and seven (delayed post-test), the children were again tested for fluency. Due to school changes and illness, five children were unable to complete all three recordings which resulted in a total of 49 complete sets of recordings.

2.2.3 Transcription and pauses

Following de Jong and Perfetti (op.cit.), all monologues were transcribed by the researcher using Praat software (Boersma and Weenick 2015). To make segmenting and coding the speech and measuring pause times somewhat easier, the pause boundaries were first determined using the Praat function 'To Textgrid (silences)' (de Jong and Wempe op.cit.). We defined a pause as silence or a nonverbal filler of 300 ms (0.3 seconds) or longer. This decision follows Lennon (op.cit.), because beginning learners speak more slowly than advanced speakers, and pauses longer than 300 ms sounded dysfluent. All pause boundaries were checked and adjusted by the researcher, if necessary. Because this study is interested in speech rate in English, silent pauses, filled pauses such as 'uh' and 'mm' and word fragments were coded and treated as pauses. L1 words which were not English, such as Kappi for 'cap' or lala for 'elder brother', were also coded as pauses and not counted as speech. (It should be noted that filled pauses such as 'um' do not show a lack of fluency for advanced speakers of a language; rather filled pauses are assumed to indicate lexical planning. Code-switching also does not necessarily show a lack of fluency. However, because the focus of this experiment was on fluency in English, the more simplified model of fluency outlined here was chosen).

After transcription, syllables were counted using the qdap module for the statistical software R (Rinker 2016) and speech rate (syllables/time unit) changes over time were calculated. The researcher was blind to the experimental group of all participants until transcription and coding had finished. Speech rate in syllables is a measure of fluency which corresponds to expert opinions (de Jong and Wempe op.cit.); however, speech rate can also be measured in morphemes. While the word ‘cat’ and ‘cat's’ both have one syllable, the word ‘cat's’ is morphologically complex (‘cat’ + possessive ‘s’), and consists of two morphemes. Because the two gesture conditions were different at the level of the morpheme, speech rate in morpheme values were also calculated. However, the fundamental patterns observed for both measures were the same.

2.3 Results

As noted above, fluency was tested before the project began. An independent samples t-test (speech rate in syllables by experimental group) compared the mean scores of the two experimental groups. The initial mean speech rate in syllables for the CG group was (M = 0.63, SD = 0.46) and the SL group (M = 0.60, SD = 0.33) $t(48.9) = 0.24$, $p = 0.81$, indicating that the groups are comparable.

The post-test happened in the week following the final presentation of gestures, followed by the delayed post-test seven weeks after the initial fluency test and five weeks after the theatre project. Comparing the two experimental groups, our first analysis showed an improvement for both with no practical differences. However, when the initial speech rate was plotted against the long-term gain on the individual level, it became clear that the experimental group which the children belonged to had a different effect on high and low performing pupils. Figure 1 (online version) shows what is termed an X-interaction, meaning that the children who had a lower initial speech rate benefitted more from the CG group, whereas the children who had a higher initial speech rate benefitted more from the SL group. Any gain in fluency is a child specific variable and measures how children compare to themselves, so cultural or L1 differences among children cannot influence our results. Because the pupils were randomly allocated to each group, we can also be confident that chance initial differences between the two groups are very unlikely to account for the difference in outcomes.

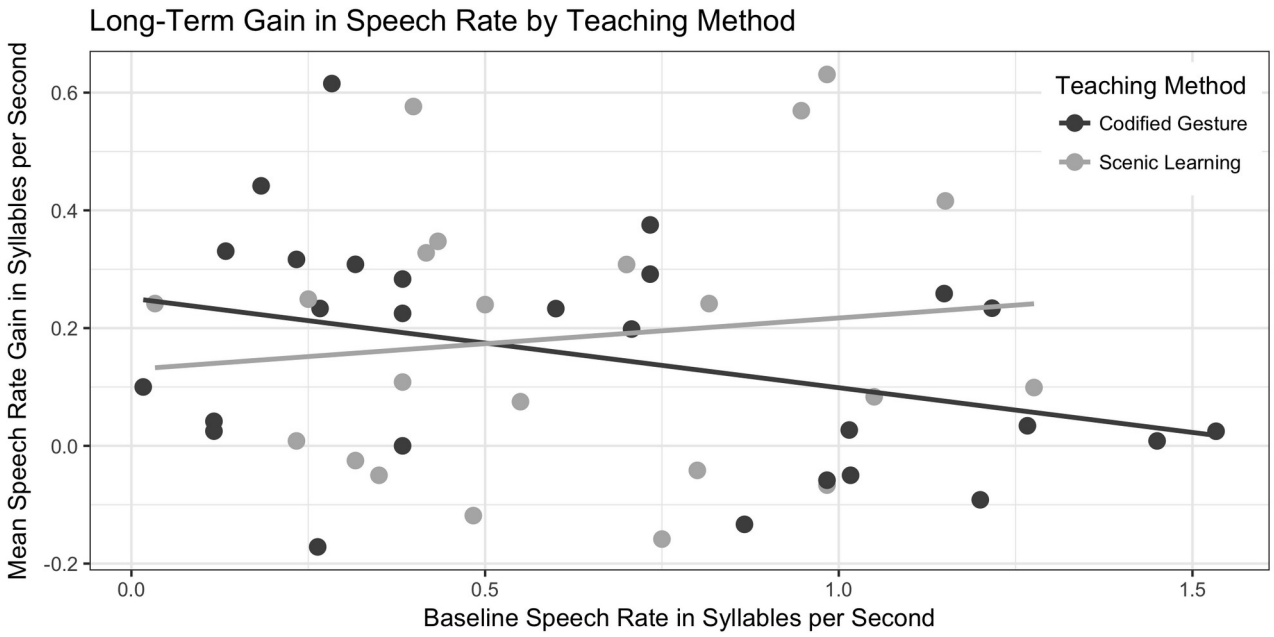

Figure 1. Long-term gain in speech rate by teaching method

2.4 Discussion

This experiment compares two teaching methods. As noted above, the methods chosen for evaluation were different, most notably in the gestures the teachers used, and access to the written text. While not the only approach to classroom research, using complete methods can establish how different teaching elements, such as gesture type and access to text, work in combination and provide more ecologically valid grounds for generalization than experiments which differ in one variable only.

2.4.1 Insights from interviews and fluency data

Based on group interviews, we know the grade six children were in general motivated about the project and appreciated ‘doing something’ with the refugee children. However, this was not the feeling for every child at every moment. The refugee children enjoyed the theatre project, but some reported their ambiguity towards learning English when the most important language in Germany is obviously German. Based on verbal feedback we also know that several teachers had initial reservations about using the new teaching gestures.

2.4.2 Implications for L2 instruction

Teachers and pupils alike bring their own backgrounds, beliefs, and past experiences into their classrooms, however beliefs about learning are not everything. From our fluency data we see that teacher choices in terms of teaching methods matter. A relatively short time investment, in this case two hours of gesture training and three hours of teaching time, can make an important difference in long-term outcomes. For the teachers who were unsure if learning the gestures would be worth their effort, this is an important finding. In contrast with the teachers expressing qualms about the gestures possibly ‘not working’, for the children, using gestures to learn seemed surprisingly obvious. The understandable question some of the refugee children had about learning English referred to the language and not the teaching method.

2.4.3 Limitations and outlook

The results of this study indicate that learning a foreign language using gestures which are morphologically complex and learning using gestures at the sentence-level affect fluency differently. At the same time, because of the X-interaction in long-term gain, it is clear that no method is per se better than another.

An important caveat to long-term fluency differences between the experimental groups is the high level of natural variation in the data. Learner data in general and data from children in particular tends to be highly varied. The children in this study represent many different cultures and linguistic backgrounds, with a significant number challenged by adjusting to life in a new country. Under these circumstances it was not possible to subject the learners to more extensive tests. Despite these limitations, we believe our study provides important preliminary evidence that many students, particularly struggling learners, may have a long-term benefit from teaching gestures which are morphologically complex.

2.4.4 Conclusions

It is known that gestures can embody speech and facilitate language learning, but gesture research from the classroom is rare. The results of this study should be of interest to English teachers of beginning learners who are in search of effective methods for improving oral fluency. In this study, using gestures at the level of morphology appears to especially benefit learners with a lower level of initial of fluency. The children in the CG condition learnt their text through interpreting their teachers' gestures, so learners who struggle with reading and writing in a foreign language may benefit more from the opportunity to learn texts through

alternative means. Thus, for students who are still developing literacy skills, codified gestures may represent a useful means of improving learning. For children who struggle with fluent speaking, ‘reading’ words from somewhere other than a page, such as their teachers hands, may benefit them more.

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Chapter 3

The Embodied Teaching of Spatial Terms: Gestures Mapped to Morphemes Improve Learning

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Abstract

Learning spatial terms in a second language is often an arduous task which learners perform with varying levels of success. While classroom-based studies of gesture have shown the importance of embodied learning, predictions about which teaching gestures are most effective remain rare. In the context of learning and performing a play, this study investigates two English language teaching methods, one with teacher gestures at the level of morphology and one with gestures at the sentence level. This experiment with a diverse group of primary-school-age children from Germany and Poland (N = 76) shows that although over time both groups made similar gains in understanding and using spatial terms, this gain was more immediate for learners exposed to one gesture per morpheme. For beginning learners spatial terms are frequent, important and abstract, hence this research may have important implications for understanding the nature of effective methods for teaching and testing abstract concepts.

3.1 Introduction

When observing the position or trajectory of objects in space, we are usually unaware that categorical distinctions are imposed on the scene. However, talking about movement and position requires that space be divided into discrete basic spatial categories. While this process may seem effortless in a language we know well, learning to use spatial terms in a second language (L2), where space may be partitioned very differently is often a difficult task. At the same time, the semantic categories associated with words like *in*, *on*, *under* and *to* are highly relevant for describing not only objects, actions and events but also creating narrative space (Lütke 2011). Moreover, in addition to relating real or imaginary scenes, physical spatial configurations also lead to abstract non-spatial meanings (Lakoff & Johnson 1999; Tyler & Evans 2003). Clearly understanding the notion of physical support in *Your keys are on the table* makes understanding the implied offer of emotional support in *You can count on me* much easier. For beginning second language learners, spatial terms are frequent and important. Effective teaching methods for spatial language are thus essential for second language acquisition.

3.1.1 Gestures play an important role in learning and teaching

As humans because of our physical and neurobiological architecture, we perceive objects and actions in certain ways. Gestures or symbolic hand movements can represent this conceptual information through form and movement (McNeill 1992; Stokoe 2000). During interaction with children, adults regularly combine objects, actions and words, and seem to intuitively recognize that gesture may scaffold children's understanding (Kang, Tversky & Black 2015; Rohlfing, Wrede, Vollmer & Oudeyer 2016). And in fact children are often better able to understand spoken messages when these are accompanied by meaningful gestures than when linked to conflicting or no gestures (Goldin-Meadow, Kim & Singer 1999). Researchers have reported that seeing gestures promotes cognitive development (e.g., Cook *et al.* 2010; McGregor *et al.* 2008) and L2 word learning (Macedonia, Repetto, Ischebeck & Mueller 2019) and that when words and body movements are used in combination, this leads to better retention (Arndt & Sambanis 2017; Kiefer *et al.* 2007; Sambanis & Walter 2019). It has been suggested that gesture used in combination with speech may reduce cognitive demands on processes of learning by allowing two different representational systems, both visual and verbal, to share the load (Goldin-Meadow 2000; see Pouw et al. 2014 for an overview).

Researchers have recently proposed the Gesture-for-Conceptualization Hypothesis (GfCH) which states that gestures schematize information and are conceptually linked not only to speaking, but also to thinking in general (Kita, Alibali, & Chu 2017). Observing gestures triggers semantic processing (Kelly, McDevitt & Esch 2009; Wu & Coulson 2007) and related to L2 learning, iconic gestures can allow linguistic units, such as a new L2 word, to be unambiguously connected to a hand movement (see also Huang, Kim, & Christianson, 2019). This connection decreases the need for semantic aspects of language comprehension, which allows the brain to save these resources for additional information processing, possibly leading to more robust learning and better retention (Hupp & Gingras 2016; Skipper 2014). Zwaan and Radvansky have suggested that words and sentences can be understood as instructions for creating a mental representation of the described situation (1998: 177). More recently, Brouwer, Fitz and Hoeks have proposed the term mental representation of what is being communicated (MRC) for the internal representation a listener or reader constructs while comprehending a sentence, story or scene (2012). They further specify that MRCs are derived not only directly from linguistic input, but also from inferences made on the basis of logical, causal or pragmatic world knowledge (2012: 136). It follows that if in addition to patterns available in speech, gestures make it easier for a listener to construct a correct MRC, this would translate into more efficient mental processing. If meaningful gestures enable learners to update their MRC with less effort and more clarity, learning would be less tied to contextual familiarity and more prone to consolidation.

Related to mental representations, the notion of embodied simulation has been proposed citing research which demonstrates that both physical and imagined manipulation lead to substantial gains in memory and language comprehension (de Koning et al. 2017; Glenberg 2011). Although different from our everyday integrated perception, human cognitive neuroscience shows that at any given moment only fragments of scenes are available to consciousness, these being guided and filtered by the demands of attention and task relevance (Cichy & Teng 2017). Following this line of thinking, gestures at the sentence level, where one hand movement corresponds with an entire sentence, could allow more time for learners to simulate the scene connected to the gestures leading to an increase in understanding.

Despite the fact that the benefits of gesture for second language learning are well documented (Macedonia & von Kriegstein 2012; Hattie & Yates 2013; Arndt & Sambanis 2017), the mechanisms by which gesture facilitates learning are not fully understood. Neuroscientific research shows that perceptual and lexical-semantic spatial information have a parallel organization in the brain (Göksun *et al.* 2013) and that simple gestures can make meaningful differences in how complex language is understood (Holle et al. 2012), however, the relationship between speech,

gesture and language comprehension is complex. Some research suggests that under certain circumstances, for example when cognitive demands are high or skill level is low, gestures may disrupt comprehension (Kelly, 2017; McNeil, Alibali & Evans 2000). Gesture theory, as outlined in the GfCH, makes predictions about the supportive effects of gestures for learning, but how to best use gestures in L2 classrooms is under-researched, leaving many questions unanswered.

While the relationship between gesture and L2 teaching and learning has been examined, few studies have operationalized spatial term learning in classroom settings, and even fewer with primary-school-age learners. This research gap is unfortunate because although L2 spatial language is clearly important, it is often perceived by teachers as challenging to teach (Lütke 2011). Qualitative and quantitative studies relevant to classroom-based English language spatial term learning are reviewed and summarized in Table 1.

Table 1:

Previous studies involving gesture and spatial relations from English language classroom settings.

Researchers	Participants	Study Objective
Johansson Falck (2018)	9 Swedish pupils 12-13 years	effect of learners applying body-world knowledge categories for *in* and *on* to L2 learning
Nakatsukasa (2016)	48 ESL university students Mage = 20.4 years	effect of teacher gestured corrective feedback on learner locative preposition production for *above, under, in, on,* and *next to*
Eskildsen and Wagner (2015)	an adult Mexican Spanish-speaking learner of English, his classmates and teacher	to investigate how common L2 gesture-speech combinations are deployed by teachers and reused within the classroom by learners to facilitate production and understanding for *under* and *across*
Rumme et al. (2008)	97 Japanese pupils Mage = 12.1 years	effect of teacher abstract pointing gestures on preposition distinction learning between *on-under, next to-between, in front of-behind,* and *near-at*

This paucity of research raises several more general issues. Knowing meaningful gestures tied to a word or sentence has been shown to enhance learning, however learning gestures in addition to speech initially increases cognitive demands (Macedonia & Klimesch 2014). Students learn more

when their teachers gesture effectively (Alibali et al. 2013), however predictions about which gestures are effective are rare. Iconic gestures, which have a ‘close formal relationship to the semantic content of speech’ (McNeill, 1992: 12) have been shown to be beneficial, but there are different kinds of iconicity (Perniss & Vigliocco 2014). How children mentally represent conceptual information changes over time (Kelly 2017), suggesting that development might influence which gestures are most effective. Further, as the MRC concept suggests, a substantial amount of the information we use to determine meaning is not associated with a single lexical item (Foster 2001; Knoeferle, Crocker & Pulvermüller 2010). In this article we do not ask if gestures per se ‘help’. For this the interested reader is referred to reviews by Macedonia and von Kriegstein (2012) and Cook (2018); (see also Dargue, Sweller and Jones (2019) for a recent meta-analysis of gesture and comprehension). Building on past research, rather we ask if evidence exists that gestures which connect specific linguistic units with specific hand movements should rather be at the sentence or the morphological level. Researchers have previously called for experiments with more specific predictions about which gestures will support learning and precisely when these gestures will be helpful (Roth 2001; Alibali et al. 2013; Cook 2018), and in doing so have specifically mentioned the variable of linguistic units as relevant (Gullberg 2013: 1872).

To shed more light on this issue, a recent study investigated the influence of teacher gestures on oral fluency in a diverse group of primary school age children (Janzen Ulbricht 2018). The experiment implemented two methods of teaching English, one with teacher gestures at the level of morphology, and one with gestures at the sentence level plus the written text. This experiment showed a difference in long-term fluency gain between the experimental conditions among the high and low performers. Here it was observed that children with a lower initial speech rate benefit more from gestures at the level of morphology, while children with an initially higher speech rate benefit more from reading plus sentence-level gestures, suggesting that the initial fluency level of learners is predictive of which type of gesture benefits fluency the most. One limitation of the previous study was that in the measure of oral fluency used (speech rate), all syllables, regardless of word or phrase complexity, were treated equally.

The present study extends this research, and examines in more detail the role of these same teaching conditions in learning English spatial terms. Since gesture has the potential to embody spatial information, gesture may be especially helpful for teaching spatial terms, as has been explored by others in L1 (McGregor et al. 2008) and L2 learning (Eskildsen & Wagner 2015; Nakatsukasa, 2016; Ahlberg, Bischoff, Strozyk, Bryant & Kaup 2018). Understanding how spatial language performance in one domain contributes to the development of performance in another may lead to findings that can enhance educational practice. As outlined in the GfCH (Kita et al. 2017),

gesture theory makes predictions about the supportive effects of gestures on learning, but guidelines about which gestures teachers should use remain underspecified. At a symbolic level gestures can be paired with different units of language. As such, gestures at the sentence level provide an interesting comparison to gestures at the level of morphology and allow us to identify the circumstances under which gestures which vary in this way may be differentially beneficial to classroom-based learning. While not the only valid approach to classroom research, experiments involving complete teaching methods are essential because they can establish how different elements, such as gesture type and access to text, work in combination. Thus such experiments can provide more ecologically valid grounds for generalization than experiments which differ in one variable alone.

The present study reports the results of a seven-week experiment that tested the effects of gesture-based L2 instruction on long-term spatial term learning. Children from two primary schools, one in Germany (n = 29) and one in Poland (n = 47), were tested on their use of English spatial terms in week 1, week 3 and week 7 to measure initial learning and retention. In week 2 of the experiment, two sets of matched codified gesture (CG) and scenic learning (SL) text-learning phases were designed for a common English theater project. While learning the play (for a total of three hours over four days), the children were randomly placed in the CG or SL conditions where they learned and memorized the same text.[19] To control for teacher effects, two teachers at each school taught the same text to both groups in each condition. In the codified CG group, the teacher provided one gesture per morpheme for all the words of the play, meaning that words and gestures were learned together. Consistent with the SL method, the teacher taught the children the play supported by gestures at the sentence level and the written text. The sample size (N = 76) was based on convenience, but as can be inferred from Table 1, is above the mid-range value of similar experiments. The schools chosen were also based on convenience.

3.1.2 Background on Gestures in the Experiment

Codified gestures refer to specific hand or arm movements which have a ‘dictionary meaning’ within a particular group (Poggi 2013). This group can have many members, such as the number of people who understand the European *What an idiot* forehead tap. This group can also be as small as

19 In this experiment, as in others, variability in participant characteristics may affect individual learning outcomes. While it is known that linguistic and socioeconomic variables often influence language learning processes (Krifka et al. 2014), these confounding variables are commonly dealt with by randomly assigning participants to experimental conditions to ensure even distribution across conditions (e.g. Novack et al. 2014). Children in this experiment were also randomly assigned to the experimental groups. This procedure was followed in all the Polish groups. In Germany the experimental groups were additionally matched for age, having an L1 other than German, being new to Germany, as well as gender.

the students of a particular teacher who has a special sign to prompt using the past tense. Codified gestures may be iconic, such as meaning *fire* by wiggling fingers to suggest flames, but may also be arbitrary, as when tapping the back of the right hand into the palm of the left to represent *dlaczego* meaning *why* in Polish sign language. Although there are important differences between codified gestures and the hand movements which make up sign languages (see McNeill 1992; Crystal 2007), compared to spoken language, sign languages have more potential for iconic forms because they are produced with the hands, face and body (Perniss and Vigliocco 2014). When meaningful hand movements are combined with new words, learners may benefit since gestures can be perceptually similar to the object or event being referenced and can add semantic information, which in turn can prime lexical representations (Roth 2001). We should note that in gesture studies there is wide agreement that hand movements can be categorized into different subtypes (Kita 2017). Although the gestures used in this study could be categorized in other ways (e.g. McNeill 1992), the term codified gestures has been used to emphasize the one-to-one relationship between movement and meaning. We should also note that research on L2 learning has used different terms for similar movements-meaning relationships at some times simply referring to gestures (e.g. Cook 2018, Goldin-Meadow 2000) and at others creating novel terms such as Voice Movement Icons or VIMs (Macedonia 2020). In summary, experimental conditions in this experiment were different in that teacher hand movement referred to fixed morphemes (e.g. {rock} + {- s}) and were the only form of input in the CG condition, and referred to fixed sentences (e.g. *Let's get out of bed!*) where learners had access to the written text in the SL condition. Conditions were the same in that both used fixed movement-meaning pairs to reinforce learning.

All of the spatial terms tested were embedded in the text of the play (for testing materials and procedures, see Section 2.3). Consistent with stories and the English language in general (Crystal 2007), some words were more frequent than others. O*ut* (as in *out of bed* and *out the window)* was mentioned seven times; *over* five times; *under* and *in* four times; whereas *around*, *between* and *through* were used three times. *To* (as in *Let's go to the window!*) and *on* (*the owl was sitting on a tree*) were only mentioned once. This difference in frequency, because inherent in the text, was the same for both experimental conditions. To conclude, there were two experimental conditions, as shown in Table 2.

3.1.3 Summary of Experimental Conditions

Table 2: Experimental Conditions

	Codified Gesture Condition	Scenic Learning Condition
a hand movement	per morpheme	for sentences
gestures for sample sentence: It's dark out there.	it + is + dark + out + there	it is dark out there [prep **stroke**] stroke = *open hands pass in front of the face covering the eyes*
gestures in sample sentence	total number = 5	total number = 1
the play was learned	**without** written text	**with** written text
time in experimental conditions	12 sessions of 15 minutes long spread over four days	

3.1.4 Research Questions

Much research on gesture and L2 learning has focused on whether gesture-based instruction benefits learners. These experiments, while necessary, lack the precision necessary to provide guidance on which gestures might support learning best. With this study we move beyond this question by testing the effects of teaching methods involving different teacher gestures at the level of linguistic units on spatial term learning outcomes. We hypothesize that during second language acquisition gestures can support the mental representation of what is being said (MRC), reducing uncertainty and resulting in more efficient language processing. We make no prior claims about one condition being more efficient than another. Matched codified gesture and scenic learning units for beginning English learners were developed and their effects on L2 spatial term learning were tested. Following a repeated-measures design, which quantifies changes over time, analyses of a gain in spatial term ability were carried out. This study is consistent with the premise that meaning is embodied and framed by the understanding that and that learning occurs as a result of collaboration with others in familiar socially constructed settings (Bruner 1983; Tomasello et al. 2012; Rohlfing et al. 2016) and addresses the following research questions:

- In the context of learning and performing a play, can a long-term gain in L2 spatial term ability be measured?
- If the same text is learned in different ways, using a gesture for every word without the written text (CG) or using a gesture for the most important sentences with access to the written text (SL), are there measurable differences between experimental groups?

3.2 Materials and Methods

3.2.1 Participants

Our study was conducted with seventy-six learners between the ages of 8 and 13 from two primary schools (M = 10.9 years, SD = 0.96, 42 females), one in urban Germany and one in rural Poland. In both locations, the instruction during week 2 was a week-long joint theater project, in Germany between members of a grade 5 class (n = 19) and a class of refugee children (n = 10) from the same school, and in Poland between two different grade 5 classes (n = 21) and between two grade 6 classes (n = 26). Of the grade 5 German children, 15 (79 percent) identified an L1 other than German as their primary home language. All the refugee children had an L1 other than German as their home language. At the time of the study the refugee children had spent between one month and three years in Germany, but 9 (90 percent) had been in Germany for less than two years. In Poland all children reported Polish as their primary home language. All children reported having previously learned English in Germany, Poland or in their country of origin. Polish and German children began learning English in school in grade three, meaning grade 5 learners were in their third year and grade 6 learners in their fourth year of English instruction. Refugee children reported between one and three years (M = 1.7, SD = 0.95) of instruction. Children who participated had submitted written consent from their parents prior to the study and agreed to participate.

3.2.2 Instruction Materials

Two sets of text-learning phases were developed, each resulting in a total of three hours of instruction. The content of the play to be taught during the project was segmented into 12 units of 15 minutes each. For each teaching phase both a version that utilized scenic learning (SL) forms of instruction and a codified gesture (CG) version of instruction were designed. As previously mentioned, in the SL condition the focus of the first six units was on understanding and fluently reading the play, whereas sessions 7-12 focused on using sentence-level gestures to speak together as a group and memorize the character parts.

3.2.3 Codified Gesture Condition

In both the CG and the SL conditions, the children had instruction in which they separately learned the same text. In the CG condition, the teachers taught a set of gestures, one for every morpheme in the play. In this condition, most words such as *under* had a single gesture, but some words such as *bears* had two gestures, one for {bear} and one to show the plural {-s}. The children were seated in a semicircle facing the instructor throughout all text learning phases. While reading the text, the teacher spoke and gestured the play, meaning that words and hand movements were learned simultaneously. (For sample gestures in the CG condition, see Figure 1.) The children were instructed to speak as soon as they recognized a gesture, but were not instructed to gesture. In Germany once the children could recognize and speak the words, they began to imitate the accompanying gestures. In Poland, although given the same instructions, surprisingly, the children in the CG grade 6 group hardly gestured. Because the focus of this experiment is on the effects of teacher gestures on spatial language learning and children are compared to themselves, this difference, although interesting, does not influence our results.[20]

20 When asked to use gesture participants often produce responses that are more strategic and thoughtful (Hattie & Yates 2013: 142). Especially in group learning situations, however, there can be pedagogical reasons for encouraging but not requiring learners to perform certain behaviours (Sambanis & Walter 2019). Given the short time teaching time and diverse learners in this experiment (refugee learners), pedagogical reasons were the decisive factor in modelling and thus encouraging but not requiring learners to perform gestures. In most groups (all in Germany and all in Poland except the mentioned grade 6 CG group) classroom observers indicated that learners reliably gestured of their own accord.

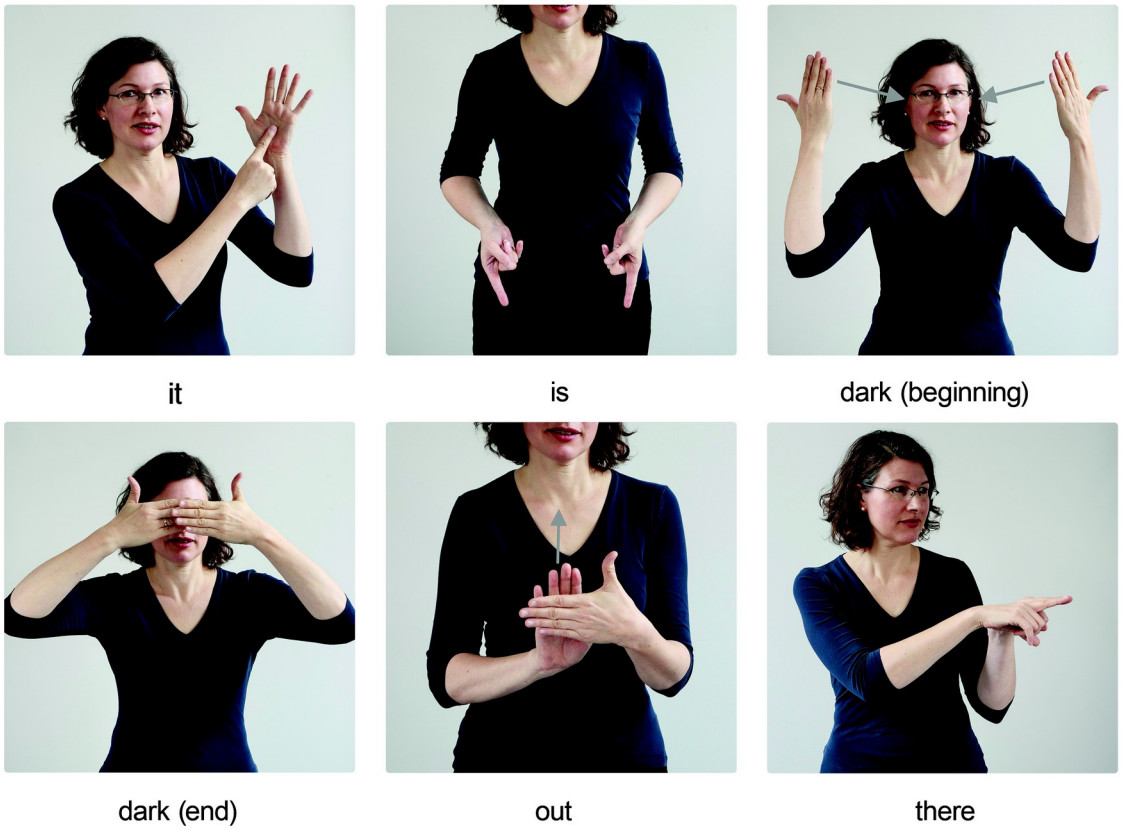

Figure 1. Sample gestures for the sentence *It is dark out there* in the codified gesture (CG) condition.

3.2.4 Scenic Learning Condition

Scenic learning is an approach which combines movement and choral repetition of words, lexical chunks or sentences. These movements, although simple, reinforce associations between words and mental images or scenes taken from daily life, hence the name scenic learning (Böttger & Sambanis 2017: 62). In previous classroom-based experiments the scenic learning approach has shown an advantage over traditional teaching methods for both vocabulary and pronunciation (Hille et al. 2010). Because the focus of the current experiment was not on whether gesture-based instruction is beneficial to learners but compares two different gesture-based methods, the SL condition was adapted. In this condition, the emphasis of the first six sessions was on understanding and fluently reading the text. Children were initially told to relax, close their eyes and listen to the teacher read, and listen for words they recognized. After listening, the teachers were instructed to work through

the text using techniques they had found successful in the past, such as reading the play in roles and in small groups.

While the text of the play remained the same, in contrast to the first six sessions, the focus of sessions 7-12 in the SL condition was on using gestures at the sentence level to memorize and practice speaking together. Following the SL approach, the most central sentences of the play were practiced accompanied by a simple movement. These movements were developed by the teachers at each school to capture the meaning of the most important sentences of the play. As can be seen in Table 2, the SL gesture for the sentence *It is dark out there* consisted of a single hand movement. This movement corresponded to the gesture for the word *dark* in the CG condition and is depicted in the dark (beginning) and dark (end) pictures in Figure 1. In the CG condition, all of the words were matched with gestures. In the SL condition, excluding the narrator parts, 78 percent of the words of the play belonged to sentences matched with gestures.

In both Poland and Germany, it was clarified that the goal of practice was for all children to memorize each speaking part independent of the role they would eventually play in the actual performance. In the SL group children had access to the text in written form, but only during the text-learning phases. After the final text-learning phase, the CG and the SL groups were combined at the grade level (meaning grade 5 and grade 6 worked separately), character roles were assigned and a narrator from each group was chosen. For the final five hours of instruction, the focus moved from learning the text to rehearsing the play on stage in an artistic way. Because of this different focus, during the rehearsal and performance children did not gesture. This is practice of using and then discontinuing gestures once learners have internalized the target language is also consistent with other L2 gesture-based teaching methods (e.g. Macedonia 2020).

Instruction

Each teacher taught both groups of students in both conditions, with no more than two consecutive sessions being taught by the same teacher. This design allowed for the control of teacher effects. To facilitate continuity of instruction in the SL condition, teachers created lesson plans of the activities in advance. In the CG condition, teachers provided gestures for all the words of the play and wrote brief notes in the teaching materials to document which text sections had been covered. Fidelity of implementation observers were present in each classroom approximately 60 percent of the time to ensure that the text was taught as designed in terms of timing, content and activities. Observers were instructed to note any deviation from the lesson plan as well as any differences in gesture

quality within conditions and recorded only little deviation. It is also important to note that before beginning teaching sessions all teachers were tested to ensure gesture proficiency and consistency.

Testing Materials

The stimuli consisted of five objects (teddy bear, box, ball, blanket and a book) on a table in a room with a chair, window and a door. Some of the test items were functionally canonical in that the trajector object (e.g. a ball) would commonly go in the landmark object (e.g. a box) in everyday environments. However, many of the test items such as, *Put the ball in the blanket.* or *Move the blanket through the chair.* were non-canonical. These items were included in order to determine whether the experimental training phases (learning the text of the play) enabled a less context-dependent understanding of spatial terms. When test items were trialed, combinations which were deemed possible but especially confusing, (e.g. *Put the table on the bear.*) or physically difficult, (e.g. *Put the chair on the table*.) were removed from the sentence set.

At the beginning of the study, a test using a set of objects not required during subsequent teaching was administered to all initial participants. (For access to online-supplemental materials and for the actual tests, see the notes section at the end of this article.) Retention was measured with follow-up visits the week following instruction and five weeks following instruction. In both schools teachers of participating classes were trained in both sets of instructional gestures (approximately 90 minutes of training plus access to the filmed gestures) and passed a test before they administered instruction in week 2. In Germany the author administered the baseline and both follow-up tests. In Poland, two teachers of the same school administered the tests. All teachers involved in the project were unaware of the study hypotheses and were only informed that the study aimed to test the effectiveness of gestures for second language learning.

The format of the baseline and both follow-up tests was the same and used three different but equivalent versions of the same test. The test objects used (bear and ball etc.) were the same for each test version, but the order of the spatial terms and the items required for a certain action were randomized and different. Using different but equivalent test versions follows the parallel-forms method for matching statistical reliability (Hilger & Beauducel 2017; Murphy & Davidshofer 2005). The order in which the three different test versions (Tests A, B, and C) were administered for the pretest, post, and retest was counterbalanced across all participants.

The format of all testing sessions was a warm-up phase, Part A in which the child heard nine recorded sentences and performed the associated actions, and Part B in which the examiner

performed nine actions and the child spoke, meaning each spatial term was tested twice, once in Part A and once in Part B. The test also included part C which was deliberately designed to be difficult to avoid ceiling effects and to make retention challenging. However, since there was no evidence of ceiling effects for parts A and B across participants and sessions, data from part C was collected but is not included in the analysis. Because we see both L2 spatial term comprehension and production as closely related skills, for data analysis scores from part A and B were combined into a general accuracy score (Novack et al. 2014). The testing session lasted 15-20 minutes. PsychoPy Experiment Builder (v1.84.2) was used to create and run the test sessions (Peirce 2009) meaning that children in Germany and Poland both heard the same instructions. (See Appendix C for testing materials and procedures.)

3.2.5 Testing Procedures

Figure 2. Coding examples for test item *Put the ball under the box.* The first picture is correct, the second and third are incorrect.

Warm up

Children first completed a warm-up phase to familiarize themselves with the room and the test objects, as well as speaking with the experimenter. This warm-up phase was scripted and involved each child repeating the name of the test objects and physically touching them.

Part A

The first section of the test was about understanding and implementing action statements by moving or positioning objects in physical space (see Figure 2). Test items were only played once. Performance was measured in the following way:

- If a child complied with the action statement, they received one point.
- If a child did not comply with an action statement, and did not make a movement, but did make eye contact, the examiner said, “Just do the best you can.”
- If a child did not comply with an action, make any movement, or make eye contact, after ten seconds the examiner said, “Just try the next one.” and the next recording was played.
- If a child made an action that was incorrect, they did not receive a point and the next recording was played.

Part B

The second section of the test was about recognizing actions and naming the position of objects in physical space. For the sentence *Put the ball under the box.* the instructor said, “Here is the ball. Here is the box.” The instructor then did the action, put the ball under the box and asked, “Where is the ball?” and noted what the child said. For sentences using *around*, *out* and *through* the experimenter asked, “Where did the [object] go?”

Performance was measured in the following way:

- If a child named the correct spatial term, they received one point.
- If the child demonstrated understanding in movement (e.g. through a spontaneous gesture or repeating a gesture from the training phase) or a language other than English, they did not receive a point.
- If a child named an incorrect spatial term, they did not receive a point and the next recording was played.

Children themselves were not given any feedback about whether or not an answer was correct, but were thanked for their participation at the end of the test. Exit interviews for all children established that in general children enjoyed the test. Even children who received no points for spatial term knowledge, reported feeling successful because they had recognized and spoken English words and in conclusion many said the test “wasn't hard”.

Removing outliers

Van den Broeck and colleagues write that in research “error-prevention strategies can reduce many problems but cannot eliminate them” sometimes making data cleaning a necessity (2005: 967). During first inspection of the data from the first school, *between* and *through*, two of the nine initial words, were identified as unusually difficult, with baseline correct answers for *through* missing entirely from one experimental group in this school. The word *out* was also removed, but for other reasons. Unlike other spatial terms, enacting an *out* command (e.g. *Put the blanket out of the box.*) requires implicit knowledge of *in.* If the blanket happens to be in the box, the same test item becomes easier than if the blanket is not in the box, which introduced additional variability into the test procedure for this particular item. Data for *between, through* and *out* were removed, meaning three of the nine original spatial terms. This same procedure was followed for both schools. This reduced the total number of test items from 18 to 12 per test and resulted in 8 percent of the data for which participants would have received a point being cleaned during analysis. Cronbach's alpha is a summary measure of the correlations between items and can be used as a measure of test reliability. The overall alpha was.76 with the mean correlation among the test items being .21. This is above .70, the level often considered satisfactory for exploratory research.

3.2.6 Data Analysis

We conducted multiple regression analyses on long-term comprehension and use of L2 spatial terms to test the long-term effects of learning a text using two English language teaching methods, one with teacher gestures at the level of morphology without access to the written text (CG), and one with gestures at the sentence level with access to the written text (SL). Our binary dependent variable (correct vs. incorrect responses on the spatial term test) was analyzed using a multilevel modeling approach. We used a hierarchical model including class and preposition as random effects with students nested within classes. Experimental group and session, meaning the time point when the tests were conducted, were included as fixed effects. All analyses were conducted with R Version 3.4.3 with the *lme4* package (Bates, Mächeler, Bolker & Walker 2015). We compared each

model with updated versions of the model that systematically excluded the main effect and interaction terms of interest.

3.3 Results

3.3.1 Data Description

Our analysis of student outcomes includes 76 students who completed all assessments and for whom a questionnaire was received about their age, years of English language tuition, and whether the primary home language was the language of school instruction. Because of data privacy laws, while it was possible to ask if a child's L1 was or was not the language of instruction (i.e. German in Germany or Polish in Poland), it was not permitted to ask what a child's L1 was. As noted above, knowledge of English spatial terms was tested before the project began. For each participant, an accuracy score (i.e., number correct on test) was calculated. Preliminary analyses indicated that there were no significant effects or interactions found for gender or age, *p's* >.05, so these variables were removed from further analyses. To test for a possible effect of location (Poland vs Germany) on the gain in spatial terms, we ran an ANOVA with school and experimental group as a between groups factor, which showed no interaction between schools, $F(1, 72) = 0.47$, $p = .49$, so this variable was also removed. The primary analysis yielded the same pattern of results whether or not the language of instruction was a learner's L1 or L2, so all reported analyses include all participants. An independent-samples t-test (number of correct spatial terms by experimental group) compared the mean scores of the two experimental groups.[21] The initial mean number of correct spatial terms for the CG group was M = 4.28 (SD = 2.80) and for the SL group M = 4.86 (3.12), $t(73.19) = -0.85$, $p = .39$ two-tailed, indicating that the groups are comparable.

3.3.2 Long-term gain in spatial term use

After the text-learning phases, experimental groups were combined (in Germany into one group and in Poland at the grade level) and the final five hours of teaching time were used to focus on presenting the play on stage in an artistic way. Given that the children had learned and practiced an adventure story which contained spatial language, but that the focus of the performance had passed, it was unknown whether spatial term comprehension and production would improve on the test. The posttest took place in the week following the final presentation of gestures, followed by the retest 7 weeks after the initial test and 5 weeks after the theater project. Comparing the two experimental

21 All analyses were conducted with R Version 3.4.3 with two-tailed tests using p > 0.05 for null hypothesis rejection.

groups in Figure 3, our first analysis demonstrated successful learning across both conditions. Our first research question asks if a long-term gain in L2 spatial term ability can be measured and can be answered through visual inspection of Figure 3.

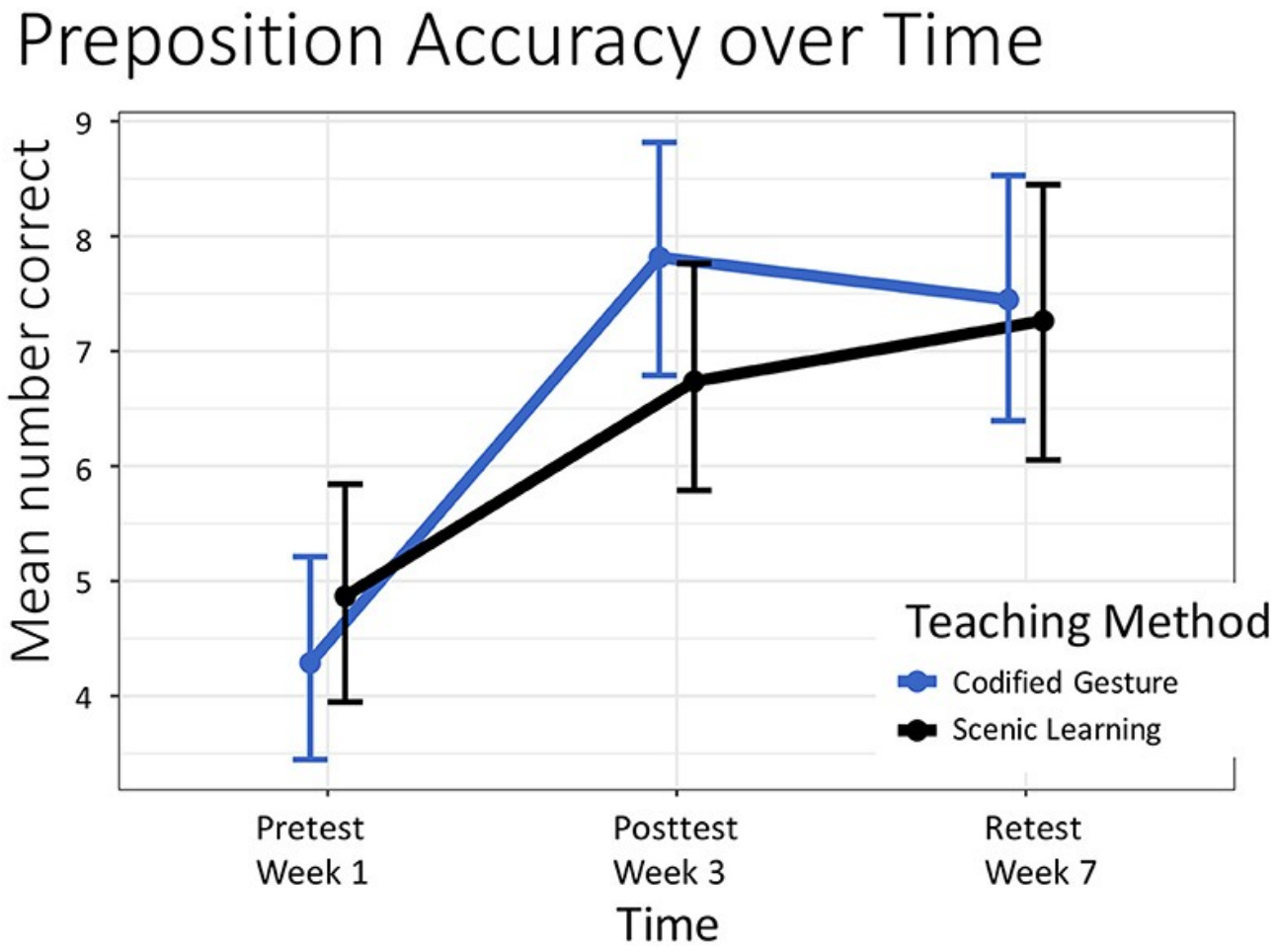

Figure 3. Change in mean spatial term accuracy over time between teaching methods. The x-axis plots the three tests, pretest (before instruction), post (one week after instruction), and retest (five weeks after instruction) for the codified gesture (CG) and scenic learning (SL) experimental groups. The y-axis plots the mean number of correct test items per teaching method. For the sake of clarity, error bars plot unadjusted 95% confidence intervals.

3.3.3 Differences between experimental groups

Figure 3 shows children's mean spatial term ability organized by mean number correct, time and learning condition and shows that both experimental groups improved over time, as demonstrated

by an increase in mean accuracy in both conditions, but with a higher gain in spatial term ability for the CG condition. The mean gain in spatial term ability (post – pre) for the CG condition was M = 3.52 (SD = 2.28) and for the SL group M = 1.86 (2.00), $t(72.73) = 3.36$, $p = 0.001$ two-tailed, $d = 0.77$, indicating that the experimental groups the children belonged to had a significantly different effect. Because this gain was calculated as a per-child variable, any gain in ability measures how children compare to themselves, so cultural or first-language differences among children cannot influence our results.

To further investigate these differences, children's spatial term ability (correct vs. incorrect responses) was entered in a hierarchical model including class and preposition as random effects, with students nested within classes. Experimental group and session were included as fixed effects.

```
m = glmer(result ~ exp_group*session + (1|preposition) +
(1|class/code), bb, family=binomial)
```

The next model excluded the interaction of group and session.

```
m0 = glmer(result ~ exp_group+session + (1|preposition) +
1|class/code), family=binomial, data=bb)
```

Comparing the results of the two models summarized in Table 3 allow us to see that the fit of the model with the interaction between experimental group and session is slightly favored.

Table 3: Summary of model fit statistics

	Df	AIC	BIC	log Lik	deviance	Chisq	Chi Df	P(>Chisq)
m	9	3060.217	3113.266	-1521.109	3042.217	6.59	2	.04 *
m0	7	3062.809	3104.069	-1524.404	3048.809	NA	NA	NA

As can be seen from the output of the first model (see Supplementary File), the interaction between the experimental group and session appears to be specific to the second time point or posttest in session 2. Based on Figure 3, this interaction is to be expected. Learners in the CG condition improve more between the first two testing sessions ($p = 0.013^{*}$), but then between session two and three students in both conditions appear to have similar knowledge at the final test ($p = 0.491$ ns).

Summary

These results in L2 spatial term learning show that while there are enhancements for both experimental groups and both lead to long-term learning processes as indicated by the retest measurement, the CG condition appears to be the initially more efficient learning procedure. The error bars for the retest, especially for the SL group, indicate more variation in learning, meaning differences between experimental groups become much less clear over time. Especially for learning which is new, this suggests that teaching over time is important in order to consolidate what has been learned (Kelley et al., 2018).

3.4 Discussion

3.4.1 Cross-linguistic logic of spatial categories

Through work on cross-linguistic categories of spatial relations, Brala concludes that categories of functional configurations are formed and organized into meaning clusters “on a combinatorial basis, out of universal, primitive, bodily-based semantic features … [which are] shared between the human language faculty and other sub-systems of human cognition” (2002: 135). This means that while different languages may treat spatial categories differently, there is an underlying implicit ‘logic’ to how these categories are formed. These categories have been found to influence compatibility effects between language processing and action or perception and provide behavioral evidence that how spatial terms are used in different languages not only ‘matter’ in terms of correct usage, but ‘matter’ in terms of how space is mentally represented, which can be very different across languages (Bowerman 1996).

3.4.2 Implications for L2 processing and embodied teaching

It has been previously established that spontaneous gestures schematize information in language-specific ways (Kita & Özyurek 2003). Thus, attention to embodied teaching methods relevant to these language specific categories could potentially benefit learning, because, as Bowerman (1996) suggests, successful L1 and L2 acquisition depends on learning to attend to these topological relationships. This experiment compares two different teaching methods. Because of the naturalistic nature of this experiment (interaction effects), there are limits to the direct conclusions one can make based on certain teaching elements. Because English was presented in two modalities (reading and gestures in the scenic learning condition and gestures alone in the codified gesture condition),

no direct claims about gesture or writing based on these results can be made. Additional studies with different paradigms are required to investigate whether different gesture types independent of reading can also facilitate L2 spatial term learning. Nonetheless, the differences in spatial term learning over time raise certain questions worth investigating. Before addressing two additional questions, we would like to return to our original research questions:

1. In the context of learning and performing a play, can a long-term gain in L2 spatial term ability be measured?

2. If the same text is learned in different ways, using a gesture for every word without the written text (CG) or using a gesture for the most important sentences with access to the written text (SL), are there measurable differences between experimental groups?

Regarding question one, visual inspection (Figure 3) and the main effect of test on spatial term ability described in the results section suggest that in both groups the benefits of learning and performing a play featuring L2 spatial terms can be measured. Note that the results shown here cannot be separated from any possible benefit (or detriment) of performing the test itself. This transfer of concept learning from one context (learning and performing in a group setting) to another (speaking and moving objects as an individual during the test) is in line with research which shows that neglecting movement as a learning strategy leaves a particularly important source of support for learning under-utilized (Sambanis & Walter 2019: 8). Moving on to question two, the difference in spatial term gain between the pre and posttest demonstrates that within the children in these schools, there was a measurable difference between teaching methods with an effect size of d = 0.77, which, when rounded to 0.80, is considered a strong effect (Cohen 1988).

The two additional questions we would like to address are:

1. Why is the CG condition more efficient?

2. What else is learned in the SL condition?

Because gestures on the level of morphology were the only input form in the CG condition, children in this condition saw more gestures. On the part of the teachers, producing more gestures meant more practice, possibly leading to more gesture consistency. In support of this viewpoint, observers also remarked on an increase in the gesture quality over time. Gesture practice also improved in the SL condition, but here, because there were simply fewer gestures, this effect would be expected to be less.

Although the Retrieval-Integration account of language processing is largely based on language data, Gunter, Weinbrenner and Holle (2015) extended it to gesture processing making this

model more widely applicable. Their experiment showed that incongruent abstract pointing leads to higher retrieval and integration effort as reflected in increased N400 and P600 amplitudes. Although only indirect support, these results suggest that the reliable teaching gestures present in both teaching conditions could directly influencing sentence comprehension and possibly learning. When presented at the same time, speech and gesture appear to encourage learners to simultaneously attend to and integrate ideas conveyed in the two modalities and thus create long-lasting and more flexible new concepts (Novack et al. 2014). Perhaps a 'cleaner' gesture signal in the CG condition or one gesture per spatial term allowed for more consolidation in a shorter time.

The question about what else was learned in the SL condition is difficult to answer. Other experiments using SL have shown positive long-term effects, but in these experiments the teaching time was considerably longer and was compared to teaching methods which were not embodied (Hille et al. 2010). Teaching in the SL condition involved reading and gestures on the sentence level for memorizing the text. The SL teaching method also has certain advantages in terms of planning, because outside of an experimental setting, gestures can be spontaneous. It is also conceivable that being a part of a scene and 'being in the moment' has emotional advantages that the CG condition, which is more closely tied to the actual text might not have. Actually moving in the scene could support learning not measured by the test. In addition, reading supports learning and is a familiar activity.

In previous experiments when measuring fluency (Janzen Ulbricht 2018), practice with SL using sentence-level gestures has been cited as being better for higher-level learners, suggesting that when a text alone can provide a clear MRC, gestures at the morphological level may not be helpful. Combined (more and higher quality gestures), these results suggest that for L2 spatial term learning, the more consistent speech-gesture input in the CG condition may more efficiently support learning, resulting in an increased ability to generalize to new situations. Hebbian mechanisms for synaptic modification explain why consolidation of learning is an important concept. Insufficient consolidation could explain why learning from second to third measurement (post to retest) in the CG condition did not increase. A follow-up experiment could space teaching over several weeks, as opposed to just one. In addition to spaced teaching, an experiment which addresses the interaction effects between gesture type and access to the written text would be of interest. A follow-up experiment could have the following four groups: 1) + gestures for every morpheme – access to the written text; 2) + gestures for every morpheme + access to the written text; 3) + gestures at the sentence level – access to the written text; and finally 4) + gestures at the sentence level + access to the written text. Because of statistical power such an experiment would require more resources (in terms of participant numbers and teacher time etc.) but could shed light on the interaction between

gesture type and access to the written text inherent in the present experiment. Given that gesture and text are readily available in classrooms, an experiment focusing on these different forms could be a worthwhile investment. Much research has shown that gesture, language and thought are closely linked. The present study exploits this relationship by investigating stable gesture meaning pairs as a teaching tool for young learners.

This naturalistic study with a diverse group of learners examined the affects of teacher gestures on long-term spatial term learning. It is widely known that gestures can embody speech and facilitate L2 learning, but gesture research from the classroom on spatial term learning is rare. Although both teaching conditions led to an increase in spatial term ability, in this study children who received gestures at the level of morphology were sooner able to retain and generalize learning than children who received gestures at the sentence level with access to the written text. Children in the CG condition learned their text through interpreting their teachers' gestures, so learners who struggle with reading and writing in an additional language may especially benefit from the opportunity to learn texts through multimodal means. Further more focused research is needed to isolate whether other factors, such the learning modalities themselves (reading vs not reading or gesture type) are relevant. Because both teaching methods described here may be applicable to the teaching of other languages, the results of this study should be of interest to researchers seeking effective methods for teaching spatial terms in languages other than English.

3.4.3 Limitations and outlook

There are, of course, many limitations to this study. The careful reader may have noticed that the *dark* gesture in Figure 1 does not have a direct semantic relationship to any spatial term. This can be explained by the task given to the teachers while creating the gestures. Teachers were asked to embody the most significant sentences of the play in movement and not given any restrictions on what should be important. To shed more light on this aspect, further studies should be conducted in order to more directly ask teachers to act out the locative words, instead of leaving this up to chance. Another justifiable point of criticism could be that the children were not more explicitly instructed to gesture (see section 1.2.1). At the same time, there is also evidence that learners benefit from observing gestures and that “more gestures” are not necessarily better for learning (Huang, Kim, & Christianson, 2019). Because languages differ in how spatial thought is expressed, it is also plausible that taking the learner’s L1 into consideration when designing gestures could have resulted in more specific and more effective learning gestures especially for the refugee children who did not share their teacher’s L1. While using complete teaching methods can establish how

instructional elements work in combination, results from this comparison cannot readily be extended to other combinations (such as gestures on the basis of morphology plus access to the text). For this reason in future research on the long-term effect of gestures on learning it would be interesting to consider including another condition for which instruction is entirely text-based and doesn't include any gestures in order to further investigate how groups differ over time.

3.4.4 Conclusion

Gestures are an integral part of classroom situations and offer teachers a powerful tool for helping learners to acquire, retain and apply knowledge to new situations. In addition to exploring instructional gestures in experimental settings, research from the classroom is necessary since conditions in the classroom have a complexity that cannot be reduced while doing justice to how education is really practiced.

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Chapter 4

Can grammatical morphemes be taught? Evidence of gestures influencing second language procedural learning in middle childhood

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Abstract

What kind of practice makes perfect when children learn to use grammatical morphemes in a second language? Gestures are communicative hand and arm movements which teachers naturally employ as a teaching tool in the classroom. Gesture theory has proposed that gestures package information and previous studies suggest their value for teaching specific items, such as words, as well as abstract systems, such as language. There is broad consensus that implicit learning mechanisms in children are more developed than explicit ones and that everyday use of grammar is implicit and entails developing implicit knowledge. However, while many learners have difficulties acquiring new morpho-syntactic structures, such as the plural{-s} and 3rd person possessive {-s} in English, research on gesture and syntax in middle childhood remains rare. The present study (N = 19) was conducted to better understand if gestures which embody grammatical morphemes during instruction can contribute to procedural learning. Using a novel task, the gesture speeded fragment completion task, our behavioral results show a decrease in mean response times after instruction in the test condition utilizing syntactically specific gestures. This increase in procedural learning suggests that learners in this age group can benefit from embodied instruction in the classroom which visually differentiates between grammatical morphemes which differ in meaning but sound the same.

4.1 Introduction

The process of learning a second language is complex, dynamic and often nonlinear (1). Behavioral and neuroscientific studies suggest that the neural representations of words consist of complex multimodal networks represented in sensory and motor brain areas in an experience-dependent way (2,3). Thus it is unsurprising that gesture has been shown to influence how we understand complex language (4) and learn abstract concepts (5). Building on the idea that cognitive representations are grounded or embodied via perception and action, this study focuses on an important aspect of second language (L2) syntax and investigates how to facilitate teaching two important L2 grammatical morphemes through gestures for the plural{-s} and the 3rd person possessive {-s} in English.

Gestures are communicative hand and arm movements which embody emotions, intentions and thoughts (6–8). There is much research providing empirical support for the role of gestures in L2 learning for aspects such as speech comprehension (9,10), word memorization (11,12) and pronunciation (13–17). Not unexpected, teachers naturally use gestures as a teaching tool in the classroom and previous studies suggest their value for L2 instruction. At the same time, research also shows that adding gesture does not automatically improve learning outcomes (18–22) leading researchers to call for more specific predictions about which gestures support learning and when these gestures will be helpful (23–25). Related arguments from many areas of cognitive science have highlighted that it is important to examine the specific types of interaction between syntax and semantics and grounding that lead to understanding (26). (See (27) for a meta-analysis on when gesture benefits listener comprehension. See also (28) for an overview related to the embodiment of syntax and grammar in the brain).

Gesture researchers have proposed the Gesture-for-Conceptualization Hypothesis (GfCH) which states that gestures can schematize information and conceptually link hand movements not only to speaking, but also more generally to thinking itself (29). Because observing gesture triggers semantic processing (30, 31) it is conceivable that gestures linked to L2 grammatical morphemes could help children learn. However, gesture research suggests that gestures must be semantically related to words in order to support long term memory (32). It is further hypothesized that it is because gesture activates visual representations of concrete concepts that it facilitates learning (33). This raises the question of what exactly gestures for syntactical morphemes would map onto. Following this line of argumentation, L2 syntax, lacking an established concrete visual referent, may be too abstract and as such gestures would not help.

4.1.1 Learning and memorization

A leading tenet of neurobiological theory on learning and memory is that two at least partially independent neural systems, the declarative and procedural memory systems, underlie learning, representing and applying relevant knowledge (34–36). Declarative knowledge, associated with learning and using novel events and facts can be quickly learned, but is slower to use, necessitates more cognitive resources than procedural knowledge, and may be rapidly degraded. Procedural knowledge, in contrast, has been implicated in skill learning and habits. Procedural knowledge requires a critical amount of practice and time and is sometimes conceptualized as implicit learning. Through the procedural memory system knowledge with a complex structure can be acquired to a large degree independently of awareness of both the process and product of acquisition (37).

Applied to L2 learning, declarative knowledge includes knowledge of morphology, as well as grammar rules and is processed slowly. Procedural knowledge is quickly processed in parallel with other cognitive processes and thus places less of a burden on working memory (38). In this experiment, as in others, participant characteristics, such as the role of knowledge about L1 grammatical morphology, influence individual L2 learning outcomes. According to Boas and Höder (39), language contact can be seen as the normal state of languages, speaker groups and individual speakers. Although not many families reported that their children had an L2 other than the language of instruction, which was German, classroom observation suggests that diverse linguistic resources sometimes played a role in normal classroom interaction and thus it is possible that they were sometimes used during L2 learning. These and other confounding variables were dealt with by utilizing a within participant design, meaning that children in the two different test conditions were compared to themselves and thus cannot influence experimental outcomes.

4.1.2 Explicit and implicit learning

It is known that implicit learning mechanisms in children are more mature than explicit ones and there is broad consensus that everyday use of grammar is implicit. While it is implicit knowledge which enables both L1 and L2 learners to use language productively (40), it is not clear which memory system is directly involved in any given linguistic task (23, 24). L2 related research provides evidence that declarative knowledge may be converted into procedural knowledge (proceduralization of declarative knowledge) and procedural (implicit) knowledge may be converted into declarative knowledge as a result of experience (41).

4.1.3 Grammar and syntax learning

Perhaps unsurprisingly the subject of if and how grammar should be taught has long been debated (42) and linguists have not only stated that syntax should not be taught, but even more controversially, that it cannot be taught (43). This is obviously not the case (32,33). While there is an obvious difference between advising against formal instruction because there is a better way and stating that syntax cannot be taught, this controversy has continued. Many learners fail to master appropriate L2 use and many teachers tend to be skeptical about their grammar instruction (46).

Syntax has been defined as the study of the organization and interrelation of grammatical elements (47). In the present study, to better understand if gestures which embody grammatical morphemes support procedural learning for syntax, we explore the impact of gesture on response time. For the purpose of this study, teaching and testing the English L2 plural{-s} and the 3rd person possessive {-s} are useful because while children are frequently taught rules associated with these grammatical morphemes, the concepts are complex (40,48) and procedural learning takes time. In summary, I argue that the plural suffix -s and the -'s clitic marking the genitive case are important because they encode grammatical categories, are syntactically relevant and are fully productive in that they can be attached regularly to any word of the appropriate class (49) (see also (28)).

4.1.4 Gestures for thinking and speaking

As previously mentioned, researchers have recently proposed the Gesture-for-Conceptualization Hypothesis (GfCH) stating that gestures schematize information and are conceptually linked to thinking as well as speaking (29). Observing gestures triggers semantic processing (31,50) and related to L2 learning, gestures could allow linguistic units, such as the plural{-s} to be paired with a hand movement (see also (51)). This stable movement-meaning connection could reduce the need for other aspects of language comprehension and allow the brain to save these cognitive resources for additional information processing, leading to more robust consolidation and better retention (52,53). Brouwer, Fitz and Hoeks have proposed the term mental representation of what is being communicated (MRC) for the internal representation a listener or reader constructs while comprehending a sentence, story or scene (54) (see also (55)). They specify that MRCs are not only derived directly from linguistic input, but also from inferences made on the basis of logical, causal or pragmatic world knowledge (54). It follows that if in addition to patterns available in speech, gestures make it easier to retrieve and integrate stored knowledge, this would translate into semantic prediction leading to more efficient mental processing (56).

Along the lines of other situation model theories (57), and relevant to linguistic theory, if meaningful gestures enable learners to update their MRC with less effort and more clarity, learning would be less tied to contextual familiarity and more prone to consolidation. On the other hand, if gestures cannot be mapped onto a meaningful pattern, they would interfere with linguistic processing and language learning. Gesture theory, as outlined in the GfCH, makes predictions about the supportive effects of gestures for learning, but, as the MRC concept suggests, much of the information used to determine meaning is not associated with one lexical item (26), so many questions remain unanswered when it comes to how best to use gestures in language instruction.

Studies on procedural learning and syntax in middle childhood

While the relationship between gesture and L2 teaching and syntax learning has been examined, few if any studies have practically examined the effect of gesture on procedural learning for L2 syntax in classroom settings with learners of primary school age. This research gap is unfortunate because it is here, in this setting and with this age group when many learners begin formal second language learning. Quantitative behavioral studies related to procedural learning and syntax in middle childhood are reviewed and summarized in Table 1.

Table 1. Previous studies involving procedural learning and syntax with primary age children

Researchers	Participants	Study Objective
Eghbalzad, Deocampo & Conway (2021) (58)	26 children 8-12 years old	To investigate the relationship between pattern recognition ability, socioeconomic status and language outcomes
Kidd & Arciuli (2016) (59)	68 children 6-8 years old	To examine the role individual differences in a non-linguistic visual task play in predicting syntax comprehension
Lum, Conti-Ramsden, Page & Ullman (2012) (60)	51 children with specific language impairment (SLI) and 51 typically developing children (mean age 10 years)	To test and examine differences in the relationship between measures of working, declarative and procedural memory and the lexical and grammatical abilities of children with and without SLI

Ferman & Karni (2010) (61)	24 participants eight from each age group; 8 year-olds, 12 year-olds and young adults (mean age 21 years)	To investigate age differences in declarative and procedural learning for producing and judging an artificial morphological rule

To shed more light on gesture and L2 learning a recent study investigated the influence of teacher gestures on oral fluency in a diverse group of primary school age children (62)(see Chapter 2 in this thesis). This experiment implemented two L2 methods of language instruction, one with teacher gestures at the level of morphology, and one with gestures at the sentence level plus the written text. When the teacher gestured at the level of morphology (e.g. it + is + dark + out + there) there was one hand movement for every morpheme. In the case of this example sentence, five gestures were used, because no words are morphologically complex. (Sentences with morphologically complex words (e.g. final + ly + every + one + is + sleep + ing) had more than one gesture per word.) When the teacher gestured at the level of the sentence, there was one hand movement (e.g. it is dark out there) which corresponded with the entire sentence. For the children who learned with gestures at the level of morphology, speech and gesture were the only forms of linguistic input during training. For the children who learned with gestures at the sentence level plus the written text, the first half of the training time was spent reading and learning the written text and the second half of the training time was spent going through the play using the sentence level gestures to memorize the text.

Results from this first experiment showed a difference in long-term fluency gain between the experimental conditions among high and low performers. It was observed while learners with a lower initial speech rate benefitted more from gestures at the level of morphology, those with an initially higher speech rate benefitted more from reading plus sentence-level gestures. This suggests that the initial fluency level of learners is predictive of which type of gesture benefits fluency the most. A follow-up study using the same teaching methods investigated spatial term learning (63) (see Chapter 3 in this thesis). Here it was found that for these more abstract words, gestured input at the level of the morpheme, as opposed to reading plus gestures at the sentence level, benefitted all learners, regardless of their initial level. Results from these two gesture experiments beg the question where the long-term improvements in learning come from.

4.1.5 Background on gestures in the experiment

Although gestures have been grouped and named according to many classifications, the term codified gesture simply refers to gestures with meanings stored as a stable link in long-term memory (64). According to the foreground-background gesture framework (65) codified gestures

are foreground gestures and are comparable to an entry in the mental lexicon where a constant hand shape and movement is assigned a stable meaning. Codified gestures can be iconic, such as meaning ‘cat’ when placing fingers on both sides of the mouth to suggest whiskers. On the other hand, codified gestures can also be determined without an obvious concrete form meaning relationship. For example, borrowed from French sign language, one could tap the forehead to create a gesture meaning ‘pourquoi’ for ‘why’. In the classroom when a teacher performs a new gesture, the semantic relationship between movement and learning content must be immediately apparent, otherwise the hand movement may not be understood and must be learned by association. When meaningful gestures are combined with new words, learners may benefit since gestures can be perceptually similar to the object or event being referenced and can thus add semantic information. This, additional embodied semantic information can in turn prime lexical representations (66). It is important to note that in gesture research there is wide agreement that hand movements can be categorized into different subtypes (29). Although the gestures used in this study could be categorized in other ways (e.g. (7)), the term codified gestures has been used to emphasize the one-to-one relationship between movement and meaning. At different times research on L2 learning has used different terms for similar movements-meaning pairs sometimes creating new terms, such as Intentional Teaching Gestures (67) or Voice Movement Icons (68) and at others simply referring to gestures (e.g. (24,69)).

Present study

Vocabulary learning has been the focus of much research on gesture and L2 instruction. These experiments, while crucial, lack the precision necessary to provide guidance on whether gestures might support learning to use grammatical morphemes in context or not. The present study extends this work and reports the results of a three-week experiment that tested the effects of gesture-based instruction on L2 plural{-s} and 3rd person possessive {-s} use in English.

Since it is difficult to directly view the rules and structures a learner has internalized, one possibility to assess learning is to look at performance and production errors (70). This can be done by providing instruction in one context, such as playing language games in a group, and testing a possible transfer of learning on an individual transfer task, such as the GSF task.

I hypothesize that during second language acquisition gestures can support the mental representation of what is being said (MRC), reducing uncertainty and resulting in semantic prediction which facilitates more efficient language processing. Based on previous unpublished results and in agreement with usage-based models of language acquisition (71) I make no prior

claims about one condition, the syntactically specific two gesture condition or the syntactically general one gesture condition, being more efficient than another. Following a repeated-measures design, which quantifies changes over time, a potential gain in procedural learning measured by a decrease in response time was analyzed. This approach is consistent with the premise that meaning is embodied and that learning occurs as a result of collaboration with others in familiar socially constructed settings (72–74), and addresses the following research questions:

1. In the context of a group training in which children use gestures corresponding to the plural s and possessive s, can a long-term gain in L2 procedural learning for the use of these grammatical morphemes be measured on an individual semantic priming transfer task?

2. Can we find evidence that seeing different grammatical morphemes for the plural and possessive s in gesture form results in measurable differences in response time?

Results will add to our general understanding of the mechanisms by which children learn and explore the nuances of when grammatical morphemes in gesture form help.

4.2 Materials and Methods

This research used a novel version of the computer-based speeded word fragment completion task (28) I refer to as the gesture speeded fragment completion task. Before and after four hours of group instruction children of one school class between 11 and 12 years old (N = 19) completed phrases, such as the dog's n_ck (neck) or the dogs pl_y (play) from which one letter was omitted, as quickly as possible. Identical phrases were completed in two conditions, a syntactically specific (two-gesture) condition and a syntactically general (one-gesture) condition.

In both conditions each item consisted of viewing the first three morphemes in gesture form (e.g. the + dog + s) followed by a semantically related written fragment (e.g. n_ck (neck)) where response time was measured on completion. Whereas the syntactically specific condition had two ‘s’ gestures; one for possessive and another for plural, the syntactically general condition had only a single ‘s’ gesture for both. All ‘s’ gestures were iconic in that their form corresponded to their sound, but while the syntactically specific gestures visually distinguished between their plural and possessive meanings, the general ‘s’ gesture did not. (See Fig 2 in the Materials and Methods section for a comparison between the possessive, plural, and general ‘s’ gestures.)

4.2.1 Participants

Our study was conducted with a convenience sample of twenty-three learners between the ages of 11 and 12 who attended the same primary school class in urban Germany (*M* = 11 years, *SD* = 0.32, 10 females). In week 1 and 3 children were tested using the gesture speeded fragment completion task (GSF task) where they completed semantically related phrases such as *the cat's t_il* (tail) or *the cats lo_k* (look) to measure initial learning and retention. In week 2 of the experiment, children received instruction for a total of four hours over four days. Of the grade 6 children, 2 identified an L1 other than German as their primary home language. All children reported having previously learned English.

Ethics statement

The experimental procedure was approved by the city department of education as well as the school leadership before the study began. Parents read an information sheet containing general information about the experiment and data treatment. All children who participated submitted written consent from their parents prior to the study and agreed to participate. After data analysis was complete the children were debriefed about the experiment and had the possibility to ask questions.

4.2.2 Design

This study employed a within participant pretest-posttest design with response time as the main dependent variable and condition (syntactically specific vs syntactically general), and time (session 1 vs session 2) as independent variables. In week 1 and week 3, before and after training instruction children were individually tested. Because the test items were randomized in their order and the order of which experimental condition came first was counterbalanced across participants, session tests consisted of different versions of the same test (75,76).

4.2.3 Training materials

This experiment investigates the role which gestures embodying grammatical morphemes can play in the acquisition of procedural knowledge for L2 phrases across multiple learning sessions. The study consisted of group instruction and the GSF task, a task designed to examine possible semantic priming effects for perception of these grammatical morphemes in gesture form. Training sessions focused on learning and using codified gestures for 32 simple English phrases such as the boy’s t-shirt or the cats look. Half of the phrases followed a [NOUN + POS-S + NOUN] pattern and half

followed a [NOUN + PL-S + VERB] pattern. The experiment proper began with a group warm-up familiarization phase. This was followed by individual GSF pretests. This was followed by group instruction and, finally, by individual GSF posttests. Tasks are described one by one below in the order in which children encountered them.

4.2.4 Warm-up training

During the warm-up training children were introduced to the 40 nouns and verbs used in the experiment. A list was presented and discussed to clarify less familiar words. Instruction then paired the written words with gestures and finally with pictures. This sequence served to familiarize children with the word-gesture pairs and to avoid children mapping the gesture for *boy* to unintended objects in the pictures (e.g. the t-shirt the boy was wearing) had they seen the pictures first. Two pictures associated with the *cat* phrases can be seen in Fig 1 (see online version). Note that during the warm-up training, where the purpose was to reinforce word meaning (e.g. for the word *crash*), some of the pictures used differed slightly from those later used during instruction to reinforce phrase meaning (e.g. *the car's crash*). During the warm-up training, for example, the picture paired with *crash* showed only one car crashing into a wall.

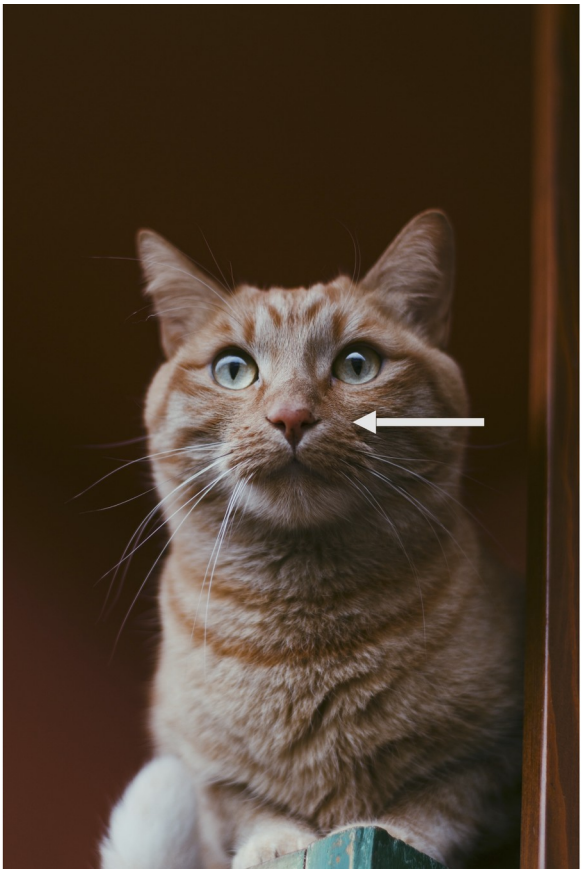

Figure 1. Sample pictures used in instruction in the cat training phases. Pictures correspond to *the cats look* and *the cat's nose.* Source of all images in the learning procedure: https://unsplash.com.

4.2.5 Gesture speeded fragment completion task

This experiment used a novel version of the speeded word fragment completion task (77) called the gesture speeded fragment completion task. Semantic priming is the finding that the processing of a target (e.g. a picture, word or sound) is enhanced when preceded by a semantically related prime (e.g. a picture, word or sound) relative to an unrelated prime. Aspects of word meanings are reflected in the topography of brain activation and priming corresponds to a transfer of activation between two lexical representations and can reveal the nature of the connection between the two units or the existence of shared representations (78). Priming is used to study semantic access in the mental lexicon and much current neuroscientific research focuses on prediction in perception and action. This can be summarized as follows: ‘When perceiving a series of events, the item occurring next can frequently be anticipated some time before it occurs, and similarly, in performing a series

of motor acts, the next-following one is typically processed before its onset' (56). While different word fragment completion tasks are used to examine semantic priming, the general idea is that participants are presented with words from which one or more letters have been omitted and while participants fill in the gap their response time is measured. The main dependent variable in such experiments is response time. Building on this general principle, Heyman and colleagues created a task using stimuli with only one blank space, where stimuli have only one correct completion and the missing letter is always a vowel (77). Because these qualities make the task engaging and allowed for a fine-grained investigation of semantic activation in the past, it was adapted it for using with L2 learners.

The gesture speeded fragment completion task exploits the homophone-like stimuli of car's vs cars or dog's vs dogs where a phrase such as the cars crash is represented by three morphemes in gesture (the + car + s) followed by a semantically related word fragment (cr_sh (crash)) which measures the response time necessary to complete the fragment. Each test is comprised of 32 items (see Appendix D) in two conditions. In Fig 2 (see online version) the upper sequences represent the syntactically specific (two-gesture) condition and the lower sequences the syntactically general (one-gesture) condition.

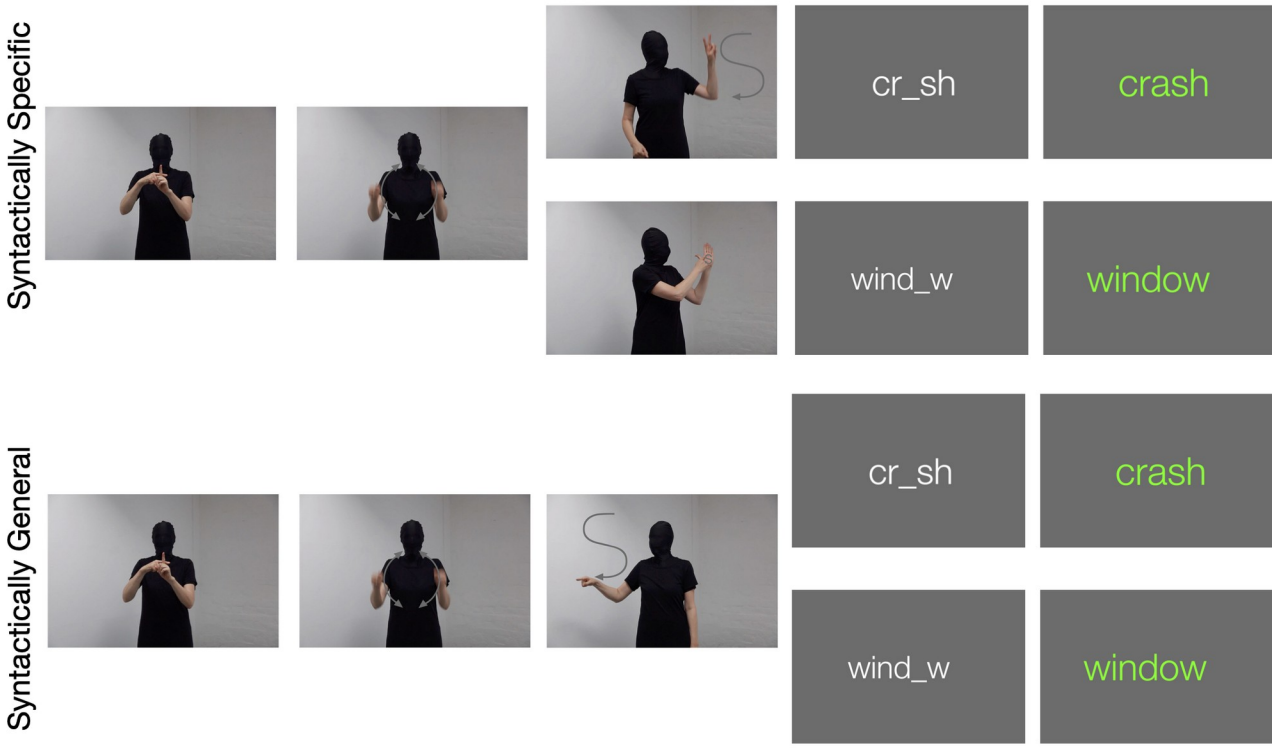

Figure 2. Schematic comparison of gestures corresponding to items *the cars crash* and *the car's window* in both conditions. A link to demonstration videos in both conditions can be found in Appendix D.

As previously mentioned, ‘s’ gestures in both conditions were iconic in that their form corresponded to their sound, but while the syntactically specific gestures in the upper half of Fig 2 made a visual distinction between their plural and possessive meanings, the general ‘s’ gesture in the lower half did not.

Children were tested after the warm-up training (pretest) and after instruction (post-test). Conditions were blocked, meaning that an individual child had all 32 items in randomized order with either the syntactically specific or the syntactically general condition first. A testing session lasted between 10 – 15 minutes including a short break between the two conditions. PsychoPy Experiment Builder (v3.1.2) was used to create and run the test sessions (79). Altogether, there were 64 trials per individual participant. When a fragment was completed with a correct keystroke, visual feedback was given comprising the completed fragment appearing in green for one second. When the keystroke was incorrect the correct word was displayed in red.

4.2.6 Instruction

The materials used for instruction were similar to the word and picture slides used in the warm-up training. These same pictures were also used in the form of small cards for some games.

Overview of the training paradigm

The training paradigm consisted of activities aimed to encourage beginning learners to create multisensory mental representations of L2 constructions (80–82). Learning activities were spread over several days to take advantage of spaced repetitions, to take advantage of testing effects, and because the content was deemed too difficult to learn in one day. Throughout the activities, learning engagement and motivation were supported in several ways:

- The words used to create the training and testing items were appealing, meaning they used words which were easy and generally well known, as ranked by young L2 German speakers of English in an unpublished study.
- The gestures used to create the training and testing items were deemed intuitive, as indicated by young L2 German speakers of English who viewed the gestures and marked on a list what they thought they had seen.
- Scaffolding was provided in such a way that teacher support faded over the sessions and encouraged a transfer of responsibility to the learners.
- Language games were played in different groups, some in pairs, some in small groups and some, such as class memory, were played all together.
- Discussion at the end of sessions allowed learners to reflect on what they learned and why it was important.

Gesture training

The gesture training was taught in one week and consisted of four 60 minute lessons spread over four days. In all lessons there was a balanced approach of direct instruction, modeling, guided practice and group games. The possessive and plural distinction was introduced in the second lesson through a sorting game modeled and played with the class with the item pictures projected at the

front of the class room. After briefly explaining in German that an ‘s’ sound can ‘mean different things’ in English, (sometimes meaning more than one, and sometimes meaning that something belongs to or is a part of something else), a game was played where as a group children pointed to pictograms symbolizing the plural or possessive gesture. After this game was played with half the items the same game was repeated but this time instead of pointing the syntactically specific and plural and possessive gestures were used. Subsequently the other half of the items were treated in the same way. Most games involved in training took between 10 and 12 minutes to play. Lessons were conducted by the experimenter with the classroom teacher present who led the feedback sessions and replaced the regular English lessons.

4.2.7 Procedures

Warm-up training procedures

In order to ensure that children were familiar with the words in the study, a warm-up training was conducted. This happened in two phrases. First, as a group learners were presented with a list of written words also containing two language-like words, haque and adair which follow the phonotactic rules of English but which are not English. After discussing which words were less familiar and revealing which words cannot be known (the pseudo-words), the 40 word-gesture pairs of the experiment were introduced in ‘word families’ or semantic fields. For example, to introduce the words in the baby semantic field (baby, crawl, smile, blanket and teddy) a slide at the front of the classroom projected the written word baby, and the experimenter demonstrated the baby gesture twice which was enacted by the children. The word-gesture demonstration was then followed by a picture-gesture demonstration before moving on to the next word. The 20 word-gesture pairs belonging to the baby, boy, car and cat semantic fields were introduced first and following a short break the remaining word-gestures pairs belonging to dog, frog, girl and horse followed.

Gesture speeded fragment testing procedures

Children participated individually at a table in a corner of an unused staff room at the school. Children were thanked for coming, because of the pandemic asked if they had washed their hands. They were then asked for their help in entering their ‘secret code’ which was the ID code used to match trials and language surveys. Children were seated in front of a laptop and after a brief explanation of why their hands needed a comfortable resting place in front of the keyboard, the first part of the task instructions were read in English: ‘You will see two words followed by a word with

a missing letter. You decide which missing letter completes the word.' Then the experimenter then demonstrated how to complete a sample fragment for a phrase not included in the task, the cats j_mp (jump). The second part of the instructions were then read in English and translated into the language of instruction, German. 'To make things easier the answer will always be a, e, i, o, or u.' Children were encouraged to find the letters on the laptop keyboard which were printed on the screen and would be used in the task before beginning the task. The task was self-paced and after the child began the task the experimenter moved to a nearby table so that the screen was not in direct sight.

After the first 32 items (between the two blocks) the children were asked if they would like to take a break. Children usually declined and helped once again to enter their 'secret code' and began the second block in the opposite condition. After completion each child was thanked and asked to notify the next child. The entire procedure usually took between 10-15 minutes per child. All fragments used in this task can be seen in Appendix D and additional details about the stimuli can be found in the Materials and Methods section.

4.2.8 Data Analysis

Multiple regression analyses were conducted on response time to test the effects of teaching using gestures which embody grammatical morphemes on procedural learning. Our continuous dependent variable (response time for word fragments) and our binary dependent variable (correct vs. incorrect responses for word fragments) were analyzed using a multilevel modeling approach. A hierarchical model including subject as a random effect. Session, meaning the time point when the tests were conducted, and condition were included as fixed effects. All analyses were conducted with R Version 4.0.3 with the lme4 package (83).

4.3 Results

4.3.1 Data Description

Our analysis of student outcomes employs a model comparison approach and includes students who completed both test sessions in both conditions. For each participant, a mean correct response time (i.e., mean response time for fragments correctly answered on the test) was calculated and responses which were slower than 2 SDs were removed. Erroneously completed targets comprised 17.9% of the data and response times slower than the individual cutoff value excluded another 3.8% of the data. PsychoPy did not accept responses faster than 250 ms and after applying the individual cutoff

value no responses were slower than 5.7 seconds, so no further cleaning was necessary. This led to an average RT in the S (two-gesture) condition of 1.98 seconds (SD = .71) at pretest and 1.77 seconds (SD = .68) at posttest and an average RT in the G (one-gesture) condition of 1.94 seconds (SD = .75) at pretest and 1.84 seconds (SD = .71) at posttest. In Fig 3 (see online version) the mean response times are plotted by session and condition. The confidence intervals are wide, reflecting the true uncertainty in the estimates of the means.

4.3.2 Differences between conditions

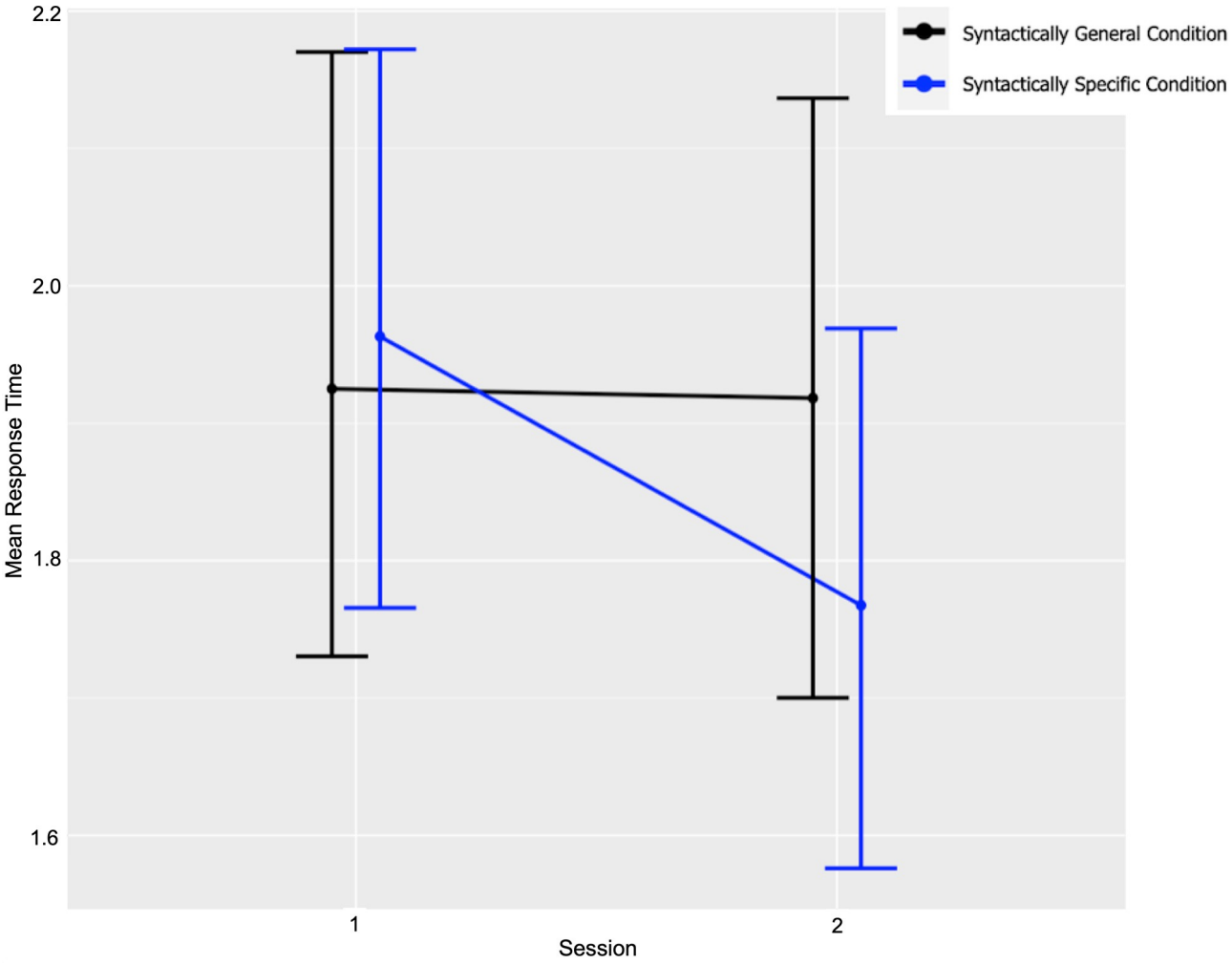

Figure 3. Change in mean response time for correct fragments between sessions by condition.

The x-axis plots the two tests, pretest (before instruction), post (one week after instruction), for the S (two-gesture) and G (one-gesture) conditions. The y-axis plots the mean response time for cleaned correct test items per teaching method. For the sake of clarity, error bars plot unadjusted

95% confidence intervals. However, this plot somewhat ignores the within-subjects design of the study. It does not tell us whether the observed decrease in RT for the syntactically specific condition over sessions is there because it occurred consistently for all subjects or because of a small number of subjects whose RT decreased very steeply. This can be checked by showing the plot separately by subject.

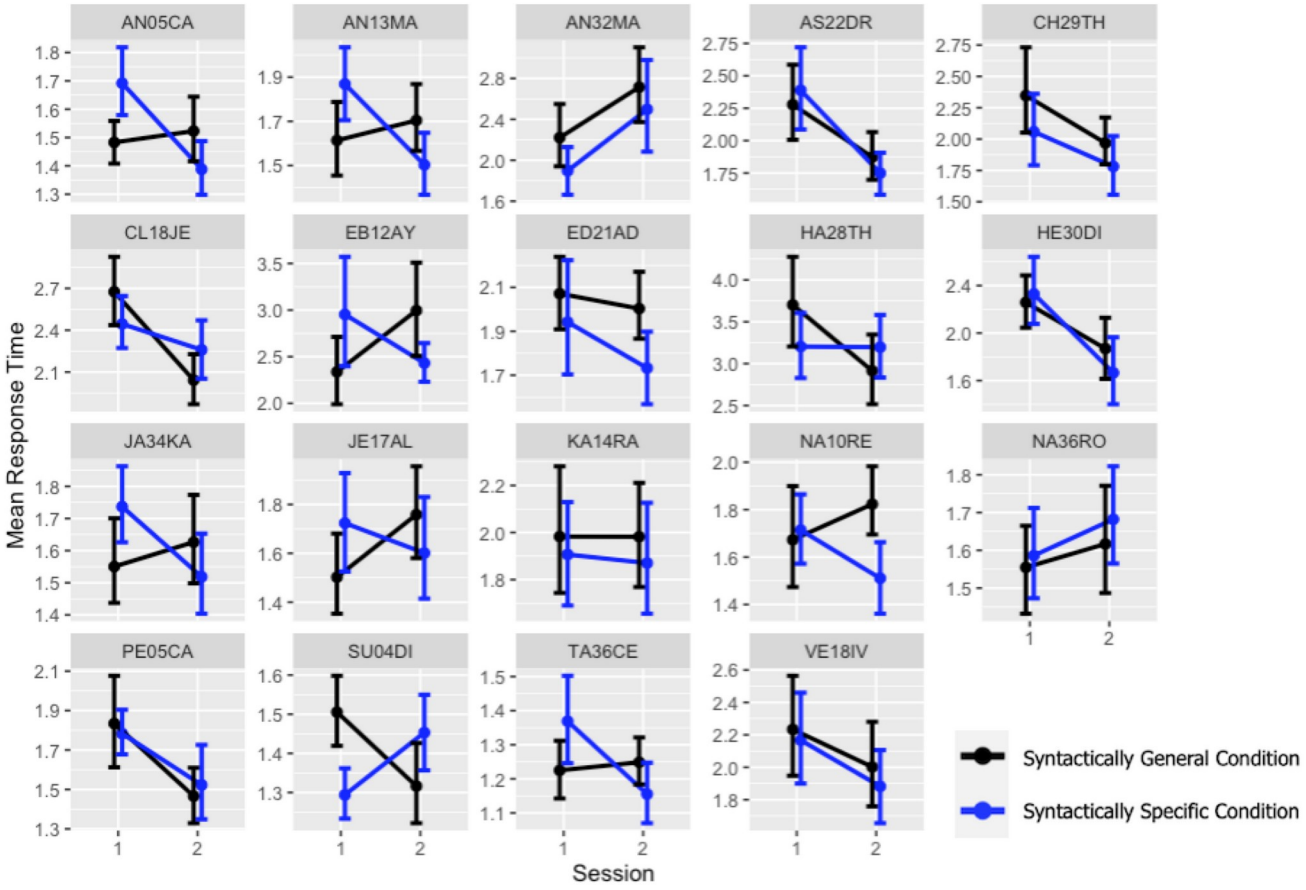

Figure 4. Change in mean response time between sessions and condition by participant.

Fig 4 (see online version) shows children's mean response time organized by session and condition. A fairly large number of subjects show a steeper session-to-session decrease in RT for condition S. But the pattern is not universal. Here again, the x-axis plots the two tests, once before instruction and once one week after instruction for both conditions. Again, the y-axis plots the mean response time for cleaned correct test items per teaching method and error bars plot unadjusted 95% confidence intervals.

4.3.3 Long-term gain in procedural learning

In order to further investigate these differences, children's response time was entered in a random effects model including subject as a random effect. Experimental session and condition were included as fixed effects. Four models were created: 1) a baseline model predicting RT with random intercepts and random slopes across subjects (mRandom); 2) a model with session as a predictor of RT and random intercepts across subjects (mRandom_session); 3) a model with session and condition as a predictors, and random intercepts across subjects (mRandom_condition); 4) a model with session and condition as predictors of RT, an interaction between session and condition, as well as random intercepts across subjects (mRandom_interaction) This incremental adding of terms is important. For example, without subjects, the first term added, no learning is possible. Without session, the second term added, it is not possible to measure a change in learning, as measured by a potential decrease in RT etc. Each time only one new component was added to the model in order to facilitate comparing them with the log-likelihood statistic.

```
Data: cleaned
Models:
mRandom: RT ~ 1 + (session | subject)
mRandom_session: RT ~ (session | subject) + session
mRandom_condition: RT ~ (session | subject) + session + condition
mRandom_interaction: RT ~ (session | subject) + session + condition + session:condition
                    npar    AIC    BIC  logLik deviance
mRandom                5 3375.6 3403.4 -1682.8   3365.6
mRandom_session        6 3373.0 3406.3 -1680.5   3361.0
mRandom_condition      7 3371.5 3410.4 -1678.8   3357.5
mRandom_interaction    8 3369.3 3413.7 -1676.6   3353.3
                     Chisq Df Pr(>Chisq)
mRandom
mRandom_session     4.5992  1    0.03199 *
mRandom_condition   3.4834  1    0.06199 .
mRandom_interaction 4.2250  1    0.03983 *
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 5. Random effects model output.

The resulting output seen in Fig 5 (see online version) shows that adding session significantly improved the fit of the model, Chisq(1) = 4.59, p = .031. Adding the fixed effect of condition did not significantly improve the model, Chisq(1) = 3.48, p = .061. However, adding the interaction

between session and condition did significantly improve model fit, Chisq(1) = 4.22, p = .039. A post hoc Tukey test showed that the S (two-gesture) and G (one-gesture) conditions differed significantly at p < .05. Comparing the results of the two models summarized in Table 2 allows us to see that the fit of the model with the interaction between session and experimental condition is favored.

Table 2. Summary of model fit statistics

	Df	AIC	BIC	log Lik	deviance	Chisq	Chi Df	P(>Chisq)
mRandom_condition	7	3371.5	3410.4	-1678.8	3357.5	3.48	1	.061
mRandom_interaction	8	3369.3	3413.7	-1676.6	3353.3	4.22	1	.039*

As can be seen from the output of the mRandom_condition model below, the interaction between the experimental group and session appears to be specific to the second time point or posttest in session 2. Based on Fig 3, this interaction is to be expected. Response times from the syntactically specific condition in the second testing sessions (p = .039 *) suggest that many learners are able to exploit the semantic information in the syntactically specific gestures enough to be measured by the GSF task.

Summary

Visual inspection of Fig 3 suggests that a gain could be measured between pre and posttest in the syntactically specific condition. While this was not true for every individual learner, as can be seen in Fig 4, this change was statistically significant (p = .039) as expressed in the mRandom_interaction model output which includes an interaction between session and condition. These changes in response time show that there are large differences between learners. Especially for learning which is new, this result suggests that teaching over time is important in order to

consolidate what has been learned (84). In summary, the results for the final model (mRandom_interaction) are presented in Table 3.

Table 3. Summary of fixed and random effects

	Fixed effects			*Random effects*
				By Subject
Parameters	Estimate	*SE*	*t value*	*SD*
Intercept	2.06	0.15	13.56	0.61
Session	–0.07	0.06	–1.25	-
Condition	0.11	0.08	1.38	-
Session x Condition	–0.10	0.05	–2.05	-

Model formula: mRandom_interaction: RT ~ (session | subject) + session + condition + session:condition

4.4 Discussion

4.4.1 Procedural learning of grammatical morphemes

Through using a novel task, the gesture speeded fragment completion task, this study sought to investigate the effectiveness of L2 teaching which visually differentiates between grammatical morphemes which differ in meaning but sound the same. Essentially, this training focused on encouraging children to connect their sensorimotor experiences (viewing and performing speech and gesture combinations in a group) to explicit information related to phrases containing the plural{-s} and 3rd person possessive {-s} in English. Both this embodied approach and the fact that particular attention was devoted to mentally simulating phrases containing grammatical morphemes which differ in meaning but sound the same provide an advance over prior empirical work (62,63). Also, it moves beyond current classroom practices on L2 instruction where learning as a

multisensory experience has so far hardly pervaded (32). Regarding training and procedural learning, the experimental results provide the following valuable insights.

4.4.2 Implications for L2 processing and embodied teaching

The main finding of this study is that under authentic teaching and learning conditions, the gesture training decreased the mean response time in the children's fragment completion performance. Specifically, following the gesture-based training, most grade-six children showed a larger pretest-to-posttest improvement on the gesture speeded fragment completion task, our test of procedural learning, in the syntactically specific (two-gesture) condition than in the syntactically general (one-gesture) condition. Given that the phrases (and fragments) in both conditions were the same, it is unlikely that sixth graders' improved performance in the syntactically specific condition is simply the result of faster fragment completion in the posttest. Rather, considering the activities the training actually encompassed, this finding suggests that children were able to use the additional information in the syntactically specific gestures for semantic prediction resulting in a greater decrease in word fragment response time in the two-gesture test condition.

Our study demonstrates that the aggregate of instructions and exercises encouraging these children to connect words and then noun and verb phrases to their sensorimotor experiences improved their fragment completion performance.

4.4.3 Limitations and outlook

It remains to be explored in future research to what extent each of the components of the training individually contribute to improved linguistic processing the gestural benefit observed in this study can be generalized to other syntactic learning situations. Also, it is yet unclear why the gesture-based training was more effective for some children than for others. Additional studies with different paradigms and more participants are required to investigate this question. Nonetheless, the changes in response time over time raise certain questions worth investigating. Before addressing one additional question, I would like to addresses the original research questions:

1. In the context of a gesture-based training, can a long-term gain in L2 procedural learning for the use of grammatical morphemes be measured on a transfer task?

2. If the same test items are used in both conditions, does seeing different grammatical morphemes in gesture form (syntactically specific vs syntactically general gestures) result in measurable differences in response time?

Regarding question one, visual inspection of Fig 3 shows a gain in procedural learning between pre and posttest. Moving on to question two, this gain is found in the syntactically specific two-gesture condition. This is confirmed by the model output which includes an interaction between test session and test condition (p = .039*). As can be seen in Fig 4, this was not true for all learners, however, what this exactly means is not easy to interpret. Learning is complex and there are many interactions between procedural and declarative learning processes. For example, following Ferman and Karni (61), in this experiment a decrease in response time was evaluated as an increase in procedural learning. However for a few learners, (presumably those with a lower level of L2 ability) it is possible that because the gesture-based training highlighting the meaning of plural and possessive grammatical morphemes, more attention and awareness (not less), could have resulted in an increase in response time for completing fragments. Ferman and Karni (41) write: "There is evidence … that as a result of training and experience, implicit knowledge can become explicit in the sense that learners can become aware of the underlying structures and regularities (rules)." For other learners, (presumably those with a higher level of L2 ability) this process of becoming aware of grammatical rules could also be associated with a temporary decrease in speed. Hebbian mechanisms for synaptic modification explain why consolidation of learning is an important concept and insufficient consolidation could provide a rationale why learning from four lessons of instruction did not increase procedural learning for all children. A follow-up experiment could space teaching over several weeks, as opposed to just one. In addition to spaced teaching, an experiment which addresses interaction effects between gesture-based instruction and L2 writing would be of interest.

The additional question I would like to ask is if the GSF task may have been too complex. In order to collect response time the task needs to go through spelling, then the word, and then the concept. This means that a knowledge of spelling is needed to access the concept and syntactic learning. On the other hand, although some children struggle with L2 writing and spelling, these skills are taught and are required for academic success, and exit interviews from testing consistently confirmed that children enjoyed the challenge of the 'game'.

4.4.4 Conclusion

This experiment uses the gesture speeded word fragment completion task and asks if learners observing syntactically specific L2 's' gestures which visually distinguish between the plural and possessive 's' enhance linguistic processing in comparison to a single 's' gesture which does not make this distinction. It is well-established that gestures support L2 word learning, however

research on the effect of gestures on syntax is rare. As a teaching tool, gestures are easily accessible and can be paired with different linguistic units. However, if there is no difference between exposing L2 learners to gestures which are syntactically general or syntactically specific, this would suggest that language teachers should not support learners by using gesture systems which make this distinction. Efficient language learning processes are key in multilingual societies and understanding when and how gesture promotes learning can help put this important teaching and learning tool to optimal use.

In conclusion, recent decades have witnessed an increase in interest in the roles of embodied teaching methods, but there is still a need for more empirical work that explores the results of student and teacher gestures in naturalistic classroom interactions. This is particularly the case for contexts of L2 teaching beyond investigating vocabulary learning. By combining gesture theory and research from the classroom, this paper provides evidence that gestures can promote procedural knowledge for difficult L2 morpho-syntactic structures, such as the English plural{-s} and 3rd person possessive{-s} in primary school. Importantly, our findings suggest that for sixth-grade children, the same verbal information can be packaged in different ways and that these nuanced differences may have important implications for teaching and learning syntax. Rather than just supporting learners to understand a grammatical rule, it is important to use teaching methods which encourage enactments of sensorimotor experiences (85). More research is certainly needed to further develop and refine such an approach. The transfer of concept learning from perceiving gestures in a social setting to solving a written task is in line with research that shows that neglecting movement as a learning strategy leaves an important source of support under-utilized (82). This present study not only serves as a useful starting point from which future endeavors can be explored, it also suggests that this would provide a valuable addition to L2 instruction.

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Chapter 5

General Discussion

5.1 Summary of the findings

Several goals have been accomplished by the experiments reported here. First, the study reported in Chapter 2 discovered a relationship between different gesture-based teaching methods and the development of long-term oral fluency when learning the same text. Specifically, employing codified gestures which show morphemes led to a more significant enhancement in oral fluency, particularly among learners with lower L2 proficiency. This suggests that instruction incorporating gestures representing morphemes facilitates comprehension for this subgroup of learners and demonstrates that learners in middle childhood are sensitive to the gesture form in which L2 meaning is presented. Second, in the study reported in Chapter 3 on the comprehension and utilisation of L2 spatial terms, it was observed that although learning through sentence-level gestures combined with access to the written text led to an improvement in L2 spatial term proficiency, this enhancement was more immediate for participants who were only exposed to codified gestures paired with morphemes, and that this was true across ability levels. Lastly, the study reported in Chapter 4 established that gestures can visually differentiate between grammatical morphemes, such as the plural and possessive {-s}. This distinction resulted in measurable differences in response time, highlighting the potential for gestures to clarify grammatical morphemes needed for learning L2 syntax and supporting L2 comprehension. Each of these experiments is discussed in turn.

5.1.1 Study in Chapter 2

Methods of L2 instruction play a crucial role in diverse, multilingual societies. While previous studies have shown support for codified gestures as effective tools for teaching abstract systems such as language (Hille et al., 2010; Macedonia & Klimesch, 2014) and math (Novack et al., 2014), this evidence is also inconclusive, because instructional gestures do not support learning in every case (Kelly et al., 2014). The study reported in Chapter 2 addresses these limitations. Within the context of learning and performing a play in school, the investigation into codified gestures was extended to two English-language teaching methodologies—one with teacher gestures at the level of morphology and the other with gestures at the sentence level. Specifically, this experiment explores whether learning the same text by different movement-based teaching methodologies, either using a gesture for every morpheme without the written text (CG condition) or using gestures for key sentences with access to the written text (SL condition), result in a measurable difference in learners' long-term oral fluency. Because this experiment (N = 54) was conducted with a diverse group of primary-age students (refugee children vs children born in Germany), it allows not only for an investigation of fluency differences between learning conditions over time, but also between learning conditions and learner groups.

This study allows us to determine differences in long-term fluency development (de Jong & Perfetti, 2011; de Jong & Wempe, 2007; Lennon, 1990; Segalowitz, 2000). The outcome is reflected in the form of an interaction in speech rate, not between learning condition (CG vs SL condition) and learner group (refugee children vs children born in German), but rather between learning condition (CG vs SL condition) and initial ability. An increase in speech rate is typically interpreted as an indicator of a robust increase in fluency (de Jong & Perfetti, 2011; de Jong & Wempe, 2007; Lennon, 1990; Segalowitz, 2000). Therefore, the evidence suggests that, although there was a mean benefit for children in both groups, when instructional gestures differ in linguistic units, the initial fluency level of learners is predictive of which gesture type benefits fluency the most. Children with a lower initial speech rate benefited more from gestures that show morphology, whereas those with a higher initial speech rate gained more from gestures at the sentence level.

These findings are in line with the Gesture-for-Conceptualization Hypothesis, which posits that gestures schematize information (Kita et al., 2017). The results also imply a connection to reading. Although reading was not assessed in this exploratory study, it can be assumed that children in the CG condition learned their text through interpreting their teachers' gestures. Consequently, learners who struggle with L2 reading and writing may benefit more from the opportunity to learn texts through alternative means, such as 'reading' words from their teachers'

hands. These findings are consistent with the position that meaning is embodied (Sambanis, 2013) and that learning is facilitated through collaboration with others in socially constructed settings (Bruner, 1983; Rohlfing et al., 2016; Tomasello et al., 2012).

5.1.2 Study in Chapter 3

Clearly understanding the semantic categories associated with words like *to*, *in*, *on*, and *under* are highly relevant for L2 learning. Symbolic hand movements can represent spatial information through form and movement (McNeill, 1992; Stokoe, 2000), and studies have shown support for codified gestures for teaching abstract systems in school (Hille et al., 2010; Macedonia & Klimesch, 2014; Novack et al., 2014), but predictions about exactly which gestures are most effective remain rare. The study reported in Chapter 3 addresses these limitations and extends the investigation of codified gestures in L2 instruction to spatial term learning. As was the case with the experiment in Chapter 2, this study took place in the context of learning and performing a play in English and also used the experimental paradigm and learning conditions detailed in Chapter 2. Again, this experiment was conducted with a diverse group of primary-age students (N = 76), this time children living in Germany and Poland.

This study allows us to determine differences in long-term spatial term learning (Brala, 2002; Lakoff & Johnson, 1999; Lütke, 2011; Tyler & Evans, 2003). The outcome is reflected in a gain in our measure of spatial term understanding (as measured by an act-out task) and use (as measured by a description task), typically interpreted as an indicator of spatial term learning (Nakatsukasa, 2016; Rumme et al., 2008). Therefore, we found evidence that the CG condition appears to be the initially more efficient learning procedure, and that this is true for learners regardless of initial ability. Despite both groups achieving similar gains in understanding and using L2 spatial terms, this gain was more immediate for learners exposed to the one gesture per morpheme condition. One explanation is related to the higher number of gestures in the speech-gesture input in the CG condition. This could have resulting in a ‘cleaner’ gesture signal. Another explanation is that the alignment of one gesture per spatial term possibly allowed for better consolidation in a shorter time.

These results align with the Gesture-for-Conceptualization Hypothesis, suggesting that gestures serve to schematize information (Kita et al., 2017) and that this principle applies not only to concrete words, but also to more abstract words like L2 spatial terms. Additionally, they correspond with the Retrieval-Integration account of language processing (Brouwer et al., 2016; Gunter et al., 2015), suggesting that speech-gesture pairs which more closely align in meaning

result in lower retrieval and integration effort (as indexed by N400 and P600 amplitudes) resulting in more durable and flexible learning. These findings are consistent with the position that overlooking linguistic action as a learning strategy neglects a crucial source of access to and support for learning.

5.1.3 Study in Chapter 4

Gesture has been shown to influence how we understand complex language and learn abstract concepts and how L2 grammar should be taught is controversial. Previous studies have focused on providing empirical support for the role of gestures in L2 learning for speech comprehension (Gunter et al., 2015; Llanes-Coromina et al., 2018; Morett & Chang, 2015), word memorization (Baills et al., 2019; Kushch et al., 2018) and pronunciation (Ghaemi & Rafi, 2018; Gluhareva & Prieto, 2017; Li et al., 2021; Yuan et al., 2019; Zhen et al., 2019). The study reported in Chapter 4 explores a key aspect of L2 syntax learning. The investigation of codified gestures (N = 19) was extended to morpho-syntactic structures—specifically, the plural {-s} and 3rd person possessive {-s} in English. This experiment uses a novel task, the gesture speeded fragment completion task. This task allows us to measure changes in individual semantic priming (Forster, 1999; Grisoni et al., 2017; Heyman et al., 2015; Pulvermüller & Grisoni, 2020). The result was manifest in a decrease in mean response times after instruction in the test condition utilizing syntactically specific gestures, typically interpreted as an indicator of procedural learning (Baddeley, 2012; Ferman et al., 2009; Ullman, 2016; Ullman et al., 2020). Results showed that specifying the meaning of two homophonic morphemes reduced children's RT in the tests, suggesting that embodying grammatical morphemes during instruction may benefit L2 learning.

This result is likely related to implicit and statistical learning and the important role that predictive processes play in learning. Therefore, these findings are in line with the Gesture-for-Conceptualization Hypothesis (GfCH), suggesting that gestures schematize information (Kita et al., 2017) and that this principle applies at the linguistic level of grammatical morphemes. Additionally, these results correspond with the Retrieval-Integration account of language processing (Brouwer et al., 2016; Gunter et al., 2015), suggesting that instruction utilizing speech-gesture pairs at the level of morphology can lower retrieval and integration effort (as indexed by N400 and P600 amplitudes) resulting in more durable and flexible learning relevant for syntax learning. In addition, in the broader picture of language learning, these findings are consistent with usage-based and constructionist models of language acquisition that predict that environments of language use result in learning in the individual language learner.

5.2 Significance

Despite the impressive amount of research accumulated until now, the field of embodied learning is fragmented (Andrä & Macedonia, 2020; Mavilidi et al., 2018) and it is quite difficult to reach consensus on how to leverage gesture as a teaching tool. A comprehensive view of gestures in the L2 classroom must include multiple perspectives. From a functional perspective, the question can be raised how gestures operate. From a teaching standpoint, the focus can shift to how gestures can be effectively employed. Additionally, a social and cultural perspective compels one to ask how gestures are shaped by the social environment from which they come, which is different from the question of how they impact social interaction and learning when they are used in any individual classroom. This thesis will conclude by outlining five specific implications. These implications can be seen as expanding on the implications presented in Sections 2.4.2, 3.4.2, and 4.4.2, encompassing both research-relevant and classroom-relevant considerations.

5.2.1 Understanding embodied instruction in diverse classrooms

One of the goals of the present work, especially in Chapters 2 and 3, where learners new to Germany were included in experiments, was to better understand embodied L2 instruction in heterogeneous classrooms (Arndt & Sambanis, 2017; Pinter, 2017; Richards & Rodgers, 2014). Gaining permission to include learners who were new to Germany was not easy to facilitate, however, involving learners from Wilkommensklassen was intentional because it resulted in a group of participants who varied widely in their backgrounds, abilities, and experiences.

In the studies presented in Chapters 2 and 3, contrasting learning the text of a play between an ELT methodology with teacher gestures at the level of morphology without the written text (CG condition) and using gestures for key sentences with access to the written text (SL condition) revealed patterns of learning. An important result from Study 1 is the differential impact of instructional methods when fluency was measured, that learners with a lower initial speech rate had a larger gain in fluency when gestures that show morphology were their only form of input, whereas those with a higher initial speech rate benefitted more from reading plus gestures at the sentence level. Combining this result with results from Study 2, that the gesture per morpheme condition was better for all learners when learning spatial terms, suggests that learning similar to the gesture per morpheme condition could enhance fluency for lower-level learners and that for learners who are already quite fluent, the same input could help higher-level learners to deepen their understanding of abstract words. Beyond more learners learning more English, which is a key aim of English

teaching, these findings have significant implications for education, as they not only have the potential to simplify teaching, but also hold promise to reduce educational inequality.

As explained in Section 1.3.2 where the Matthew Effect is mentioned (see Promoting equity in L2 instruction), heterogeneity poses challenges for educators. A common pedagogical response is differentiated instruction or scaffolding which both adapt teaching by focusing on individual profiles and levels of ability (Gibbons, 2015; Smit & Humpert, 2012). While these strategies are valuable, they have the potential to overwhelm teachers with the task of creating many versions of the same materials. Furthermore, having created multiple versions of materials, teachers may feel pressure to ensure that the right learner gets the correct material for their perceived level, which can be different than what the learner actually wants. However, if gestures have the potential to serve as a means of scaffolding for learners across ability levels because learners can 'take what they need' from the visual signal, using gestures has the potential to simplifying teaching by providing a flexible common point of reference. This is significant because 'Equity in education means creating a level playing field for all children' (Schleicher, 2023). Instruction in Germany has been shown to favour learning for children with German as their L1 (Maluch et al., 2016; Stanat et al., 2010) and, at the same time, not always addressing the needs of more advanced students (Barucki et al., 2015; Haß, 2017). Crucially, some research from ELT has even indicated that bilingual pupils in bilingual programs learn less than children who attend regular classes (Bechler, 2014).

In addition to support understanding on learning outcomes in diverse classrooms at the individual level, the study presented in Chapter 4 provides additional evidence about how children may have learned from one another. This does not imply that children did not learn from one another in Study 1 and 2, but rather that more of the input on the phrases that were learned took place in the form of learning games played in small groups without direct input from an instructor (see Section 4.2.6). This situation, where children enact gestures and receive feedback from their peers, is highly convergent with extended cognition, which posits that gestures can have an intra-cognitive function that extends beyond their internal cognitive or communicative function (Clark, 2003; Pouw et al., 2014). In essence, the examples of social learning highlighted in this thesis (see Section 1.3.3), such as how new instructional gestures gain *taken-as-shared* meaning, can be seen as examples of extended cognition. In exploring the role of gesture in this regard, it becomes evident that embodied learning offers multiple pathways for students to fully participate in lessons at their own pace. While children learning from one another is not unique to gesture-based L2 instruction, when educators encourage learners to externalize cognitive processes through gestures, they also facilitate a more inclusive and dynamic learning environment. As noted by Respondent 5

in an anonymous teacher survey, this leads to ‘a higher willingness and concentration in the … learning phases.’[22]

All the experiments detailed in this thesis underscore the importance and potential of structuring learning experiences to accommodate diverse groups of learners. For instance, activities such as organizing pictures without verbal instructions or engaging in collaborative arts and crafts projects fostered participation and comprehension among students with different levels of language proficiency. Moreover, the use of cuing gestures provided a structured approach to learning, enabling students to integrate multiple sources of information while maintaining attention. By creating a supportive environment with clear guidelines and structured activities, teachers can help students feel secure and engaged in the learning process, which is essential in L2 learning (Sambanis & Ludwig, 2024).

5.2.2 Insights into theoretical perspectives of L2 learning

At its most basic level, a theory is a collection of statements about natural phenomena, such as language learning, that explain why these phenomena occur the way they do (Kuhn, 1962). In short, theories can both explain known phenomena and make predictions about what might happen under specific conditions. In the introduction to their book Theories in Second Language Acquisition (SLA), Bill VanPatten and Jessica Williams (2007) pose the question why there are so many competing theories on second language learning. As an explanation, they offer the parable of four blind men meeting an elephant for the first time and making comparisons about what they touch:

> One, holding its tail says, ‘Ah! The elephant is very much like a rope.’ The second one has wrapped his arms around a giant let and says, ‘Ah! The elephant is very much like a tree.’ The third one has been feeling along side the elephant’s massive body and says, ‘Ah! The elephant is very much like a wall.’ The fourth, having seized the trunk, cries out, ‘Ah! The elephant is very much like a snake.’ For us, SLA is a big elephant that researchers can easily look at from different perspectives (p. vii).

Following this example, some of the ‘parts of the elephant’ that are mentioned in this thesis include the ‘eyes’ of usage-based approaches to language acquisition, useful for reading intentions of other speakers and finding patterns in language (Tomasello, 2000), or the ‘mouth’ of the gesture-for-conceptualization hypothesis (Kita et al., 2017), ready to portion information in order to make it easier to digest and remember. In the work presented here, multiple theoretical constructs

22 For the questions and answers of all respondents to the survey on which this comment is based, see Appendix A.

complement one another to account for different phenomenon, and not all mentioned in Chapters 2, 3 and 4 will be discussed here. However, if results of this thesis have implications for L2 teaching and learning, they should also be linked to theories of L2 learning. Implications from this thesis can be aligned with several common theories of SLA, which will be discussed, before concluding with a description of why these theories alone are insufficient for explaining gesture-based language learning.

The four theories relevant to L2 that will be discussed are: (a) skill acquisition theory, (b) sociocultural theory, (c) declarative/procedural model, and (d) usage-based language acquisition. The argument made here is that these theories are all relevant to understanding L2 learning, and, because they focus on 'different parts of the elephant', the insight they provide is unique. The use of different theories is what Blake and Gardner, call 'remaining theory and method agnostic'. This approach enables educators to more easily 'adopt relevant approaches for the problem at hand rather than trying to force the facts into particular theoretical frameworks' (2007, p. 63). This is important because good foreign language teaching requires knowledge of language acquisition theory, and understanding psycholinguistic data for the classroom necessitates familiarity with teaching practices (Bechler, 2014). The selection of these theories of language acquisition may seem somewhat arbitrary, but they are commonly addressed in teacher training, at some times being explicitly stated and at others merely implied (Lightbown & Spada, 2010).

Skill acquisition theory (a) views L2 learning as closely related to acquiring other skills where instruction and practice are a part of learning. Here practice—understood as engaging in something with the intention of improving it—plays a crucial part in L2 learning (Robinson, 2005). The power law of learning is a key concept in skill acquisition theory (Lantolf & Thorne, 2007, p. 99). One of the objectives of the present work, specifically in Chapter 2, was to determine whether instruction using codified gestures (Hille et al., 2010; Macedonia & Klimesch, 2014; Novack et al., 2014) would lead to differences in long-term oral fluency development (de Jong & Perfetti, 2011; de Jong & Wempe, 2007; Lennon, 1990; Segalowitz, 2000).

An important result from the study presented in Chapter 2 is the differences in the impact of instructional methods on fluency. Specifically, learners with a lower initial speech rate exhibited greater gains in fluency when gestures that show morphology were their only form of input, whereas those with a higher initial speech rate benefitted more from reading plus gestures at the sentence level. As mentioned in the introduction (see Section 1.4), this thesis adopts an enriching theories approach to experimentation. Relevant to skill acquisition theory, these findings suggest that the nature of the practice phases as described in Sections 2.1.3 and 2.1.4, as well as in 3.2.2 and 4.2.6, facilitate changes in L2 speaking behavior with different learning conditions helping learners

of low and high initial abilities to progress from initial, effortful L2 behavior to fluent, and highly skilled L2 speech.

Sociocultural theory (SCT) (b) has its origins in Lev Vygotsky's work (1978) and views L2 learning as primarily developing from social interaction. Unlike psychological theories, which see thinking and speaking as related but separate processes, sociocultural theory emphasizes their tight integration, placing great importance on how individuals gain control of and reorganise cognitive processes during social activity (Lightbown & Spada, 2010, p. 47). Developmental processes take place through participation in family life at home as well as peer groups in institutional settings like schools. Relevant to instructional gestures, people are understood to use existing cultural artefacts and create new ones to meet their needs (Lantolf & Thorne, 2007, p. 201). Vygotsky proposes that imitation, meaning the ability to replicate the internal activity of others, is uniquely human and 'the source of instruction's influence on development' (1987, p. 211).

One of the goals of the study reported in Chapter 3, was to determine whether benefits associated with instruction using codified gestures from the experiment reported in Chapter 2 would extend to long-term spatial term development (Brala, 2002; Lakoff & Johnson, 1999; Lütke, 2011; Tyler & Evans, 2003). In addition to imitation, this goal relates to Vygotsky's genetic law of cultural development which states that: 'Any function in the child's cultural development appears twice' (Vygotsky, 1978, p. 57) suggesting that cognitive functions emerge on the social level (as an interpsychological category) before being internalised on the psychological level (as an intrapsychological category). Taking the context of participating in a class play, (see Lena's description in Section 1.3.3), the learning process for 'around' would unfold as follows: Initially, the concept 'around' is encountered and understood through a hand gesture (in the CG condition) or through the action of turning around (in the SL condition) within the social context of learning the text. Later the concept is understood within the context of the play. Lena herself doesn't physically move, because she is stationary as a tree, but the bears walk around her as part of the performance. Through this social interaction and enactment, she gains a practical understanding of the word's meaning in a concrete embodied manner. Later, or perhaps while waiting for the bears to pass, this understanding is internalised on a psychological level, allowing Lena to apply the concept of 'around' in contexts beyond the immediate social setting of the play, such as the subsequent test. Thus, the work of this thesis extends considerations aligned with sociocultural theory for intentionally designed learning environments that can stimulate qualitative L2 developmental changes.

The declarative/procedural (DP) model (c) posits that there is no clear neurobiological evidence indicating that languages areas of the brain underlie language alone, and suggests that

given the evolutionary reuse of mechanisms and structures, similar principles likely apply to the declarative and procedural memory systems (Ullman, 2016). This model proposes that language learning begins with declarative knowledge, also known as knowledge ‘that’, and that through practice declarative knowledge may become procedural knowledge, or knowledge ‘how’ (Lightbown & Spada, 2010, pp. 39–40). Classroom learning often embodies this transition, where learners grasp rules initially as declarative knowledge and then practice until they become proceduralised resulting in a rule that can ‘be applied but has been forgotten’ (Lightbown & Spada, 2010, p. 40). Interestingly, evidence from animal studies indicate that despite similar outcomes, the types and forms of knowledge in these two systems is frequently different. For example, rodent studies suggest that navigation can be accomplished through procedural memory, such as learning specific turns in a certain point in a maze, or through declarative memory, or through declarative memory, by employing strategies such as landmarks (Ullman, 2016). If learning L2 grammar is like finding a way through a maze, this suggests that different methods of instruction may lead to the same outcome.

In Chapter 4, the present work aimed to explore whether instruction using codified gestures could extend to semantic priming (Forster, 1999; Grisoni et al., 2017; Heyman et al., 2015; Pulvermüller & Grisoni, 2020), thereby indicating the potential efficacy of gesture-based instruction in teaching L2 grammatical morphemes. This result was manifest in a notable decrease in mean response times after instruction in the test condition employing syntactically specific gestures, which has typically been interpreted as an indicator of procedural learning (Baddeley, 2012; Ferman et al., 2009; Ullman, 2016; Ullman et al., 2020). This finding underscores the possibility that gesture-based instruction can effectively engage procedural memory in learning grammatical structures. Referring to learning grammar, Ullman (2016) states: ‘Such knowledge should often be learned first by declarative memory, but eventually by procedural memory, at which point it should be more automatized. Thus, both first and second language learners should generally depend initially on declarative memory for grammatical functions’ (p. 961). In the training phases, learners did not receive explicit (oral or written) instruction on the patterns necessary for grammatical accuracy. This highlights the significance of understanding how language knowledge is processed in different memory systems.

Given the potential advantages of procedural memory in language learning and the facilitative role of gesture-based instruction in engaging procedural memory, teaching grammar through gestures emerges as a promising approach. In his description of a usage-based approach to L2 learning (d) Nick Ellis (2019) writes:

> Language cognition is shared across naturally occurring, culturally constituted communicative activities. Language is the quintessence of distributed cognition. Language and usage are like the shoreline and the sea. Usage affects learning, and it affects languages, too. So, our understanding of language learning requires the detailed investigation of usage, its content, its participants, and its contexts—the micro level of human social action, interaction, and conversation, the meso level of sociocultural and educational institutions and communities, and the macro level of ideological structures (p. 39).

Compared with other theories of language learning, the usage-based theory of language acquisition is in some respects unique in its comprehensive approach, intersecting disciplines such as psycholinguistics, ELT and ethnography. From a usage-based perspective, the question can be asked if learning is social action or long-term portability (Eskildsen et al., 2024). The present thesis underscores the transformative power of embodied social action, such as performing the 'cat' codified gestures described in Section 4.1.5 in a group setting. Through such experiences, social actions can become encoded as long-term individual learning. Although the usage-based theory of language acquisition is only named as such in Chapters 3 and 4 (see Sections 3.1.4 and 4.1.5), the idea that L2 learners may benefit from gestures which highlight language patterns pervades all chapters. This theory offers insights relevant to psycholinguistics, because patterns can be found in the brain and differences that these patterns from the brain and the body make can be measured. Additionally, the usage-based theory of language acquisition holds significance for ELT because it provides a way to understand the role of embodied cognition in language learning processes. By emphasising the importance of pattern recognition in language learning more broadly, this theory provides a framework for understanding how learners engage with and internalize L2 linguistic pattern.

A final topic of discussion, relevant to theoretical perspectives of L2 learning in classrooms, but not directly related to the focus of this thesis, revolves around whether language processing relies on amodal brain systems, or if it draws on modality-preferential brain areas, such as motor or sensory-motor regions. This distinction is relevant because if one understands language to be grounded in the body, or not, influences how one teaches. However, given the stance of this thesis, that language is embodied, an in-depth discussion of the nature of perceptual symbolic systems is beyond this thesis and the interested reader is referred to Barsalou (1999). Ultimately, theories of L2 learning that disregard the embodied dimension risk inadequacy in explaining the complexities of language learning phenomena.

5.2.3 Enhanced experimental research

A further contribution of the present work, particularly the studies presented in Chapter 2 and 3, is the development of a naturalistic research paradigm. In the complex process of learning an L2, various factors influence learning outcomes including prior language proficiency, learner personalities, learning strategies adopted, how materials in the classroom are used, as well as interpersonal interactions between students and teachers (Foster, 2020; Laufer & Hulstijn, 2001). How these factors should be researched in ELT has been a long-standing issue of debate (Beretta, 1986). Controlled approaches to empirical L2 research are invaluable, however they may overlook certain causes of results, especially when dealing with real-world teaching problems. While students can be distracted by their peers, resulting in missed instructions for a task, for example, they can also be encouraged and helped by them. The studies presented in Chapters 2, 3, and 4 of this thesis address questions about gestures and L2 learning at the biological, cognitive, rational, and sociocultural levels (Nathan, 2021) and represent an effort to bridge this divide between controlled research environments and the real-world complexities of language learning in naturalistic settings. An important result of this thesis used in the experiments in Chapters 2 and 3 is the development of a new research method called a theatre experiment which offers a structured means of data planning and collection, which can capture subtle changes in language data within naturalistic settings, like schools (Janzen Ulbricht & Kruger, 2023; see also Janzen Ulbricht, 2022; Janzen Ulbricht & Uhl, 2020).

These experiments can be employed to investigate the learning outcomes of embodied teaching methods, such as gesture-based teaching or drama pedagogy for L2 learning, where social interaction plays an important role in learning, and provide a unique vantage point to capture nuanced changes in language data. By incorporating controls for various influencing factors inherent in real-world learning environments, theater experiments offer a more holistic and nuanced understanding of dynamic learning process. As systems of education strive to reduce educational inequality, adopting research paradigms that are robust and reproducible is crucial. Learning research and the body are not always easy to bring together. The theater experiment paradigm, as a tool which has been shown to elucidate the efficacy of teaching methods, may hold promise in addressing other pressing questions regarding L2 teaching and learning (Janzen Ulbricht & Kruger, 2023), such as how inclusive teaching methods measure up for learners of multilingual classrooms. In the words of educational researcher John Hattie (Hattie, 2012), the pertinent question about teaching methods should shift from whether a teaching method works to how well it fares relative to

an alternate approach that a teacher could choose everything else being equal—a question that theater experiments are poised to answer effectively.

5.2.4 Contribution to embodied teaching practices

Throughout this thesis, the concept of embodied learning has been defined as an approach that integrates physical experiences into the learning process, thereby enhancing understanding, and retention. The experiments presented in Chapters 2, 3, and 4 were conducted in naturalistic school settings and generated many innovative teaching activities and materials designed to effectively engage learners. However, academic papers often lack the detailed instructions necessary for implementing learning games and activities in the classroom. Two examples of published teaching materials building on the work of this thesis are *Learning a play through codified gestures: Cat and Dog write a letter* (Janzen Ulbricht, 2020) as well as *A dentist to the rescue* (Janzen Ulbricht & Spindler, 2022) with a focus on teaching English in multilingual classrooms. Compared with academic papers, the format of these publications is concise, yet detailed and flexible, in that the same procedures could easily be transferable to other content areas.

Expanding on the contributions of this thesis to embodied teaching practices for ELT, this section mentions two additional elements that were not mentioned in previous chapters. Firstly, the method of cuing speech proposes a strategy to address the challenge of balancing teacher-talking time with student-talking time in the classroom (Harmer, 2015; Haß, 2006) by proposing a strategy to maximize student participation. A final contribution addresses the nature of the relationship between gesture and learners who face difficulties maintaining attention in the classroom setting. Attention and time-on-task are seen as highly relevant to learning in the classroom (Guarino et al., 2018; Komorowska, 2021; Kuhl & Chun, 2014; Radesky & Christakis, 2016), and it can be argued that classroom management is essentially about helping learners to attend or change their focus (Scrivener & Thornbury, 2012). The following quote, also located in Appendix A, is a reflection from Respondent 1, a teacher who took part in Experiment 1 on fluency. In an anonymous survey she shared her experience using codified gestures as a teaching tool with her class:

> Ich habe in unserem ‘Cat & Moon’ Projekt unglaublich viel gelernt. Es hat mich in so vielen Bereichen über meine bisherigen Grenzen hinausgeschubst, dass ich zwischendurch dachte, es könnte ein wenig zu viel sein. Letztlich bin ich daran jedoch sehr gewachsen... Ich habe eine neue Methode des Unterrichts kennengelernt und festgestellt, dass gerade Kinder mit Aufmerksamkeitsdefiziten, sich dabei längere Zeit konzentrieren konnten.
>
> I have learned an incredible amount in our ‘Cat & Moon’ project. It has pushed me beyond my previous limits in so many areas that I thought it might be a little too much in between. In the

> end, however, I have grown a lot... I got to know a new method of teaching and found that especially children with attention deficits could concentrate for a longer period of time.

Research on gesture and attention has revealed that visual attention is closely linked to gesture perception in face-to-face interaction (Gullberg, 2003) and that gestures are effective in focusing visual attention and establishing joint attention (Rohlfing et al., 2016). Teaching English in a manner that embraces the abilities that diverse learners have not only fosters inclusivity, but also affirms the significance of students' voices, their experiences and the languages they know. The transformative potential of such an approach, exemplified by the quote above, as well as *The project is good* vignette about a student retelling a play to her family in Section 1.3.3, underscore the importance of embodied practices, such as theater, in language learning experiences. As reflected in the teacher's response above to participating in Experiment 1, the integration of codified gestures into teaching methodologies not only expands pedagogical horizons but potentially also improves attention spans, particularly among students with attention deficits.

Along with other gesture research, this thesis underscores the significance of embodied teaching practices by suggesting that attention to L2 gestures, in particular those at the level of morphology, could potentially benefit many. Although intuitive at some level, this insight is not common knowledge and is valuable information for educators, as well as and teacher training instruction, which will be addressed in the next section.

5.2.5 Practical implications for teacher training

In a UN Chronicle Sylvia Schmelkes writes: 'Teachers are key agents for learning. Their training is crucial' (2020). This set of experiments suggests that teachers who invest a relatively short amount of time in learning and using gestures, can expect significant benefits in terms of L2 learning for their students (e.g. 90 minutes of training time in Study 2, see Section 3.2.4 under Testing Materials). This finding has practical implications for programs of teacher training and professional development, and should encourage educators to explore gesture-based methods in their own teaching practices. However, in addition to the evidence of L2 learning detailed in Chapters 2, 3, and 4, anonymous teacher survey results based on experience and personal reflection during the experiments are also important. The implications of these results for practice are threefold and will be explained in turn.[23]

Teaching a class a play in a foreign language is complex. When teachers implement theater projects involving learners with different linguistic and cultural backgrounds, this requires even

23 Were other segments of the survey selected, the points highlighted here would have been different, but these three align with fieldnotes and comments from teachers about areas that were important to them.

more expertise. As previously mentioned in Section 5.2.4, Respondent 5 writes that: ‘I have grown a lot.’ Exactly what this growth consists of is not specified, but this statement is followed by a list which can be understood as illustrating what he or she learned: (a) how to coordinate such a [theater] project, (b) how to include a second class [in such a project], (c) the steps which are necessary and meaningful for students to learn and perform a play, (d) how gestures affect the students [learning].[24] It follows that teacher education programs should not only convey knowledge on the steps that are necessary for using instructional gestures for L2 learning and integrating gesture-based teaching into the curriculum. Additionally, they should provide training that emphasises the importance of meaningful theater project planning, including understanding the steps necessary for students to effectively learn, practice and act out a play in order to enhance student learning experiences.

Another teacher, Respondent 3, positively mentions gestures as a method of teaching that she or he saw as being especially beneficial for children with attention deficits: ‘I got to know a new method of teaching and found that especially children with attention deficits could concentrate for a longer period of time.’ Respondent 5 also mentioned that ‘gestures act as a kind of mnemonic device for remembering text blocks’ and that ‘pupils are challenged on both the mental and physical level, … [promoting] ... activity and attention.’ There are few studies on gesture and L2 learning for students with attention deficits or ADHD. However, it is known that attention during instruction is crucial for educational quality (Komorowska, 2021) and that gestures can capture attention. Considering that didactic techniques have been shown to be more significant than learners’ self-reported motivation (Guilloteaux & Dörnyei, 2008), and that learners may not always accurately assess the effectiveness of the methods they employ, (Schilitz, 2021), the role of teachers and their choices in instructional methods have an outstanding role to play in educational outcomes.

A final practical implication of this thesis relevant for teacher training identifies a misunderstanding that should be addressed, or at least cleared up before instruction with L2 gestures begins. One of the survey questions asked respondents to explain why they believed codified gestures might be ineffective as a teaching tool by suggesting a scenario where a hypothetical colleague uses gestures in class and the respondent finds the idea unreasonable and inappropriate. This line of questioning sought reasons behind perceived ineffectiveness or unsuitability of codified gestures as a teaching tool. Respondent 1 answered: ‘In an authentic language situation, communication partners will hardly resort to codified gestures. In this sense, gestures are therefore a crutch that will not be available in reality. In addition, they require a high degree of concentration from the pupils, which cannot be maintained permanently by the pupils.’

24 These statements have been slightly edited for clarity. For the original statements, see Appendix A.

This statement suggests that any gesture training for teachers should include clarifying the temporary role gestures have in language learning and the short duration they should be used to cue speech during instruction.

5.3 Limitations and future perspectives

Nathan asserts that ‘learning phenomena span neurons, individuals, groups, and whole cities’ (2021 p. 69), emphasising the importance of investigation into learning that considers the many influences present in authentic situations. Within this framework, it becomes evident that there are crucial connections between basic research which investigate fundamental principles, and applied research, which seeks practical applications of these principles in real-world contexts. The research presented here demonstrates strength on two fronts. First, it lies in how the three experiments are built on and complement one another. Second, in its exploration of whether integrating gesture into language learning helps L2 learners distinguish differences between possessive {-s} and plural {-s}, an area which has not been tested before. While these experiments can be considered a success in providing basic support for the effects of gestures on L2 learning (Kaschak & Glenberg, 2000), this success might be qualified by two limitations. First, weaknesses may be found in the theoretical framing and the methodology. The theoretical framing, drawing on neurobiology, applied linguistics and education might appear eclectic. Second, the experimental methodology, which focused on learning under classroom conditions, needed to be run under more or less normal teaching circumstances. This is not a choice that all researchers find easy to understand and value. However, because these experiments were run under authentic classroom conditions, each of the three experiments presented here give a concrete answer to how social interaction and language learning can be structured. A more long-term investigation in this pedagogical setting which includes children who are new to Germany using a pre-post design could provide more detailed answers about possibilities for balancing imaginative play, as exemplified in the *I know—the cars crash* vignette from Section 1.3.3, and methods for embodied L2 speaking and writing, for example.

As mentioned in Section 1.1, the best tool is only useful when someone uses it. This is also true for L2 codified gestures and highlights the importance of teachers and their choices in how to engage, or not engage with embodied learning. In the arena of L2 teaching, many decades of research show that gestures serve as valuable tools, but their effectiveness ultimately depends on how teachers integrate and employ them in their instructional practices.

Building on the work of Verhallen and Schoonen (1993), an experiment on gesture-based learning and changes in L2 lexical depth for vocabulary would be worthwhile. Building on the work

of Ölmezer-Öztürk and Öztürk (2021), an experiment on L2 gesture-based learning, fluency and a potential decrease in speaking anxiety would be worth pursuing. Another important area of future research should be learning (theoretical and experimental) about the relationship of codified gestures to sign language in diverse L2 circumstances, as well as compiling existing research on what is known about 'good' instructional gestures. When children and teachers see codified gestures, they often assume that they are sign language. Many sign-naive teachers like the idea of using sign language in L2 teaching, based on the conception that it is another natural language that children could build on if they wanted to. There is also limited research on which gestures or signs best assist Deaf signers' L2 reading comprehension, so this too would be an interesting and helpful research (Nielsen et al., 2011). Navigating complex symbolic systems is a part of everyday life (Clark, 2003; Cooperrider, 2017; Marian, 2023), so further research about when gestures taken from sign language help non-signing hearing learners and under which conditions would also be an intriguing and useful endeavour.

5.4 Conclusion

Gestures play a crucial role in supporting communication and the evidence presented in this dissertation strongly supports the integration of gestures into ELT as a highly effective learning strategy. The focus was on codified gestures: a form of L2 instruction that is deeply rooted in the body. The first study found that learning the same text with different teaching methods, such as codified gestures paired with morphemes or sentences, was associated with a different development in long-term oral fluency. In particular, codified gestures paired with L2 morphemes were associated with a greater increase in fluency for the learners with less L2 ability, providing evidence that instruction including gestures that show morphology is a more accessible form of linguistic information than reading words from a page for learners from this group. The second study on using and understanding L2 spatial terms found that although learning through sentence level gestures plus access to the written text results in an increase in L2 spatial terms ability, this gain was more immediate for learners exposed to codified gestures paired with L2 morphemes. The third study found that gestures can visually disambiguate between different grammatical morphemes for the plural and possessive {-s}, resulting in measurable differences in response time when compared to gestures without this distinction. Overall, the present work highlights the importance of grounding education in meaningful individual and group experiences to enhance understanding and retention, while also providing valuable insights to further develop L2 instruction.

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A

Supplementary material to

Chapter 1

Anonymous Teacher Survey Responses

After the final theater performance in Experiment 1, teachers were sent a link to a website where they could fill in an evaluation form without providing their name. Three of the ‘teachers’ are the main classroom teachers whereas two are teaching aids who are regularly in the classroom. All have training and experience in education. The numbers refer to the respondents, i.e. response 1 is always from teacher 1. Respondents answered between 21 February 2016 and 30 September 2017.

Q1) Was sind geeignete Lehrmethoden und Ansätze in den Kontext in dem Sie arbeiten? Warum sind sie geeignet?

1) Ich arbeite vor allem möglichst Kleinschrittig und so transparent und klar wie möglich in den Aufgabenstellungen. Wiederholungen und viele Beispiele in der Erstbegegnung mit neuen Phänomen helfen meinen Schülern beim Verstehen. Einer mündlich gehaltene intensiven Erstbegegnung (Film- o. Ton-dateien / Lehrer präsentiert) und gegebenenfalls Vermittlung folgt meist eine kurze schriftliche Einzelarbeitsphase. Der dritte Schritt ist dann oft die eigene mündliche Anwendung (durch die Schüler) in kommunikativen Handlungssituationen (Partnerarbeit, Rollenspiel ...). Ich gehe also vom (lehrerzentrierten) Input über das

Q1) What are suitable teaching methods and approaches in the context in which you work? Why are they suitable?

1) In my work I use instructions which are as detailed and as clear as possible. When a phenomena is new, repetition and many examples help my students to understand. This first presentation is intense and oral (film or recordings or presented by the teacher), and, if necessary, is usually followed by a short written individual work phase. The third step is often personal speaking (by the pupil) in a communicative situation (partner work, role play…). I go from (teacher centred) input to constructing understanding to oral re(production) in directed contexts of action in order to achieve as high a level of teaching

konstruktivistische Erschließen zum mündlichen (schülerzentrierten) (re)produzieren in (gelenkten) Handlungskontexten, um eine möglichst hohe Authentizität des Unterrichts zu erreichen und Englisch auch immer als sprachliches Mittel zur Begegnung zwischen Menschen zu erleben.

authenticity as possible so the students experience English as a linguistic means for encounters between people.

2) Lieder, Tänze, rhythmisches Sprechen und Nachsprechen, Sprachspiele und auch Gestik und Mimik

2) Songs, dances, rhythmic speech and recitation, language games and also gestures and facial expressions.

3) Alles ist gut, was die Kinder aktiv einbindet, Ihnen Handlung ermöglicht.

3) Everything is good that actively involves the children, allows them to act.

4) Abwechslung von Projektbezogener und Lehrerzentrierter Arbeit mit individuellen Hilfen und Plänen.

4) Variety of project-related and teacher-centered work with individual help and plans.

5) Arbeit mit Bildkarten und Wimmelbildern, Spiele zur Wortschatzwiederholung, Sprechgesänge und Lieder (auch mit Bewegungen), Rollenspiele, Textarbeit mit Verständnis sichernden Aufgabenstellungen, Ausflüge (Lernen am anderen Ort) u. a.

5) Working with picture cards and hidden object pictures, games for vocabulary repetition, chants and songs (also with movements), role-playing games, textual work with comprehension-enhancing tasks, excursions (learning in another place) etc.

Q2) Ihrer Meinung nach, warum sind kodifizierten Gesten als Lehrerwerkzeug richtig gut?
Stellen Sie sich vor ihr/e Kollege sagt er/sie benutzt kodifizierte Gesten im Unterricht. Sie finden die Idee toll und freuen sich. Warum?

Q2) In your opinion, why are codified gestures really good as a teaching tool?
Imagine your colleague saying he/she uses codified gestures in class. They love the idea and are happy. Why?

1) Ich habe in unserem "Cat & Moon" Projekt unglaublich viel gelernt. Es hat mich in so vielen Bereichen über meine bisherigen Grenzen hinausgeschubst, dass ich zwischendurch dachte, es könnte ein wenig zu viel sein. Letztlich bin ich daran jedoch sehr gewachsen. Wie koordiniert man ein solches Projekt? Zumal mit einer zweiten Klasse als Gast? Welche Schritte sind für die Schüler zum Erlernen des Spielens und des Spiels notwendig und sinnvoll? Wie wirken sich die Gesten auf die Schüler aus? Wann mache ich was mit wem und wo?

1) I have learned an incredible amount in our "Cat & Moon" project. It has pushed me beyond my previous limits in so many areas that I thought it might be a little too much in between. In the end, however, I have grown a lot. How do you coordinate such a project? Especially with a second class as a guest? Which steps are necessary and meaningful for the students to learn how to act out a play? How do the gestures affect students? When do I do what with whom and where?

2) Eine "Draufsicht" auf das Verhalten der Schüler mit anderen Kindern der Schule, mehr Nachdenken über nonverbale Führung des Unterrichts, Umgang mit Gesten.

2) A "bird’s eye view" of the behaviour of students with other children of the school, more reflection on non-verbal teaching, dealing with gestures.

3) Ich habe eine neue Methode des Unterrichts kennengelernt und festgestellt, dass gerade Kinder mit Aufmerksamkeitsdefiziten, sich dabei längere Zeit konzentrieren konnten.

3) I got to know a new method of teaching and found that especially children with attention deficits could concentrate for a longer period of time.

4) Hat meine Erfahrung bestätigt, dass einige Schüler die Gesten gern übernehmen.

4) Confirmed my experience that some students like to adopt the gestures.

5) Während des Projektes war zu beobachten, dass die Gesten den Lernprozess und das Erinnern unterstützen. Die Gesten wirken als eine Art Eselsbrücke zum Erinnern der Textbausteine. Außerdem ermöglichen sie einen dynamischeren Lernprozess. Die SchülerInnen sind sowohl auf der mentalen als auch auf der physischen Ebene gefordert, was nach meinen Beobachtungen die Aktivität und Aufmerksamkeit der SchülerInnen fördert.

5) During the project, it was observed that gestures support the learning process and memory. The gestures act as a kind of mnemonic for remembering the text blocks. They also enable a more dynamic learning process. The pupils are challenged on both the mental and physical level, which, according to my observations, promotes the activity and attention of the pupils.

Q3) Ihrer Meinung nach, warum sind kodifizierten Gesten als Lehrerwerkzeug richtig schlecht?
Stellen Sie sich vor ihr/e Kollege sagt er/sie benutzt kodifizierte Gesten im Unterricht. Sie finden die Idee sehr unvernünftig und wirklich daneben. Warum?

Q3) In your opinion, why are codified gestures really bad as a teaching tool?
Imagine your colleague saying he/she uses codified gestures in class. You find the idea very unreasonable and really out of line. Why?

1) In der authentischen Sprachsituation werden Kommunikationspartner kaum auf kodifizierte Gesten zurückgreifen. Gesten sind in diesem Sinne also eine Krücke, die in der Realität nicht zur Verfügung stehen werden. Zudem erfordern sie von den Schülern ein hohes Maß an Konzentration, das von den Schülern nicht permanent gehalten werden kann.

1) In an authentic language situation, communication partners will hardly resort to codified gestures. In this sense, gestures are therefore a crutch that will not be available in reality. In addition, they require a high degree of concentration from the pupils, which cannot be maintained permanently by the pupils.

Comment from researcher: I wonder if the above response was from a teacher's aide who saw the gestures in use, but did not learn to use them or receive any orientation? I have no way of knowing. The gestures are for learning, not intended as something one does when one knows English!

2) Bei größeren Schülern stößt es vielleicht auf Unverständnis, wäre zu albern, Schüler könnten in der Pubertät zu sehr dazu neigen, zu übertreiben (hatte ich in der Vergangenheit sehr oft!!!)

2) Older pupils may encounter incomprehension, too silly, pupils in puberty might be inclined to exaggerate. (I have experienced this very often in the past!!!!)

5) Zeitintensiv in der Vorbereitung; spontane Äußerungen sind nur begrenzt (im Rahmen des Repertoires an Gesten) möglich; bei der Verwendung von Gesten kann es sein, dass die Bedeutung des zugeordneten Wortes für Kinder ohne Kenntnisse in der jeweiligen Sprache nicht deutlich wird (sinnentleertes Lernen).

5) Time-consuming to prepare; spontaneous expressions are only possible to a limited extent (in the context of the repertoire of gestures); when using gestures, it may be possible that the meaning of the assigned word for children without knowledge of the respective language may not be clear (learning without meaning).

Q4) Was hat Ihnen persönlich dieses Projekt gebracht?

Q4) What have you personally gained from this project?

5) Die unterstützende Wirkung von festgelegten Gesten und Bewegungen im Lernprozess wurde mir noch einmal deutlich vor Augen geführt. Interessant war auch zu erleben, dass die Gruppe, in der die kodifizierten Gesten zur Anwendung kamen, eine höhere Bereitschaft und Konzentration in den Textlernphasen an den Tag legte.

5) The supporting effect of scripted gestures and movements in the learning process was once again clearly demonstrated to me. It was also interesting to see that the group in which the codified gestures were applied showed a higher willingness and concentration in the text learning phases.

Interessant für den Selbstversuch hätte ich das Erlernen der kodifizierten Gesten in Kombination mit einem Text in einer mir nicht bekannten Fremdsprache gefunden (analog zum Erleben der Willkommensklassenkinder in den Textlernphasen des Projektes).

For me personally, I would have found it interesting to learn the codified gestures in combination with a text in a foreign language not known to me (analogous to experiencing the welcome class children in the text learning phases of the project).

Q5) Ihrer Meinung nach, was hat dieses Projekt Ihr Schüler gebracht?

Q5) In your opinion, what did this project do for your student?

1) Am Ende war es das Strahlen in den Augen der Schüler, das mir Signal genug war, dass das Projekt auch für die Schüler eine große Bereicherung war. Sie hatten die Chance Englisch als Präsentationsmedium zu erleben, ohne es als Schulaufgabe zu verstehen. Für die Schüler war die Herausforderung ein Theaterstück auf die Bühne zu bringen. Das sie dabei Englisch nutzen trat in den Hintergrund und wurde dadurch selbstverständlich und natürlich. Das ist für mich ein ganz großer Erfolg des Projekts!

1) In the end it was the beaming eyes of the students, which was enough to signal that the project was a great enrichment for the students as well. They had the opportunity to experience English as a presentation medium without understanding it as a school task. For the students, the challenge was to bring a play to the stage. The fact that they used English in the process took a back seat and became normal and natural. For me, this is a great success of the project!

2) Kontakte knüpfen mit einer anderen klasse der Schule, mit ihnen zusammenzuarbeiten, sich gemeinsam mit ihnen zu präsentieren! Englischkenntnisse unter Beweis stellen, Freude und Spaß am darstellenden Spiel.

2) Having contact with another class of the school, to work with them, to present themselves together with them! Testing their English language skills, enjoyment and fun in the performing arts.

3) Sie haben Spaß gehabt. Ich bin gespannt, ob sich das Projekt auch nachhaltig positiv auf den Englischunterricht auswirkt.

3) They had fun. I am curious to see whether the project will have a lasting positive impact on English lessons.

4) Da sollte man die Schüler befragen.

4) The students should be asked.

5) Erlernen einiger englischer Worte, gutes Aufmerksamkeitstraining, Spaß an den kreativen Aufgaben.

5) Learning some English words, good attention training, fun with creative tasks.

B

Supplementary material to

Chapter 2

Sample of equivalent play

During peer-review the publisher requested information about the level of difficulty in language for the play learned and performed in Experiment 1. In the end, this text was not included in the final publication, but here it does provides information about the level of language and character of the play.

The Adventure of the Seven Cats

Narrator:	This is the adventure of seven cats -
Owl (indignant):	Whooooo!
Narrator:	And an owl. The seven cats are in bed.
Cat 1:	We are all in bed...
All:	But we can't sleep!
Cat 1:	Let's get out of bed.
Cats 2-7:	(whisper): Out of bed?
Cat 2:	Let's go to the window!
Window 1 and 2:	To the window?
Cat 3:	(afraid): It's dark out there!
Cats 4-7:	Don't be afraid.
Cat 4:	Let's go out the window!
Window 1 and 2:	Out the window?
Cat 5:	(louder): And down the tree!
Tree:	Down the tree?
All Cat:	Out the window. Down the tree!
Tree:	Down the tree, but don't scratch me!

C

Supplementary material to

Chapter 3

The complete spatial term testing materials and procedures can be found at: https://osf.io/y8z6a/

D

Supplementary material to

Chapter 4

The complete gesture speeded fragment completion task application including demonstration videos in both gesture conditions can be found at:
https://github.com/natashajanzen/GestureSpeededFragments#readme

The list of GSF test items can be found at:
https://github.com/natashajanzen/GestureSpeededFragments/blob/master/extras/

The data that support the findings of this study are openly available in Open Science Framework at:
https://osf.io/kne6y/

Eigenständigkeitserklärung zur Dissertation

Natasha Janzen Ulbricht

Erklärung zur Dissertation mit dem Titel ‘Gesture-based language learning – Can more learners learn more?’

1. Hiermit versichere ich,

- dass ich die von mir vorgelegte Arbeit **selbständig** abgefasst habe, und
- dass ich **keine weiteren Hilfsmittel** verwendet habe als diejenigen, die im Vorfeld explizit zugelassen und von mir angegeben wurden, und
- dass ich die Stellen der Arbeit, die dem Wortlaut oder dem Sinn nach anderen Werken (dazu zählen auch Internetquellen) entnommen sind, unter Angabe der Quelle kenntlich gemacht wurden, und
- dass die Arbeit nicht schon einmal in einem früheren Promotionsverfahren angenommen oder abgelehnt wurde.

2. Mir ist bewusst,

- dass Verstöße gegen die Grundsätze der Selbstständigkeit als Täuschung betrachtet und entsprechend der Promotionsordnung geahndet werden.

Natasha Janzen Ulbricht
Berlin, den 20.04.2024