Doctoral theses at NTNU, 2015:193

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ISBN 978-82-326-1042-6 (printed ver.)
ISBN 978-82-326-1043-3 (electronic ver.)
ISSN 1503-8181

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Printed by NTNU Grafisk senter

Abstract

The overall objective of the present thesis was to investigate the semantic underpinnings of a selection of spatial prepositions in Norwegian and French, to assess sources of difficulties for the use and comprehension of such prepositions in an L2, and to investigate how knowledge of the meaning of spatial preposition in a second language changes with increasing proficiency. This was studied within the Functional Geometric Framework, FGF (Coventry & Garrod, 2004), which permits for a fine-grained study of underlying semantic features relevant for spatial preposition usage; geometric routines, dynamic-kinematic routines and object knowledge. Data consisted of preposition production and acceptability judgments, and were collected from five participant groups: one L1 Norwegian group, one L1 French group, and three different L2 French groups.

An important finding in the present thesis is that geometric and functional information underlie comprehension prepositions in both Norwegian and French in similar ways to those theoretically studied by Vandeloise (1986) and to those established in a large body of experimental work for English prepositions. Despite some typological differences in the expression of space in Norwegian and French, native speakers of Norwegian and French make meaning distinctions based on geometry and function in analogous ways. Differences in preposition usage between the two languages stem primarily from language-specific ways of combining object labels and prepositions. Such combinations are sometimes arbitrary, and language conventions may override strong geometric or functional cues for preposition choice. The consequence of the findings for L1 Norwegian and L1 French is that Norwegian learners of L2 French should be able to rely on their intuitions about the semantics of preposition in Norwegian for a native-like comprehension of French prepositions. However, findings in the present thesis are that while L2 users with relatively high L2 proficiency are able to make native-like distinctions based on functional information for prepositions denoting location on the vertical axis, they differ from native speakers in the meaning-distinctions they make based on geometrical information. These findings are directly comparable to findings from a large study of the L2 acquisition of prepositions in English and Spanish (Coventry, Guijarro-Fuentes, & Valdés, 2011). It is therefore likely that the weighting of geometric information for the meaning of spatial prepositions in the L2 takes longer to readjust than the weighting of functional information, at least for prepositions denoting location on the vertical axis. Moreover, findings in the thesis are that both preposition production and judgments about the acceptability of preposition usage are more consistent in the L2 user groups with the highest L2 proficiency. This indicates that the semantic network for spatial prepositions undergoes structuring and tightening as proficiency in the L2 increases, and that lexical knowledge continues to develop in depth also after a preposition has entered into the L2 user's productive vocabulary.

Acknowledgements

Først og fremst vil jeg takke min hovedveileder, professor Mila Dimitrova Vulchanova, for støtte gjennom hele prosjektet og for innsiktsfulle og kritiske kommentarer til arbeidet mitt. Mila har et stort nettverk av internasjonale forskere og hun deler det generøst. Ved å trekke meg med i utarbeidelse av prosjektsøknader og ved selv å arrangere internasjonale kurs, summer schools og konferanser, har hun satt meg i stand til å utvikle mitt eget nettverk av etablerte og unge forskere.

Videre vil jeg takke min biveileder, professor Hans Petter Helland, for oppmuntring hele veien, for å legge til rette for min datainnsamling i Caen, og for kritisk og helhetlig lesing av avhandlinga. Jeg har satt stor pris på å samarbeide med ham om undervisning og sensur i fransk lingvistikk.

Takk til professor Kenny Coventry som generøst ga meg tillatelse til å bruke testmateriale han har utviklet. Hans kommentarer da han stilte som mester på min mesterklasse, var uvurderlige.

Bjørn Grønnesby fortjener en stor takk for å ha laget online-versjonen av testene mine og en base for innsamling av dataene – og ikke minst for å ha reddet meg fra ukesvis med endeløs klipp og lim! Takk også til resten av IT-HF, som må være den beste IT-supporten som finnes.

Jeg er også takknemlig overfor en rekke personer som har bidratt på ulikt vis til dette prosjektet. Takk til kolleger ved Université de Caen Basse Normandie og NTNU som tillot at jeg kom på deres forelesninger for å rekruttere deltakere. En stor takk går til alle deltakerne i studien, uten dem ville det ikke blitt noen avhandling. Professor Joel Talcott fortjener takk for uvurderlige råd om statistikk. Takk til førsteamanuensis Nelly Stenkløv for språkvask av artikkelen på fransk, for faglige diskusjoner og for samarbeid om undervisning. I alt fire anonyme fagfeller har vurdert artikkel I og II, og deres kommentarer har vært til stor nytte.

En helt spesiell takk går til Arne Halvorsen. Han trodde på meg, oppmuntret meg og ga meg permisjon med lønn for å utarbeide søknad om stipend. Uten det dyttet hadde jeg nok ikke starta på dette prosjektet. Det var en trygghet å kunne diskutere fransk grammatikk og andre store og viktige spørsmål med ham. Jeg er svært glad for at han rakk å lese og kommentere mine to første artikler, jeg skulle så gjerne hatt hans kommentarer til resten.

Jeg må også takke alle gode kolleger ved Institutt for språk og litteratur. Ved franskseksjonen er alle dedikerte fagpersoner, dyktige forelesere og inspirerende kolleger, og jeg er takknemlig for å ha fått samarbeide med dem. Spesielt må jeg takke Sophie for å ha tvunget meg til å snakke fransk i alle kaffepauser, Priscilla for alltid å være på jobb i helgene, og dessuten Christina for samtaler om alt mulig annet enn avhandlinga!

Kjære Sindre og Anne, dere er verdens beste ph.d.-venner! Takk for godt samarbeid, fortreffelig reisefølge og mye latter. Å kunne dele glede, tvil og fortvilelse med dere, er det som har holdt meg i gang. En ekstra stor takk til Anne, som har lest alt jeg har skrevet før noen andre, alltid stilt opp enten jeg har trengt råd eller noen å diskutere funn, analyser eller ideer med, og som har vært der når jeg har trengt ei hand å holde i. Jeg hadde ikke klart dette uten deg.

Sist, men ikke minst, tusen, tusen, tusen takk til Lars Bjørnar, Johannes og Jenny Marvel for deres uforbeholdne støtte og uendelige tålmodighet!

Trondheim, mars 2015

Kjersti Faldet Listhaug

List of papers

Listhaug, K.F. (2014). Les prépositions spatiales en français et en norvégien : une étude expérimentale et comparative. *Syntaxe et sémantique,*15, 199-229.

Listhaug, K.F. (under revision). Spatial prepositions in the L2: Geometry vs function.

Listhaug, K.F. (unpublished manuscript). Spatial prepositions in the L2: Does proficiency have a role?

List of abbreviations

2L1	Two first languages
2LA	Second language acquisition
ANOVA	Analysis of variance
BIA+	Bilingual Interaction Activation Model
BLC	Basic locative construction
CLB	Construction locative de base = Basic locative construction
DFM	Distributed Features Model
FGF	Functional Geometric Framework
FL1	L1 French
FL2	L2 French
FLE	Français langue étrangère = French as a foreign language
L1	First language, native language
L2	Second language
L3	Third language
LO	Located object
M	Mean
NL1	L1 Norwegian
RHM	Revised Hierarchical Model
RO	Reference object
SD	Standard deviation
SE	Standard error
SLA	Second language acquisition
UG	Universal Grammar
UPGMA	Un-Weighted Pair-Group Average linking rule

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1 Introduction

One area in which second language (L2) users can usually be identified by native speakers is in their use of spatial prepositions. Acquiring the semantics of spatial terms is generally regarded as particularly challenging for second language learners (Becker & Carroll, 1997; Munnich & Landau, 2010). The present thesis deals with the acquisition of spatial prepositions in French as a second language by native speakers of Norwegian. The research questions deal with the interrelationship of geometrical and functional information for the use of spatial prepositions in French and Norwegian as native languages (L1) and the interaction of these information components during L2 acquisition of spatial prepositions. The acquisition of L2 spatial prepositions is seen as a dynamic process where lexical knowledge develops and stabilizes over time. Together, the three articles included in the thesis shed light on how multiple constraints influence lexical knowledge for spatial prepositions in the L2, and contribute to the identification of sources for difficulties for the use and comprehension of such prepositions in in a second language. Findings are that L2 learner groups become more consistent in preposition production and judgment with increasing levels of proficiency. However, although L2 users with relatively high L2 proficiency may produce prepositions in a native-like manner, they may still differ from native speakers in how much weight they attribute to some of the aspects underlying spatial preposition meaning. The population targeted are late L2 learners in a non-immersion, i.e., formal instruction, context, and their results are compared to those of L1 speakers of French and Norwegian. The articles in the thesis are relevant for research on spatial prepositions in general and on the acquisition of spatial prepositions in a second language in particular. They are also relevant for models of second language lexical development. Furthermore, the articles are relevant for a large population of L2 learners, namely those who learn a second language in school in their native speaking environments.

A total of 123 participants took part in the study. Of these, 26 participants formed a native Norwegian group and 24 a native French group, whereas a total of 73 L2 French participants, in three different groups, have taken part. While the L2 participant groups have different proficiency levels, the study is not longitudinal. All participants were over 18 years old at the time of the study and gave informed, written consent to participation. The project was approved by and registered with the Norwegian Social Science Data Services (NSD).

For the last thirty years spatial language has been extensively researched. The reason why spatial language has become such an important field of study across a variety of theoretical and methodological approaches, is that it offers the possibility of addressing (at least) two fundamental issues in the study of language. First, spatial language is an area in which the relationship between linguistic and non-linguistic representations can be studied. As spatial language maps onto concrete situations in the world surrounding us, this is an ideal domain for testing how representations

stemming from perceptual systems and linguistic representations integrate. Second, as the languages of the world differ considerably in how they lexicalize spatial relationships, spatial language constitutes a particularly interesting domain for studying the question of linguistic universals. These two fundamental issues have given rise to two different strands within research on spatial language. One strand has focused on the construal of meaning in terms of how linguistic representations, which are typically static, arbitrary and discrete, interact with perceptual systems which are dynamic, non-arbitrary and continuous representations emerging from the sensorimotor systems (Barsalou, 1999; Carlson & Kenny, 2006; Coventry & Garrod, 2005; Coventry & Garrod, 2004; Coventry & Guijarro-Fuentes, 2008; Coventry, Lynott, et al., 2010; Crawford, Regier, & Huttenlocher, 2000; Feist & Gentner, 2003; Joyce, Richards, Cangelosi, & Coventry, 2003; Landau & Jackendoff, 1993; Lipinski, Spencer, & Samuelson, 2009). The other strand has been preoccupied with the extensive variation with which spatial relationships are expressed across different languages of the world and to what degree this variation is also reflected in non-linguistic spatial representations, i.e., whether the language learned affects how we think about space. (Bowerman & Choi, 2001; Levinson, Kita, Haun, & Rasch, 2002; Majid, Bowerman, Kita, Haun, & Levinson, 2004). The perceptual-representational approach has brought about insights into what properties underlie representations for spatial language, whereas the linguistic diversity route has come to highlight some of the important variation that manifests itself in the lexicalization of spatial relationships in human language, showing that generalizations about the relationship between language and human cognition need to take diversity into consideration. However, the two fields have come closer together in that the systematicity with which perceptual-representational properties constrain variation is slowly being uncovered. Recently, advances in neuroscience have contributed further to our understanding of how linguistic and non-linguistic processing interacts (Chatterjee, 2008; Coventry, Christophel, Fehr, Valdés-Conroy, & Herrmann, 2013; Kemmerer, 2006; Noordzij, Neggers, Ramsey, & Postma, 2008). This interaction may be more complex than what has been assumed so far (Wolff & Malt, 2010).

Whereas research on the relationship between linguistic representations and sensorimotor representations has produced studies largely based on data from a single language, and predominantly English, research on the diversity with which spatial relationships are expressed linguistically typically involves two or more languages. These languages are often typologically distinct, come from different language families and may have different means for expressing spatial relationships. One oft-cited example is English and Korean. However, languages which are not typologically different to the same extent as English and Korean also differ in the expression of spatial relationships. An indication of this is the difficulties faced by second language learners when learning to express location in a new language, even when the L1 and the L2 are not typologically very different.

The study of the acquisition of spatial prepositions in a second language may feed from both of the two research strands in spatial language, taking into consideration both the nature of perceptual

constraints and cross-linguistic variations for encoding space while looking at factors influencing the development of lexical knowledge in the L2. Thus, L2 research on spatial language may contribute further to the understanding of how perceptual spatial representation and spatial language co-vary across languages. In identifying the particular subsets of properties that make L2 acquisition of prepositions difficult, findings within SLA can further our knowledge of what might remain universal in spatial language and what might be subject to modulation by the L1.

1.1 Objectives and research questions

The overall objectives of the present study were to investigate the semantics of spatial prepositions in Norwegian and French, to assess sources of difficulties for the use and comprehension of spatial prepositions in a second language and to investigate how knowledge of spatial preposition meaning and usage changes during the L2 acquisition process. The focus is on the semantics of a subset of spatial prepositions expressing static location and the features which affect their acquisition in the second language.

The framework adopted for studying these phenomena was the *Functional geometric framework for spatial language (FGF)* (Coventry & Garrod, 2004) which distinguishes three sources of information for the meaning of spatial prepositions: geometric routines, dynamic-kinematic routines and object knowledge (see section 3.2.2).

The following main research questions address the overall objective:

1. Can the semantics of spatial prepositions in Norwegian and French be described in terms of the FGF?
2. Where do difficulties in preposition usage in the L2 stem from – geometric or functional information?
3. Do L2 learners rely on L1 intuitions about preposition usage?
4. Does proficiency play a role in the use and comprehension of L2 spatial prepositions?

A first aim of the study was to investigate cross-linguistic similarities and differences with respect to how the components of the FGF underlie spatial preposition comprehension in L1 Norwegian and L1 French. It was hypothesized that the same geometrical and functional parameters that have previously been found to guide spatial preposition usage in English would also be effective in Norwegian and French, and that any differences between the two languages in the interaction of these parameters would be differences of degree rather than substantial differences in underlying representations for spatial prepositions. A second aim was to investigate how the same parameters integrate in representations for spatial prepositions in the L2, and to what degree L2 users rely on intuitions about spatial preposition usage in the L1 or come to develop a comprehension of the underlying constraints similar to that of native speakers of the target language. Importantly, the study aimed at teasing apart

L2 users' overt performance, which at more advanced proficiency levels might be error free and thus resemble that of native speakers, and their underlying intuitions about L2 preposition usage (Coventry et al., 2011). Acceptability ratings provide a means for moving beyond a study of production data to a more fine-grained account of underlying semantic features affecting representations for L2 spatial prepositions. A third aim of the study was to explore the development of lexical knowledge for L2 spatial prepositions with growing proficiency by investigating how L2 users map between perceptual information and linguistic L2 forms, i.e., what conceptual category boundaries and distinctions L2 users make and how these change with increasing proficiency.

1.2 A note on language used in the present thesis

Traditionally, in Norway, doctoral theses within the domain of French studies, to which I belong, are written in French. The present thesis is written in English, with the exception of one paper, which is written in French. There are two main reasons for this language choice. First, cognitive linguistics and psycholinguistics have their roots in an Anglo-oriented research tradition and the main body of research within the discipline(s) is therefore diffused in English. As a consequence, the established terminology of the domain is largely English, and any terminology developed in other languages tends to be less standardized. Furthermore, the type of experimental studies undertaken in the present work are still more common within the English speaking research paradigm than in the more traditionally oriented French one. Second, the contributions of studies looking at a growing body of languages are extremely important in a field of study where one tries to establish universal trends and patterns in human language and lexicalisation. For the results of such studies to be available to the larger research community, they have to be presented in English. Therefore, the most important reason to write and publish in English is to disseminate, to a wider research community, findings about language acquisition that do not pertain to English, and to disseminate research that breaks with the hegemony of English as the language studied. Findings from the studies included in the present thesis are also interesting in a local, Norwegian context. A large number of Norwegian readers understand English whereas only few would be able to read in French. Moreover, journals specializing in spatial language and cognition predominantly accept papers in English only. Thus, in varying degrees, even French researchers within spatial cognition publish their research on French in English (Aurnague, Hickmann, & Vieu, 2007; Borillo, 2007; Hickmann, 2007; Vandeloise, 1994, 2005, 2008). When some work here is published in French, the same considerations have come into play. There is extensive research on French prepositions. However, little seems to have been done within the framework adopted here, so dissemination of results to a French-speaking community is equally interesting.

1.3 Structure of the present thesis

The thesis is organized as follows: Section 2 provides a summary of the three papers which report on the studies in the project. In Sections 3 and 4, the overall theoretical background for the work is summarized. Section 3 provides an overview of issues related to spatial language. First, section 3.1 deals with spatial prepositions and definitions and terminology related to their study. Section 3.2 addresses the issue of function in spatial language and the relationship between spatial language and spatial perception. Section 3.2.2 introduces the Functional Geometric Framework. Section 3.3 discusses the relationship between linguistic and non-linguistic spatial representations, i.e., the question of linguistic relativity. Section 4 deals with second language acquisition and in particular the development of lexical knowledge in the second language. In section 4.3.1, central models of the bilingual lexicon are discussed, whereas section 4.3.2 is concerned with the notions of vocabulary size and depth. Section 5 discusses in detail the methodology used in the experiments, including test administration, considerations, methods for analysis and limitations of the study. Section 6 discusses the main findings from the studies, and their implications for what we can say about the development of lexical representations for spatial prepositions in the L2. Section 7 contains overall conclusions from the present studies. Appendices are found in section 9. Then follow the three papers in the order in which they are summarized in Section 2.

2 Summary of papers

2.1 Paper I: Les prépositions spatiales en français et en norvégien : Une étude expérimentale et comparative

Paper I, "Les prépositions spatiales en français et en norvégien : Une étude expérimentale et comparative", is published in *Syntaxe et sémantique*. It reports on a study which investigated the underlying factors affecting comprehension and production of spatial prepositions in L1 Norwegian and L1 French based on the Functional Geometric Framework (Coventry & Garrod, 2004). Although culturally similar, French and Norwegian are typologically different; French is a Romance language, Norwegian a Germanic language. Within Talmy's well-known distinction (Talmy, 2000a), Norwegian is classified a satellite-framed language, whereas French is usually classified among the verb-framed languages. French does however display both types of framing (Kopecka, 2006). The paper gives a brief introduction to how static location is expressed in the Basic Locative Construction (BLC) in the two languages. It introduces the spatial prepositional systems in French and Norwegian and the ways in which spatial semantic content is distributed over sentence constituents in the BLC in the two languages. In French, a neutral verb with no real semantic content (*être*) is predominant, whereas posture verbs (*ligge, stå, sitte*) are preferred in Norwegian.

The study targeted four static spatial scenes; two scenes concerning the topological spatial relations of containment and support and two scenes concerning placement on the vertical axis. Stimuli consisted of pictures associated with a sentence of the type *The located object is ___ the reference object*. 26 native speakers of Norwegian and 22/24 native speakers of French were asked to rate prepositions as to how acceptable each preposition was to complete the sentence so that it corresponded to the depicted spatial scenes. Systematic changes to geometrical and functional properties of the scenes were predicted to affect acceptability ratings for spatial prepositions in the two native speaker groups. The importance of geometrical and functional constraints underlying the use of spatial prepositions in French has been extensively studied theoretically; to my knowledge, however, this has never been tested experimentally. Norwegian spatial prepositions have mainly been studied from a syntactic perspective. There is reason to believe that also Norwegian spatial preposition usage results from the same types of geometric and functional constraints, but this has never been tested. There is substantial cross-linguistic variation in how topological spatial relations are partitioned and lexicalized. Location on the vertical axis displays less variation, moreover, infants very young have been found to form reliable categories for 'above' and 'below'. Based on this, it was hypothesized that any differences between Norwegian and French would occur within the topological scenes. Furthermore, it was predicted that the differences between the languages would amount to differences of degree rather than to substantial differences in the ways in which geometry and function underlie spatial prepositions.

Indeed, the study found that with respect to location on the vertical axis, native speakers of French and Norwegian did not differ significantly in how they modified acceptability ratings for spatial prepositions as a function of changes to geometric and functional properties of the spatial scenes. With respect to spatial prepositions in the topological domain, some differences between the two groups were found. These differences were restricted to specific reference objects. First, differences occurred in cases where the reference object was a plate, labelled *fat* in Norwegian and *plat* in French. Where L1 Norwegians rated *på* ('on') a 'perfect' preposition with the plate, L1 French users hesitated between *dans* ('in') and *sur* ('on'), with neither *dans* nor *sur* achieving high acceptability scores. Second, when the reference object was either a hand (French: *main*, Norwegian: *hånd*) or a dish (French: *assiette*, Norwegian: *skål*), Norwegian participants found *på* ('on') significantly less acceptable for describing the situation than the French participants found *sur* ('on'). Significant differences did not occur between the two groups with respect to how changes to the functional or geometric information affected acceptability ratings. It is therefore argued that geometric and functional properties of spatial relationships underlie spatial preposition meaning in much the same way in the two languages. Differences do not stem from these parameters themselves, but from the ways in which language specific labels (nouns) for reference objects co-occur with prepositions.

The results of the study, although not detailed enough to disentangle the respective weightings for geometric routines, dynamic-kinematic routines and object knowledge for the individual prepositions in each of the languages, clearly indicate that all of these parameters underlie spatial preposition usage and comprehension in both languages. As such the study provides additional cross-linguistic support for the Functional Geometric Framework. It also establishes clear parallels between the two languages in the importance of these parameters. Results are in line with theoretical assumptions put forward for French spatial prepositions by Vandeloise (1986, 2004), and also with experimental evidence about the interdependency of geometric and extra-geometric information for the use of spatial prepositions in English and in Spanish (Coventry & Garrod, 2005; Coventry & Garrod, 2004; Coventry & Guijarro-Fuentes, 2008; Coventry, Prat-Sala, & Richards, 2001). Taken together, the cross-linguistic evidence suggests that geometric and dynamic-kinematic routines regularly underlie lexicalization of spatial properties in these types of spatial prepositions.

The article sets the stage for the following investigation of acquisition of L2 spatial prepositions by late Norwegian learners of French. As overall preposition usage in the two languages was affected by the same parameters, and moreover, as changes to geometric and functional information affected acceptability ratings in in analogous ways in the two languages, Norwegian learners of French can in fact rely on their L1 intuitions about preposition usage for the correct use of L2 spatial prepositions. Some cases, however, are prone to transfer. This is the case when words co-occur in different ways in the two languages, predominantly within the topological domain.

2.2 Paper II: Spatial prepositions in the L2: Geometry vs function

The study reported in Paper II, "Spatial prepositions in the L2: Geometry vs function", investigated the interaction of geometrical and functional information for the meaning of L2 spatial prepositions in relatively advanced Norwegian L2 users of French based on Coventry and Garrod's (2004) FGF. Knowing that prepositions are hard to learn in an L2, researchers have asked whether difficulties in L2 acquisition lie first and foremost in identifying functional properties to be associated with prepositions in the L2 or whether geometry poses more of a problem for the comprehension of spatial prepositions. Research points in both directions. Munnich and Landau (2010) found that functional properties underlying spatial preposition usage are particularly hard to master in a second language. Coventry et al. (2011), on the other hand, found that L2 users differ from L1 users on geometrical properties. Furthermore, they found that L2 users made gradually more native-like distinctions based on geometric information with increasing proficiency while they were equally sensitive to functional information across all levels of proficiency.

The aim of this study was to tease apart the importance of geometric and functional information for the representation of spatial prepositions in Norwegian L2 users of French, and to identify which of the components were potentially more difficult to master. Furthermore, the study aimed at establishing whether and to what degree the L2 users relied on the constraints imposed by geometry and function on preposition usage in their L1. The study investigated the interaction of geometrical and dynamic-kinematic routines for location on the vertical axis in 28 upper intermediate to advanced L2 users of French. The methodology used was the same as in Paper I. Participants were asked to rate prepositions as to how successful they were in completing a sentence so that the sentence corresponded to the situation in a series of pictures showing a woman holding an umbrella. In the pictures, the geometric relationship between the woman and the umbrella was systematically manipulated. Functional properties of the spatial scene were manipulated by the introduction of rain into the pictures. The results of the L2 users were compared to those of 24 native French and 26 native Norwegian controls[1].

It was hypothesized that, because of the relatively high proficiency level of the L2 participants in the study as well as the parallelisms previously found between French and Norwegian, the L2 participants would provide overall acceptability ratings similar to those of the native speakers of French, but that they would still differ from them in the degree of adjustment to geometrical and functional changes to the spatial scenes. The judgment task was thought to tap into intuitions about preposition usage, and as such be sensitive to fine-grained semantic conceptual components underlying this usage. The advantage was that the influence of geometric and functional properties could be investigated also after L2 users might display error free production of spatial prepositions.

[1] These are the same as the participants in the study reported in Paper I.

Results showed that the L2 users of French did not differ significantly from L1 users of French on how they modulated acceptability ratings as a function of changes to the functional information in the scenes. Nor did they differ significantly from L1 users of Norwegian on this parameter. However, the L2 users did differ from L1 users of French with respect to how they modulated acceptability ratings following geometrical changes to the scene. L2 users did make clear distinctions in acceptability ratings across the geometric manipulation, but they did so to a lesser degree than the native speakers. These findings are in line with findings in Coventry et al. (2011). Interestingly, L2 users differed from L1 users on Norwegian in the same way. This is taken as an indication that the L2 users did not rely on L1 knowledge in this case.

The conclusion is that functional information is available to the L2 user early in the acquisition process, whereas native-like representations in terms of geometry take longer to develop. The findings are interesting as they indicate a similar trajectory for the development of spatial language semantics in the second language as has been found in first language acquisition (Feist, 2008a). Moreover, the results show that although the L2 participants in the study would be able to choose the correct preposition to describe the scenes, their performance still differed from that of native speakers with respect to the importance of geometry. This shows the importance of tasks which go beyond production and error data when assessing L2 lexical knowledge in relatively advanced learners.

2.3 Paper III: Spatial prepositions in the L2: Does proficiency have a role?

In Paper III, "Spatial prepositions in the L2: Does proficiency have a role", an exploratory study investigating the development of conceptual representations for L2 spatial prepositions in Norwegian learners of French is reported. Linguistic knowledge consolidates over different timeframes. On the one hand, new words can be integrated into the lexicon in a matter of hours. This is necessary for later retrieval and production of an item. On the other hand, the process of entrenchment, during which an item becomes so deeply rooted in long term memory that it can be effortlessly activated and retrieved, is a longer lasting one. According to Ellis (2006) learners may first attend to one cue at a time and only later in the acquisition process become sensitive to the interaction of multiple cues so as to develop a fundamental understanding of a concept. With respect to spatial language, a study on the acquisition of spatial prepositions by English L1 speakers showed that functional information is mastered early on whereas adult-like representations for geometric information takes time to develop (Feist, 2008a). A similar pattern has been found for the acquisition of L2 spatial prepositions (Coventry et al., 2011).

The study comprised two experiments. First, an explorative study aimed at establishing tendencies in preposition production over two different levels of proficiency. In this experiment, production data, i.e., spatial prepositions, from participants with either a lower intermediate to intermediate proficiency level (N=23) or an intermediate to upper intermediate proficiency level (N=22) were explored using

cluster analysis. Stimuli consisted of pictures of spatial scenes, each picture accompanied by a sentence[2]. Participants were asked to fill in a preposition so that the sentence corresponded to the depicted scene. Participants were all L1 Norwegian university students of French. One group was tested at the beginning of the first year of study, the other at the end of the first year of study. None of the groups received any explicit instruction in preposition usage at university. Second, with the aim of establishing whether conceptual development continues after initial word learning, rating data from two groups of participants with higher levels of proficiency (intermediate N=14, and advanced N=14) were compared. It was hypothesized that consolidation of lexical knowledge would continue after initial word learning, and also after native-like output was reached.

Results from experiment one showed that L2 preposition production was more structured and consistent in the group with the highest L2 proficiency. The cluster analysis yielded meaningful clusters for both proficiency groups. However, in the least proficient group there was considerable variation in preposition production, and one particular cluster formed around cases where participants had failed to produce a preposition. Participants in the more proficient group had converged towards specialized prepositions for specific spatial configurations and there were very few cases where participants failed to produce a preposition. Furthermore, the results showed that topological prepositions (*sur* and *dans*) were produced earlier than projective prepositions (*sous, au-dessus de*). Analyses of the rating data in experiment two did not yield significant differences between the two participant groups. Still, the data revealed differences in rating consistency between the two groups. Variance was always bigger in the group with the lowest proficiency, showing that within-group variation diminished with increased proficiency. Moreover, in a previous study comparing rating data from L1 and L2 users of French (Paper II), the same pattern emerged; variance was bigger in L2 user ratings than in native speaker ratings. The findings were taken to indicate continued development in semantic structuring in the L2 also after a preposition can be successfully produced.

Together findings from the two experiments are that as proficiency in the L2 develops, the semantic network for spatial prepositions undergoes conceptual structuring and tightening. It seems little exposure is needed for consolidation of items to happen. Nevertheless, the process of semantic structuring continues also after initial entry of an item into productive vocabulary, as can be seen both from the converging patterns in production data and from the increasing consistency in acceptability ratings. It was also found, however, that in some cases L2 learners converge on a non-target pattern, displaying transfer from their L1. Lexical feature reassembly (Stringer, 2011) can account for this type of transfer where L2 learners fail to reassemble spatial semantic features on lexical heads in the L2.

[2] The same stimuli were used across all experiments reported in Paper I, II and II.

3 Space and language

3.1 Spatial expressions

Spatial expressions may take many forms depending on the linguistic devices available in various languages as well as pragmatic considerations for the context of their use. Languages differ in the types of linguistic entities used for expressing location; verbs, particles, adpositions, nouns, or combinations of these, may all serve to express spatial relationships between objects. A fundamental property of spatial expressions is that they serve to relate two entities in a spatial configuration, one located with respect to the other. In *the apple is in the bowl*, the apple is located relative to the bowl. The element which is located somewhere, here the apple, is called the *figure*, the *located object*, the *trajector,* or, in Vandeloise's terms, *la cible.* The entity in relation to which this object is located, here the bowl, is called the *ground*, the *reference object*, the *landmark,* or *le site* (Coventry & Garrod, 2004; Lakoff, 1987; Langacker, 1987; Talmy, 1983, 2000b; Vandeloise, 1986). In the remainder of this work I will use the terms located object (LO) and reference object (RO) to refer to these two entities.

3.1.1 Spatial prepositions

Prepositions are a group of invariant words functioning as heads of prepositional phrases (PPs), often referred to as "relational terms" as they serve to establish a relationship between two elements. They form a closed class with a limited number of words compared to other word classes (Borillo, 1998; Cervoni, 1991; Faarlund, Lie, & Vannebo, 1997, p. 411; Grevisse & Goosse, 1986, p. 1503; Riegel, Pellat, & Rioul, 1998; Svenonius, 2003, 2004; Talmy, 1983). Spatial prepositions are prepositions which answer to the question *where?* and enter into spatial expressions where they serve to specify the position of objects in space, or their change of position in space (Coventry & Garrod, 2004; Le Pesant, 2012). *Locative prepositions* are used to describe the position of one object in relation to another, i.e., static spatial relationships, whereas *directional prepositions* are used to describe a change in position, i.e., dynamic spatial relationships (H. H. Clark, 1973; Coventry & Garrod, 2004, pp. 6-10; Faarlund et al., 1997, pp. 418-429).

Locative prepositions are usually divided into two classes: *topological prepositions* and *projective prepositions* (Borillo, 1998; Bowerman, 1996a; Coventry & Garrod, 2004, pp. 6-10; Kemmerer & Tranel, 2000). Topological prepositions are used for static spatial relationships that typically do not depend on a particular point of view or of the orientation of the objects involved. Such prepositions are for instance *in* and *on*. The group also includes proximity prepositions, which are prepositions denoting distances between objects, e.g. *near* and *far*. Projective prepositions give information about regions of space that are projected from one of the objects in the spatial scene which then serves as an anchor in a direction from which the other object can be found. Such prepositions are *over*, *under*, *in front of*, *behind*. In these cases, changes in the objects involved, such as rotation or whether or not

they have an intrinsic orientation, may affect preposition use. In some cases the use of these prepositions may also depend on the point of view adopted, i.e., the chosen *reference frame*. We distinguish between three types of reference frames: intrinsic reference frame, relative (egocentric) reference frame and absolute reference frame. The intrinsic reference frame is based on the "built-in" orientation of reference objects. Some objects have a clear front and back (and as a consequence a lateral orientation, and perhaps even a canonical top or bottom) such as human beings. Based on this intrinsic orientation, we may say that a ball is in front of a man. A relative reference frame is one that is adopted from the point of the viewer. Although a tree or a boulder does not have an intrinsic front or back, it is possible to say the ball is in front of the tree. Usually, this means that the ball is located somewhere between the viewer/speaker and the tree. The absolute reference uses fixed directions, such as north, east, south and west. Some terms may be used with all three reference frames (e.g. above), others may only be used with the intrinsic or relative reference frames (e.g. to the right of). In many cases more than one frame of reference can be applied to a spatial scene, something which may lead to different interpretations of the spatial expression, particularly if reference frames do not coincide. Consider the expression *The ball is in front of the car*. Depending on the orientation of the car, which has an intrinsic front, and the frame of reference adopted, the expression has several possible interpretations. If the car is facing the speaker, and the ball is between the car and the speaker, the intrinsic reference frame and the relative reference frame coincide. However, if the side of the car is facing the speaker and the ball is located between the speaker and the car, *the ball is in front of the car* is only correct if a relative reference frame is applied. Correspondingly, if the ball in this situation is located somewhere to the front of the car, the expression is only correct if an intrinsic reference frame is applied to the scene. Further interpretations come into play if prepositions denoting lateral relationships are applied, such as *to the right/left of*. Languages vary considerably in the use of reference frames. Some languages allow a relatively free use of all three, other languages predominantly use one. An example often cited is Tzetal, which, although allowing the intrinsic reference frame, predominantly uses absolute reference frames also in small scale spatial descriptions (P. Brown & Levinson, 1993b; Levinson, 2003; Levinson et al., 2002). The question of linguistic relativity in spatial language has often been addressed in relation to how reference frames are used cross-linguistically, and what effect this has on non-linguistic spatial cognition in different populations (e.g., Levinson et al., 2002; Li & Gleitman, 2002). Although cross-linguistically interesting, the use of particular reference frames is outside the scope of the present work, and I will not address the question of reference frame in any further detail.

The focus in the present thesis is locative prepositions and their use for the description of static spatial relationships between concrete objects. Particularly, the issues addressed here are the semantics of topological terms and projective terms for locations along the vertical axis and their acquisition in a second language.

3.1.2 Functional or lexical category

Spatial prepositions are a difficult category to classify. On the one side they are closely related to functional words; they are uninflected, they belong to a close-classed category, and they are realized in particular (functional) syntactic slots. However, they are also similar to lexical items in that they have a semantic content. This has led to their classification among both the lexical and the functional categories (den Dikken, 2006; Svenonius, 2004) in the linguistic community. Some linguists treat them as "semi-lexical" categories (Gaatone, 2001; Littlefield, 2005; Mardale, 2011; van Riemsdijk, 1998), and may thus distinguish between functional and semi-lexical prepositions; Littlefield (2006) found that semi-lexical prepositions, such as *in, on* and *under*, were acquired earlier by children speaking English than functional prepositions such as *of* (*the description of the man*). In some respects, they are similar to verbs in that they impose selectional criteria on their arguments and assign case and theta roles (Mardale, 2011; Svenonius, 2003, 2004).

Spatial prepositions are among those prepositions which the most clearly express semantic content. Their role in language and thought is central for describing experiences and properties of the world, and, for languages that have prepositions, they are basic components which allow for the expression of (spatial) relationships between objects. In this study, it is precisely this semantic component of prepositions which is targeted. Here, spatial prepositions are treated as lexical items. Hence, they are assumed to be part of the mental lexicon, to be stored and to have semantic features and to be referential. The interest here is in the perceptual and linguistic knowledge which underlie conceptual representations for spatial prepositions. Therefore, as much of other factors, syntactic and lexical, contributing to a spatial expression's meaning as possible are avoided. The study only looks at PPs which function as subject predicates after a copula verb. This is done in order to specifically target the semantic properties of prepositions with as little interference from the semantic content of a verb as well as from various syntactic positions as possible (see section 3.1.4). So in the sentences *The cup is on the table* and *The cup is under the table*, all of the semantic difference is captured by the preposition alone. In these examples, the preposition's syntactic place cannot account for the semantic difference between the two sentences.

French has some prepositions which are notoriously void of semantic content, the so-called colourless prepositions or *prépostions incolores*: *à*, *de* and *en* (Spang-Hanssen, 1963; Togeby, 1965). These can be used with spatial meaning (*Jean est au piano.* 'Jean is at the piano.'), but they lend themselves to a multitude of various, abstract uses. To the extent that they are included in the present study, they are part of complex prepositions (*à côté de*).

3.1.3 Prepositions in Norwegian and French

Both Norwegian and French have prepositions which encode spatial relationships. Both languages also have a system allowing for both coarse-grained and fine-grained specification of the spatial

content encoded. In both languages simple prepositions encode coarse-grained spatial relationships, whereas complex prepositions allow for the expression of a more precise nature.

Both languages have simple prepositions such as s*ur, dans, sous* and *på, i, under* (see also Paper I). Norwegian prepositions are predominantly transitive, requiring NP, AP, clausal or PP arguments, however, some prepositions can be used intransitively: *Soverommene er oppe* 'The bedrooms are upstairs' (Kristensen, 1995). In some cases, the argument of the preposition can be reestablished from the context: *Hun hentet en kurv og la blomstene oppi*. 'She got a basket and put the flowers in (it)'. Similarly, French prepositions take NPs, APs, PPs or clauses as their complements (Helland, 2006). In French, the complement can also be omitted in certain contexts and with particular prepositions *Elle habite à côté (de moi)* 'she lives next (to me)'[3], however, the argument is usually identifiable from the context (Melis, 2003; Togeby, 1965). Some prepositions take prefixes if they are used without a complement, and for this reason they have traditionally been treated as adverbs rather than intransitive prepositions: *Les bijoux sont dedans.* 'The jewelry is inside'.

Both languages also have complex prepositions. These constructions often combine prepositions and nouns, as in *à côté de, à droite de* in French *and ved siden av, til høyre for* ('at the side of'/next to, 'to the' right of) (Borillo, 1998; Faarlund et al., 1997, pp. 416-417). Complex prepositions vary in how fixed their structure is. Some of them clearly behave like a simple preposition would, i.e. their internal structure is fixed and cannot be changed or modified. Other complex prepositions allow for modification to the structure (Adler, 2001). Sometimes it can be difficult to distinguish these complex prepositions from ordinary PPs with complements (Borillo, 1997, 1998):

(1) *Il attendit [[au pied de] [l'immeuble]]*.
He waited at the foot of the building.
(2) *Il attendit [[dans] [[le hall] [de l'immeuble]]]*[4].
He waited in the hall of the building.

In the first case, *au pied de* is a complex preposition with a complement *l'immeuble*. In the second, *dans* is a simple preposition with *le hall de l'immeuble* as its complement. Complex prepositions encode space in a more fine-grained way than do simple prepositions, allowing for more specific identification of regions of space or highlighting properties of the reference object, as in (1) above, or even the located object.

In addition to complex prepositions like these Norwegian has what can be termed compound prepositions. These are prepositions resulting from the combination of two prepositions. *Inni* ('in-in' 'inside'), *oppi* ('up-in'), *nedi* ('down-in'), *uti* ('out-in'), *innpå* ('in-on'), *oppå* ('up-on'), *nedpå*

[3] Example from Helland (2006, p. 199).
[4] Examples from Borillo (1998, p. 82).

('down-on'), *utpå* ('out-on') (Faarlund et al., 1997, pp. 415-416). The first element is usually a preposition with an adverbial character, often prepositions which traditionally have been classified as adverbs on the ground that they can be used without a complement. Despite the fact that it applies to a closed-class category, the paradigm is highly productive in Norwegian, and can be found with all types of prepositions. The combination of two prepositions has the function of highlighting certain properties of the spatial relationship, and as such they constitute a more fine-grained system of lexicalisation in the spatial domain (Bakken & Vikør, 2011; Kristensen, 1995). They are frequent, and they have been argued to constitute full-fledged lexemes with entries in the mental lexicon different from their component parts. In certain dialects, pronunciation has altered the surface form, for instance where *oppunder* - composed of *opp* ('up') and *under* ('under') - has become *punni* (Bakken & Vikør, 2011).

In the present work, the majority of prepositions investigated are simple prepositions, although some complex prepositions have also been part of the test material. The analyses of rating data, however, focus predominantly on simple prepositions. The exceptions are the French prepositions *au-dessus de* 'over', which have a complex form (à + le dessus + de = 'at + the upside + of'), as well as *au-dessous de* 'under', and *en dessous de* 'under'. There is no simple preposition expressing superiority in French. *Au-dessus de* expresses a generic "over" relationship, and this meaning does not seem to be particularly linked to the preposition's constituent parts. Although it may not formally belong to the simple prepositions, it is included in analyses in the current work as if it were. This is on the basis that there is no other simple preposition that could capture the semantic content of *au-dessus de*, that is has been produced by native speakers in contexts that typically elicit simple "over" in Norwegian and in English (alternatively 'above'). Inferior location on the vertical axis, however, can be expressed using three different prepositions in French: the simple preposition *sous,* and the two complex prepositions *au-dessous de* and *en dessous de*. This asymmetrical relationship of terms to denote location on the vertical axis is interesting in itself in an L2 perspective, as it may have implication for the acquisition of these prepositions. Therefore, *au-dessous de* and *en dessous de* are also included in some of the analyses in the present work, and in these cases they are also compared to simple prepositions.

There are no cognates among Norwegian and French prepositions, with the exception of the loan into Norwegian of *vis-à-vis*. Prepositions in French and Norwegian may have different combinatorial and word formation properties, still, the structure of PPs is relatively similar in the two languages. However, the two languages differ somewhat in how semantic content is distributed over spatial expressions, both static and dynamic.

3.1.4 Basic locative construction

While both are Indo-European languages, Norwegian is a Germanic and French a Romance language. Etymologically the two languages are quite different, even if Norwegian has a number of loan words

from Latin, French and other Romance languages. With respect to the expression of location, the two languages fall into different categories in Talmy's well-known typological framework for the expression of motion events, where he distinguishes between satellite framed and verb framed languages (Talmy, 1985, 1991, 2000a, 2000b). Norwegian is a satellite framed language. It expresses movement using manner verbs and typically encodes path in a satellite (Dimitrova-Vulchanova, Martínez, Eshuis, & Listhaug, 2012). French is a Romance language and has typically been treated as a verb-framed language encoding path in the verb and (optionally) manner in an adjunct gerundive construction. However, French habitually displays both types of framing (Kopecka, 2004, 2006; Pourcel & Kopecka, 2005; Stringer, 2011). Nevertheless, the verb-framed pattern seems to be the productive one and the one which is the most frequently used (Hickmann & Hendriks, 2006; Hickmann, Taranne, & Bonnet, 2009; Kopecka, 2006, 2013). Norwegian and French also differ in the distribution of semantic content in static spatial expressions.

Various types of constructions may serve to express static location. Therefore, cross-linguistic comparisons of locative expressions are often based on what is known as the Basic Locative Construction (BLC). The BLC is defined as a default construction used to answer the question "Where is X?" (Levinson & Wilkins, 2006). The Basic Locative Construction has been used specifically in elicited production of spatial descriptions of scenes for the purpose of comparing the expression of space in several languages. Quite a tradition has developed in the lines of Bowerman, using the Topological Relations Picture Series (http://fieldmanuals.mpi.nl/volumes/1992/bowped/) . In both French and Norwegian, the structure of the BLC is NP + VP + [P + NP], where the first NP corresponds to the located object and the PP-internal NP to the reference object. However, the languages differ in the type of verbs used in the construction.

In French, the copula *être* 'be' or another neutral locative verb such as *se trouver* 'be/be located' are by far the most frequent, whereas a small percentage of BLCs contain posture verbs such as *être debout, être allongé, être pendu* and *être assis* (Kopecka, 2004). On the other hand, French also allows for locative expressions which differ from the BLC on a semantic level, such as resultative constructions *le téléphone est accroché au mur* 'the telephone has been hung on the wall=the telephone is hanging on the wall' or constructions with active verbs *l'enclos entoure la maison* 'the fence surrounds the house'. Neither construction is a response to "Where is X?", hence, neither can be classified as BLCs. Such constructions allow speakers of French to express more semantic content than the typical BLC with a copula verb allows for. Both these types of construction, however, would be problematic when investigating the semantic properties of spatial prepositions. The latter because it more often than not, excludes the preposition all together (it is a transitive construction). The first because verbs in resultative constructions tend to combine with more generic prepositions, such as *à* and *de*, which, as we have seen, are notoriously known for their lack of concrete semantic content (*prépositions incolores*). Also, these more semantically loaded verbs often contain an element which

etymologically has been a prefix, adposition or particle: *emboîter* (en + boîter), *embouteillir* (en + bouteillir), *accrocher* (à + crocher) – with the antonym *décrocher* (de + crocher), *attacher* (Petit Robert: "de l'ancien verbe *estachier* « attacher », avec changement de préfixe"), *suspender* (sus + pendre) etc. Interestingly, antonyms can be formed by a prefix with the opposite meaning, but this also in most cases entails a shift in preposition *attacher à*, *détacher de*. The shift in preposition indicates that it may not be as semantically empty after all, and that treating even these abstract prepositions as mere functional words may not be straight forward.

In Norwegian, the most frequently used verbs in the BLC are posture verbs. Posture verbs encode properties of the located object relative to the reference object, such as its horizontal orientation (*ligge* 'lie'), its vertical upward (*stå* 'stand') or downward (*henge* 'hang') orientation, or, with animate located objects, whether it is sitting as opposed to standing (*sitte* 'sit') (Ameka & Levinson, 2007; Lemmens, 2002, 2005). So in Norwegian, the spatial orientation of the located object is almost obligatorily encoded in the verb (Holm, 2013; Kuteva, 1999). A BLC with the copula verb *være* 'be' is possible, although a more marked construction. The felicitous use of the copula depends on the context, linguistic and visual. If someone asks *Hvor er mobilen min?*, "Where is my mobile phone", for instance, the use of the copula in the question may prime the use of the copula in the answer *Den er på hylla i gangen.*, 'It's on the shelf in the hallway.' despite the fact that in ordinary communication the more natural choice would be *Den ligger på hylla i gangen.*, 'It lies on the shelf in the hallway.'. Thus, while posture verbs are preferred, copula constructions are not ungrammatical.

It seems posture verbs in Norwegian can combine with various spatial prepositions. Still, the more semantically loaded predicates are also more restrictive in the selection of prepositions with which they may combine. Therefore, the verb contributes to the overall semantic content associated with the preposition. Controlling for this influence across languages can be extremely demanding, if not impossible. Studies targeting the comprehension and production of spatial prepositions in static locative constructions across languages therefore do wisely in minimizing any semantic influence from other components in the construction. There is a long tradition of investigating spatial preposition semantics using copula sentences, both within and across languages. Vandeloise (1986) provides examples using practically only copula sentences. Other researchers have maintained the same format for both theoretical and experimental studies (Carlson-Radvansky, Covey, & Lattanzi, 1999; Coventry & Garrod, 2005; Coventry & Mather, 2002; Feist & Gentner, 2003; S. Garrod, Ferrier, & Campbell, 1999; Hörberg, 2008; Richards, Coventry, & Clibbens, 2004). The advantage of the copula is that it serves merely as a term establishing a predicative relationship between the subject and the subject predicate in the clause, without providing substantial semantic content. In the case of the BLC, the truth of the sentence must be verified with reference to visual stimuli. Therefore the copula does not restrict the type of preposition that is likely to occur with it, nor does it impose specific interpretations when combined with specific prepositions. As it is the acquisition of the

semantic content of the preposition itself which is of interest here, it was important to keep influence from other entities to a minimum.

3.2 Function in spatial language

The meaning of spatial prepositions is obviously linked to the relative position of objects in geometrical space. It is therefore not surprising that many accounts for the meaning of such prepositions involved geometry, often in form of formal descriptions of the "fixed" relative position of objects in space. Cooper (1968, p. 23), for instance, defines the meaning of *in* as "X in Y: <X is smaller than Y>, X is located internal to Y", where X is the located object and Y is the reference object. However, such approaches soon fall short of capturing the meaning of spatial prepositions as they fail to account for the full range of preposition use. For instance, an account of the meaning of *in* would have to cover full inclusion: *a gold fish in a bowl*, partial inclusion: *the flowers in the vase*, partial inclusion but "inverted" orientation: *the light-bulb in the socket*, inclusion not within a containable inside but a surface: *a crack in a cup, a dent in a can*, or indeed, non-inclusion: *an apple in a basket* if the apple rests on other apples so that it is actually not within the containable inside of the basket at all (Figure 2). Consider also *the tree in the pot* where the located object, the tree, may be physically bigger than the reference object, the pot (Figure 1).

Figure 1. Tree in pot

Figure 2. Apples in basket

Common to all spatial prepositions is that they never seem to encode specific metric distances or positions in Euclidian space. Rather, they serve to indicate regions where an object is located or schematic relationships between entities.

The extensive polysemy of spatial prepositions has been a problem for models of language use and the lexicon (Talmy, 1983). Herskovits (1986) introduced a three-level representation consisting of an idealized geometric meaning, a series of use types and pragmatic principles to allow for the adaptation of use types to a wide range of uses. Lakoff (1987) argued that embodiment was a key element for the referential properties of language and that spatial relations were at the heart of metaphoric

extensions, such that non-spatial domains such as for instance time and emotion could be understood in terms of spatial conceptual structures. Polysemy in prepositions was treated in terms central prototypical spatial senses, image schemata, from which all other uses were derived (see also Brugman & Lakoff, 1988). However, these accounts have been criticised both for using geometric relationships between objects as the foundations for the image schemata, thus neglecting functional properties of the objects involved (Coventry & Garrod, 2004), and for providing a catalogue of meanings of *over* without moving beyond the description of polysemy (Coventry & Mather, 2002). Simultaneously, researchers began to explore the functional properties underlying spatial preposition usage (Carlson-Radvansky & Radvansky, 1996; Coventry, Carmichael, & Garrod, 1994; S. C. Garrod & Sanford, 1988; Talmy, 1988). In the French context, Vandeloise (1986) was among the first to voice functional constraints on preposition usage. Here I limit myself to a brief presentation of Vandeloise's approach to spatial preposition meaning.

3.2.1 Vandeloise and *la connaissance du monde*

Vandeloise's (1986) study of the semantics of spatial prepositions in French sets out to find the best system for describing spatial expressions. He rejects geometry as the only logical and objective system available to describe spatial expressions, and proposes instead a system based on "la connaissance du monde". His fundamental objective is to "établir une correspondance entre la description linguistique de l'espace et la connaissance extra-linguistique que nous en avons." (Vandeloise, 1986, p. 17) He establishes five groups of what he calls universal features (*traits universels*) which are indispensable for the description of spatial preposition semantics (p 30): 1) directions determined by the symmetry of the human body, 2) concepts of naive physics, 3) access to perception / perceptual access, 4) the potential meeting (*la rencontre potentielle*), and 5) general and lateral orientation.

Some of these are simple, some are complex. Often when Vandeloise is cited, his notions of the relationships *porteur/porté* ('bearer/burden') and *contenant/contenu* ('container/content') are the ones which are mentioned. The first terms in these relationships refer to reference objects with the properties of being either supporting surfaces (*porteur*) or containers (*contenant*), whereas the second terms refer to the located objects, i.e., objects which are being either supported (*porté*) or contained (*contenu*). These relationships are part of Vandeloise's second universal feature: naive physics. Furthermore, they are complex because they cannot be easily captured by one defining feature. Rather, they constitute *familles de resemblance*, family resemblances, which are defined as concepts represented by different combinations of the features which characterise them (Vandeloise, 1986, p. 108). The relationship container/content, for instance, has six characterising features: a) the position of the content relative to the container does not change when the container is moving, b) the container prevents its content from transgressing its limits in more than one direction, c) before containment, the content moves towards the container rather than the reverse, d) the container envelops the content, e)

the container protects the content, and, f) the container hides the content (Vandeloise, 1986, pp. 222-228; 1994; 2005, p. 224; 2008, p. 13). The meaning of the preposition *dans* ('in') is in Vandeloise's terms defined by the container/content relationship: "D_m: *x est dans* (a material entity) *y* if *x* and *y* are the first and the second term of the relationship C(ontainer)/c(ontent)" (Vandeloise, 2008, p. 13)[5]. No feature is sufficient, nor necessary, for the use of the preposition *dans*. However, all felicitous instances of *dans* share at least one feature of the family resemblance container/content. Prototypical cases of containment satisfy all six features of the family resemblance, as in *the water in the bottle*, whereas more marginal cases may satisfy only a few. Consider the relationships in Figure 1 and Figure 2 above. In both cases a, and c are satisfied, b is satisfied in Figure 1, but to a lesser degree in Figure 2, whereas d, e, and f are not satisfied for either situation. Languages differ in how they package these features together and in how they extend preposition usage along the features. Not all features are equally pertinent in all languages. On the other hand, the family resemblances constitute complex primitives which are globally understood by pre-linguistic infants, serving as 'anchors' for the acquisition of the spatial terms related to them in different languages. This account, then, considers the role of pre-linguistic universals essential to spatial language learning (Vandeloise, 2005). So in Vandeloise's account, the functional aspects of spatial relationships are highly important, whereas geometry is downplayed. Perceptual experiences with the external world, as well as knowledge of this world, are fundamental to his model of spatial language use. Furthermore, knowledge of the world is considered kinetic and dynamic, reflecting the speaker's liberty to consider objects and spatial scenes from a multitude of perspectives, which is fundamental to his model for spatial language use (Vandeloise, 1986, pp. 239-241). As such, Vandeloise's model earns it place within cognitive approaches to language use and language learning. Still, his approach to spatial preposition semantics remains a formalist one in as much as prepositional meaning is defined in terms of formally represented family resemblances, and in the method of exploring family resemblances looking at "rules of usage" (Aurnague, 2001, pp. 17-18; Col, 2010).

3.2.2 The Functional Geometric Framework for Spatial Language

In addition to the growing focus both in theoretical and experimental research on the functional properties underlying the semantics of spatial prepositions, research on pre-linguistic knowledge of object properties, force dynamics and geometry, which has shown that infants are able to form representations on the basis of such information (e.g., Hespos & Baillargeon, 2001; Kim & Spelke, 1992; Needham & Baillargeon, 1993; Quinn, 1994), has contributed to the need in psychology and in cognitive linguistics for a model that takes into consideration the various sources of information

[5] This is the definition given in Vandeloise (2008, p. 13). It seems, however, that x and y in the conditional clause should have changed places and that the sentence should read "if *y* and *x* are the first and the second term of the relationship C(ontainer)/c(ontent)." Cf. the definition in Vandeloise (1986, p. 222): "*a est dans* […] *b* si **le site** et **la cible** sont […] le premier et le deuxième élément de la relation contenant/contenu." (My **emphasis.)** *Le site* = the reference object, *la cible* = the located object.

which make up spatial representations and how words can be mapped onto these. Such a model was proposed by Coventry and Garrod (2004). The Functional Geometric Framework for Spatial Language (FGF) is a framework which "aims to capture the representation of spatial relations not just in how viewers see such relations, but also in how they act on the world they see, and in terms of how objects meaningfully interact with that world." (Coventry & Garrod, 2004, p. 54) . Coventry and Garrod place perceptual representation centre-stage in the situation-specific meaning of spatial prepositions. Information stemming from the visual system as well as knowledge accumulated through interaction with the world are taken as essential components for the build-up of spatial representations and for the meaning of spatial prepositions. The FGF sets out to capture how language and perceptual knowledge integrate for spatial terms, and in doing so places "perceptual representation at the heart of the situation-specific meaning of spatial terms." (Coventry & Garrod, 2004, p. 5). As such, the framework clearly positions itself within embodied and situated theories of language. Put simply, embodied and situated theories of cognition (also referred to as *grounded cognition*) hold that conceptual representations are constructed through our experiences with, actions in and simulations of the physical world (Barsalou, 2008; Barsalou, Simmons, Barbey, & Wilson, 2003) and that properties of the world and our bodies "afford, enable and constrain" our perception and action, thus affecting cognition (Tversky, 2008, p. 201). The main tenant within embodied theories of language is that semantic representations are not purely *amodal* (i.e., non-perceptual, abstract) and symbolic, but rather distributed over modality-specific representational systems; meaning is constructed on the basis of mental simulations engaging neural systems which are also involved in perception and action (Glenberg & Gallese, 2012; Glenberg & Kaschak, 2002; Kemmerer, 2010; Willems & Casasanto, 2011).

According to the FGF, sources for the representation of spatial prepositions are of two types. The first source type is geometric information, the second comprises extra-geometric information. The extra-geometric information also comes from two sources; dynamic-kinematic routines and object/situational knowledge. Information from all three components integrates to form situation models onto which spatial prepositions can be mapped, and from which the situation-specific meaning of spatial prepositions can be established. The components of the FGF are shown in Figure 3.

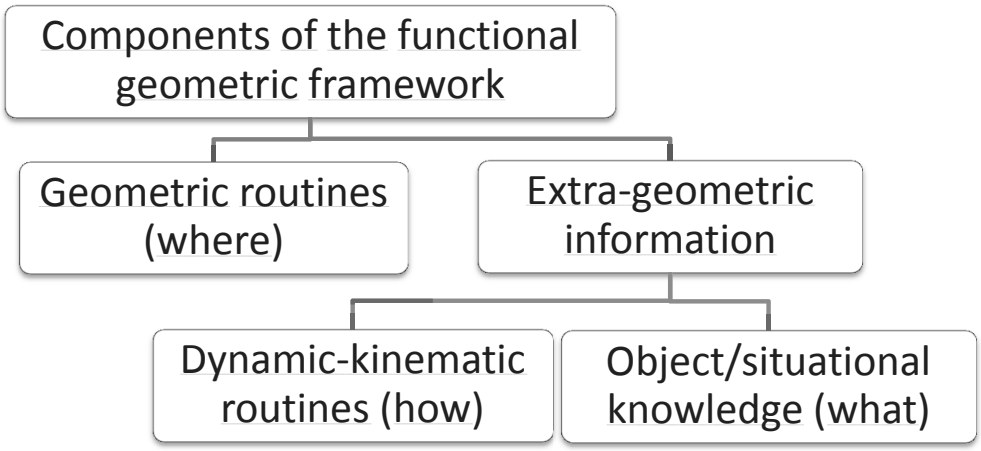

Figure 3 Components of the Functional Geometric Framework for Spatial Language. (From Coventry & Garrod, 2004, p. 55)

3.2.2.1 Geometric routines

The first component, geometric routines, relates, of course, to geometry. It recognizes the importance of where objects are located relative to each other in Euclidean space for the selection of and felicitous use of spatial prepositions. Rather than basing geometric information on formal or logical definitions of geometric relationships, the focus here is on routines which calculate geometric relations on the basis of visual information. Geometric routines in Coventry and Garrod (2004) terms draw upon results from research on visual routines (S. Ullman, 1984), on how visual routines may serve to ground spatial language in perception (Regier & Carlson, 2001), theories of how geometry can handle diverse instances of inclusion, as in the *Region connection calculus* (Cohn, Bennett, Gooday, & Gotts, 1997), and theories of spatial template construction (Logan & Sadler, 1996). Thus, geometric routines stem primarily from visual routines and serve to compute complex geometric relations between objects. An example of a geometric routine is one that computes whether an object is inside or outside another object, important for the use of a preposition like *in*. Another geometric routine is one which computes whether an object is in a region above another object, important for the use of a preposition like *over*. According to the authors, such routines are not necessarily automatic; they may not always be applied to a spatial scene and can be dependent on a particular context or task, yielding different perceptual representations for the same scene in different contexts. Within the FGF, for instance, information from the other components may drive specific geometric routines.

3.2.2.2 Dynamic-kinematic routines

The second component of the FGF, dynamic-kinematic routines, is non-geometric and relates to how force dynamics affect objects in a spatial scene. Dynamic-kinematic routines are routines which

calculate how objects will behave over time when subject to physical forces, such as gravity (Coventry et al., 2005; Coventry & Garrod, 2004). Different types of dynamic-kinematic routines have been identified for different spatial relationships. Perhaps the most well-known dynamic-kinematic routine is *location control*. Location control refers to the capacity of a reference object to control the location of the located object over time, like a matchbox will control where its' content of matches is: If you move the matchbox, the matches inside will move with it. The importance of location control for instances of containment and support, and thus for the use of prepositions like *in* and *on* has been recognized for a long time (S. Garrod et al., 1999; Vandeloise, 1986, 1992, 1994). Evidence for location control come from a number of studies where the relative control exerted on the located object by the reference object has been manipulated. Here I mention only a few of these. If an alternative source of location control is introduced, for instance by attaching the located object to a string or chain, the appropriateness of English prepositions *in* and *on* are reduced (S. Garrod et al., 1999). The appropriateness of *in* and *on* is also higher when the located object is shown to move together with the reference object than when the located object moves independently of the reference object (Coventry & Prat-Sala, 2001; Richards et al., 2004). Furthermore, Feist and Gentner (2003) found that the animacy of both the reference object and the located object affected use of the English preposition *in*; an animate reference object, like a hand, was more likely to elicit instances of the preposition *in* (and *on*) than was an inanimate object while an inanimate located object, like a coin, was more likely to elicit instances of *in* (and *on*) than was an animate located object like a firefly. A hand can exert volitional control over its content (the hand can close), increasing location control, whereas a firefly can fly away, diminishing the degree of location control exerted by the reference object. Important to relationships on the vertical axis is a routine which calculates *threatening contact* or *blocking contact* (Coventry & Garrod, 2004, p. 136). This routine assesses whether objects are in positions such that one object will fall onto the other or whether an object can block something from falling on another object. Consider a teapot and a teacup and a situation where tea is poured from the pot into the cup. For the teapot to be *over* the tea cup, it has to be in such a position that the tea coming from the spout will end up in the cup. Thus, successful interaction or potential successful interaction between objects influences the appropriateness of prepositions like *over* and *under* (Carlson-Radvansky et al., 1999; Coventry & Mather, 2002; Hörberg, 2008). The degree to which the located object, for example an umbrella, can protect the reference object, for example a woman, from a threatening contact, in this case rain, also influences the appropriateness of prepositions. *Over/under* are more appropriate if the located object fulfils this blocking function (Coventry et al., 2001). Eye-tracking studies have shown that participants looked at the potential end states of falling objects, even in static scenes. When shown static images of content poured from one container to another, people "simulated" where the content would end up. Furthermore, this affected their judgements about the appropriateness of spatial prepositions (Coventry, Lynott, et al., 2010). Moreover, evidence of mental animation driven by language has been found in a brain imaging (fMRI) study (Coventry et al., 2013).

Dynamic-kinematic routines therefore calculate how objects interact in the physical world as well as how they will potentially interact over time. This is an essential property of spatial language as "[…] spatial language tells us that objects will remain in the *same* relative positions over time, and that objects may or may not be in a position to interact with each other."(Coventry & Garrod, 2004, p. 51) Like geometric routines, dynamic-kinematic routines are perceptual and can be flexibly applied to spatial scenes; depending on the particular situation, a dynamic-kinematic routine may not always be applied to the scene (Coventry & Garrod, 2004, p. 141).

3.2.2.3 Object/situational knowledge

Finally, the third component of the FGF, object/situational knowledge, takes into consideration language users' stored representations for objects, how they can be used and how they relate to each other in context (Coventry et al., 2005; Coventry & Garrod, 2005; Coventry & Garrod, 2004). We know that teapots and teacups are functionally related. We know the handle is for holding the teapot and the spout is for pouring. We know tea is usually poured form the pot into the cup and not the other way around. The importance of object knowledge for spatial language has been established over various types of experiment. For instance, whether objects are functionally related (a pencil and a pencil sharpener) or unrelated (a pencil and a matchbox) has shown to affect the appropriateness of prepositions (van der Zee, Adams, & Niemi, 2009). Carlson-Radvansky et al. (1999) asked participants to place a picture of a located object "above" or "below" a reference object. Critically, for some reference objects, the functional part and the centre of mass were misaligned; on a toothbrush the functional part is the bristles. When objects were functionally related, like a toothbrush and a tube of toothpaste, the located object was placed closer to the functional part of the reference object than when objects were functionally unrelated, like a toothbrush and a tube of oil paint. So, how objects typically interact, influences how we talk about where they are located.

However, objects may be used to fulfil functions they are not usually known to have; a suitcase may be substituted for an umbrella as protection against the rain. Coventry et al. (2001) found that the appropriateness of spatial prepositions for scenes where objects were used in a non-stereotypical way was affected by the same geometric and dynamic-kinematic changes as for scenes where objects were used in a stereotypical way. This is taken as evidence that the way in which objects are functioning *in context* is important for spatial language, i.e., both object and situation knowledge matters.

Object and situational knowledge may drive or affect the type of visual routine evoked for a spatial configuration (Coventry & Garrod, 2005; Tversky, 2005). Within linguistic communities objects may be habitually conceptualized in specific ways. Consider the topological domain where *in* and *on* may be applicable to more or less the same situations. Evidence for how object labels may drive geometric routines comes from studies where one object has been labelled using different nouns. An object which is labelled a *plate* is usually associated with the preposition *on*, whereas if the same object is

labelled a *dish* or a *bowl* it may be associated with the preposition *in* (Coventry & Prat-Sala, 2001; Feist & Gentner, 2003). Thus, the label given to an object may affect its perceived function (Coventry & Guijarro-Fuentes, 2008). Such differences are also found between languages. Speakers of English know that trees can be conceptualized as containers for birds (*birds in a tree*) but as supporting surfaces for apples (*apples on a tree*) and leaves (*leaves on a tree*). Speakers of French, however, habitually conceptualize trees as containers for both birds and apples (*des oiseaux dans l'arbre* 'birds in the tree', *des pommes dans l'arbre* 'apples in the tree'), but as supporting surfaces for leaves (*des feuilles sur l'arbre* 'leaves on the tree'). In Norwegian, closed containers for liquids, such as bottles, pots and cans, are, quite counter-intuitively, associated with the preposition *på* 'on' rather than (or at least more frequently than) *i* 'in': *Det er kaffe på kanna*. 'There is coffee **on** the coffee pot.'

3.2.2.4 Integration of information from multiple sources

The core tenant of the FGF is that the situation-specific meaning of a spatial preposition derives from the integrated information from all three components of the framework. On the basis of geometrical information, dynamic-kinematic information and object and situational information speakers create a *situation model* which fits the spatial scene where the meaning of the preposition is the output of that model. A situation model is a mental representation of the world or a described state of affairs (Coventry & Garrod, 2004, p. 130; Zwaan, 1999; Zwaan & Radvansky, 1998). Mental models are informed by multiple modalities, creating abstract representations of scenes and events. Importantly, situation models are built flexibly depending on selective attention to specific aspects in the on-line situation or for the purpose at hand. In language use and comprehension, mental models play an important role as they serve as an interface between the world and the language used to talk about that world (Zwaan, 2003). The importance of multiple sources for the comprehension and production of spatial prepositions, and the complexity of their interaction, has also been addressed elsewhere (Carlson & Kenny, 2006; Feist & Gentner, 2012).Within the FGF, integration of information from all three components allows for a context-specific conceptualization of the objects involved in the spatial scene and of the relationship between them (Coventry & Garrod, 2005). Knowledge of objects and of the contexts in which objects co-occur contributes to the relative importance of geometric and dynamic-kinematic routines for the formation of informative situation models. Moreover, situational knowledge may also contribute to situation models where objects are functioning non-prototypically, as in the example above where a suitcase functioned as an umbrella. Importantly, dynamic-kinematic and geometric routines can be applied flexibly depending on how salient information from the routines is for the creation of a maximally informative situation model of a spatial scene (Coventry & Garrod, 2004, p. 141). By "informative situation model" a model which allows for the strongest inferences possible about the relationship between the reference object and the located object still consistent with the spatial scene is meant (Coventry & Garrod, 2005; Coventry & Garrod, 2004). In a situation where there is complete inclusion of located object within the reference object, location

control entails from the geometrical relationship between the two objects, and may not have to be computed by a dynamic-kinematic routine (Figure 4). Still, geometric and dynamic-kinematic information converge in this case, yielding a situation model unto which *in* can easily be mapped; *the goldfish is in the bowl*. In cases of partial inclusion, however, geometric information alone does not necessarily yield sufficient support for the use of *in*, and the importance of dynamic-kinematic information about degree of location control increases. In situations like those in Figure 5 and Figure 6, where the canonical orientation of the container is reversed, the importance of location control is evident. The light bulb can be successfully described as being *in* the socket in Figure 5 because the light bulb is screwed into the socket such that the socket holds the light bulb in place. However, *in* seems less appropriate for describing the relationship between the flowers and the vase in the situation in Figure 6, as the vase is unlikely to hold the flowers in place over time.

Figure 4 Goldfish in bowl.

Figure 5 Light bulb in socket

Figure 6 Flowers in vase.

The relative importance of the components of the FGF varies between prepositions. For instance, English prepositions *above/below* are more strongly influenced by changes to geometry than *over/under* whereas *over/under* are more strongly influenced by changes to extra-geometric information than *above/below* (Coventry & Mather, 2002; Coventry et al., 2001). Similarly, prepositions in different languages may not be associated with equal weightings for the components of the FGF even if they are usually considered translation equivalents (Coventry & Guijarro-Fuentes, 2008; Hörberg, 2008). Because objects can be conceptualized in various ways (the same container could be considered a plate or a bowl) they may processed using different routines resulting in situation models which reflect the situation-specific conceptualization (see also Carlson & Kenny, 2006). So in this model, the meaning of spatial terms does not reside in a stored representation for the term, rather it follows from the combination of multiple constraints associated with words and visual scenes in particular instances and the mental models built from these constraints. The advantage of the

FGF, therefore, is that it does not require multiple entries in the mental lexicon in order to accommodate for the various relationships a single spatial term can encode.

The view that the meaning of spatial prepositions derives from the situation-specific integration of multiple constraints is consistent with recent views in embodied cognition and linguistics. According to such views, semantic representations for words are perceptual and multi-modal. Reading or hearing a word activates neural networks which were also activated when the referents of the words were experienced (Barsalou, 1999, 2008; Barsalou et al., 2003; Glenberg & Gallese, 2012; Glenberg & Kaschak, 2002; Pulvermüller, 2002; Simmons, Hamann, Harenski, Hu, & Barsalou, 2008; Smith & Gasser, 2005; Zwaan, 2003)[1]. Thus, understanding a word is a simulation of an experience with its referent, including how the referent looks, feels, smells, and can be interacted with. The meaning of a word is therefore necessarily distributed over modality-specific systems. According to the FGF, spatial language learning entails binding linguistic symbols (words) to perceptual representations (i.e. grounding linguistic symbols in perception), as well as learning how words co-occur with other words. Children thus have to learn how perceptual symbols co-occur, for instance how tea pots habitually co-occur with tea cups and that in pouring situations the tea pot and the tea cup are in position to functionally interact. Furthermore, they have to learn how linguistic symbols co-occur, that is, how words co-occur with other words, e.g., *bowl* with *in*, *plate* with *on*, *tea* with *pot* and *cup*. Finally, they have to learn how perceptual symbols and linguistic symbols co-occur, mapping the linguistic symbols onto the perceptual ones, thus binding linguistic and perceptual information together (Coventry, 2013; Coventry & Guijarro-Fuentes, 2008). In this way, prepositions have to be mapped to the specific objects involved in a spatial scene and to the labels used for those objects, moreover, they have to be mapped to the relationship between those objects, a relationship which is, as we have seen, best captured by a situation model (Coventry & Guijarro-Fuentes, 2008). In fact, an implementation of the FGF using constrained connectionism has shown that spatial terms can be learned from the binding of spatial language to the processing of visual scenes (Cangelosi et al., 2005; Joyce et al., 2003). The focus in this line of work has been the link between visual information and language, and particularly visual information pertaining to the functional or non-functional interaction of objects. However, the semantic representations for objects stem from a multitude of perceptual input.

Learning the full range of spatial arrays that are covered by a preposition takes time. In fact, after a word form is established in long term memory, something which happens relatively fast, learning its full meaning is a lengthy process which can last for years (Clark, 2010). There is evidence that children do not attain adult-like semantic representations for spatial prepositions until adolescence

[1] There is, however, evidence that word meaning representations rely on amodal brain regions dedicated to language and that dynamic interaction with perceptual representations occurs in secondary, multi-modal brain regions (Bedny & Caramazza, 2011; Bedny, Caramazza, Grossman, Pascual-Leone, & Saxe, 2008).

(Feist, 2008a) and that the distinctions they make may not be exactly the same as adults do (Richards & Coventry, 2005; Richards et al., 2004). Languages vary in how their linguistic symbols co-occur with perceptual symbols, and how semantic features are packaged under spatial terms. Learning the conventional mapping between the term and the situation model is therefore language specific. However, there is reason to believe that the components of the FGF are at play across languages (Coventry & Guijarro-Fuentes, 2004, 2008; Coventry et al., 2011; Coventry, Guijarro-Fuentes, & Valdés, 2012; Feist, 2008b; Hörberg, 2008).

The Functional Geometric Framework constitutes one model of how spatial language can be grounded in perceptual routines and of how representations stemming from perceptual systems and linguistic representations integrate in the construal of meaning. However, the importance of language itself in the development of mental representations for space has also been widely studied. An important strand of research in the spatial domain has investigated the extent to which the language learned influences mental representations for space also in non-linguistic contexts, i.e., the extent to which spatial language affects spatial thought.

3.3 Spatial language and spatial thought

In the early 1980s, Ray Jackendoff asked how we can talk about what we see (Jackendoff, 1983). One of the reasons spatial language has been so widely studied in cognitive linguistics is, as we have seen, that it offers a unique insight into the relationship between language and perception. Spatial descriptions map onto relatively concrete spatial situations in the world surrounding us. Many languages have restricted inventories of spatial terms[1]. Still, there is great cross-linguistic variation in how languages carve up space using spatial terms. A major debate in research on spatial language has therefore been the relationship between non-linguistic spatial representations and the language used to describe them. The study of the relationship between language and thought is not restricted to spatial language. A multitude of other language-thought interfaces have also been studied, including colour, object naming patterns, grammatical gender, and patterns in the lexicalization of locomotion, etc. (e.g., Boroditsky, Schmidt, & Webb, 2003; Malt et al., 2008; Malt, Sloman, & Gennari, 2003; Steels & Belpaeme, 2005). Common to the debate across all these domains is whether the language learnt maps onto pre-linguistic universals, or whether the language learnt shapes conceptual representations, i.e., the question of linguistic relativity. The debate is not limited to universals within semantic domains. Evans and Levinson (2009) asked whether indeed there are any linguistic universals at all. They argue that diversity is what characterizes the human communication system, and that what has to be studied is the human capacity for acquiring and processing such diverse linguistic realizations. The purpose of the present study is not to contribute to the debate on linguistic relativity. However,

[1] This is especially true for languages where prepositions are used to express spatial relationships.

the debate has been so central to spatial language research that any study of the acquisition of spatial language, in the L1 or the L2, must consider the findings and arguments which have characterized it.

Over the years, two opposing points of view have been advocated regarding the relationship between linguistic and non-linguistic representations of space. According to the first point of view, spatial language maps onto pre-linguistic spatial universals. The opposite view holds that spatial language itself shapes mental representations for space. More recently, a third view has emerged which represents a middle way between the universalist and the relativist approach. This alternative view has developed as a number of studies of the relationship between spatial language and non-linguistic representations for space have indicated that the relationship is a not straight-forward one. Common constraints have been found to underlie both linguistic and non-linguistic spatial representations. However, whereas effects of language on spatial thought have been reported, these have not been found to permanently affect non-linguistic semantic representations. These three views are discussed in the following.

3.3.1 Spatial language maps onto pre-linguistic universals – the "modular" view

One view of the relationship between spatial language and spatial thought is that spatial language reflects universal, non-linguistic representations of space (H. H. Clark, 1973; Hayward & Tarr, 1995; Jackendoff, 1983; Johnston & Slobin, 1979; Landau & Jackendoff, 1993; Mandler, 1996; Talmy, 1983). One of the foundations for this view of the relationship between linguistic and non-linguistic spatial representations was research showing how infants form conceptual representations for space well before they start producing language (e.g., Kim & Spelke, 1992; Needham & Baillargeon, 1993; Quinn, 1994). In this view, spatial language maps onto non-linguistic spatial perception and memory, and as a result, spatial terms are constrained by spatial meanings. Certain mental elements seem to underlie all spatial language, namely elements such as place, path, region, ground and figure, and the predominant pattern of asymmetry between figure and ground, where the ground typically is larger, more stable, and more back-grounded than the figure (Landau & Jackendoff, 1993; Talmy, 1983). Because such non-linguistic representations were seen to be largely universal, the semantic structure of any language could be studied in order to get an understanding of what the universal concepts of space are. A further argument in favour of this view was the uniformity in the order of acquisition of spatial terms across languages. Studies showed that the first words to be acquired are words for containment (*in*), words for support and contiguity (*on*), and, somewhat later, words for visibility or occlusion (*under*). Then come notions for proximity (*next to, beside, between*), and, finally, words for projective relationships (*in front of, in back of, behind*) (Bowerman, 1996a, 1996b; Johnston & Slobin, 1979; Meints, Plunkett, Harris, & Dimmock, 2002; Tomasello, 1987). Such regularities in order of acquisition are to be expected if learning spatial language is a matter of relating spatial words onto already established conceptual representations of space. Furthermore, spatial terms, such as for instance *up, down, out*, and *off,* have been found to be rapidly learned by children, and subsequently

generalized and abstracted across entities and events in a robust and systematic way (Bowerman & Choi, 2001, p. 479; Smiley & Huttenlocher, 1995). This has been taken to be consistent with a relatively easy mapping of spatial terms onto pre-linguistic concepts of spatial relations. The actual rate with which individual spatial terms are acquired cross-linguistically may depend on features of the linguistic stimuli such as lexical diversity, for instance whether there are overlapping spatial terms in the language, something which can make the correct mapping of the terms to the spatial concept more difficult (Johnston & Slobin, 1979).

Mandler (1996) argued that infants have a mechanism which enables them to abstract regularities from perceptual input and to form initial conceptual representations on the basis of these abstractions. This innate mechanism for abstracting meaning is not dependent on interaction with objects, but is an attentive process in operation when objects are examined or compared to other objects. The result is a "redescription" of the perceptual information the infant processes. The output of the mechanism is "image schemas" which are abstract conceptual representations onto which language can be mapped (Mandler, 1996, pp. 371-373; 2000, pp. 17-22). A variety of such pre-linguistic image schemas are available to the child, but they have to be repackaged linguistically as language learning begins. Different languages package meanings together in different ways, hence the diversity in how languages encode space (Mandler, 1996, p. 378).

Landau and Jackendoff (1993) investigated the differences in underlying mental representations for "objects" and "places". The authors maintain that mental representations underlying object recognition draw on rich geometric information (details of object shape), whereas representations underlying spatial representations (places) draw on sparse geometric information where only highly schematized aspects of object shape are relevant. This is reflected in a large lexicon of object labels (nouns) and an extremely restricted number of terms (i.e., prepositions) which express the spatial relationship between objects. Furthermore, Landau and Jackendoff (1993) argue that this difference is fundamental to spatial representation in that representations for objects and representations for places stem from different sub-modules in the brain; the "what" and "where" systems. These different systems impose universal constraints on spatial representations; the "what" system offers rich object shape information, whereas the "where" system offers only sparse and schematic information. These universals also impose constraints on language acquisition. Children learning to talk about where objects are located come to the language-learning task prepared to attend only to schematic information about geometric properties of the reference and located objects and to non-geometric regions (Landau, 1994; Landau & Jackendoff, 1993, p. 236).

3.3.2 Language shapes spatial categories – the relativist view

The opposite, relativist view is related to the so-called Sapir-Whorf hypothesis which claims that the language one speaks shapes ones conceptual categories. According to the relativist view, non-

linguistic spatial representations are themselves shaped by spatial language (Bowerman, 1996a; P. Brown & Levinson, 1993a; Levinson, 2003; Levinson et al., 2002; Pederson et al., 1998). Much of the evidence for spatial universals was based on studies of English. However, there is considerable variation in how languages lexicalize and partition space, and more properties of spatial relationships are encoded in language than the universalist view had previously allowed for. Moreover, some of these properties crisscross the pre-linguistic categories which had been proposed by the universalists. One of the most well-known examples of this is the differences in encoding of containment and support (i.e., degrees of location control) in English and Korean. Containment is encoded in English by the preposition *in*, whereas support is encoded by the preposition *on*. In Korean, however, a distinction not relevant in English is encoded: that between tight fit and loose fit (Choi & Bowerman, 1991). In English there is a distinction between putting a cup *on* the table and a piece of Lego *on* another piece of Lego on the one hand, and putting an apple *in* a bowl and an earplug *in* the ear on the other. In Korean, the verb *kkita* is used for putting a piece of Lego on another and an earplug in the ear, whereas the verb *notha* is used for putting a cup on the table, and the verb *nehta* for putting an apple in a bowl (Bowerman, 1996a). Thus, in Korean, tight-fitting events are described by one verb, *kkita*, irrespective of containment and support.

Bowerman (1996a) argues that languages structure space differently, and that these differences manifest themselves in many ways, including the assignment of roles to objects in spatial scenes (reference object vs located objects), for instance in descriptive language use, the conventional conceptualization of objects, and in the detail and type of information spatial descriptions normally convey. In the relativist point of view, the language the child learns integrates with pre-linguistic knowledge of spatial properties and serves to shape these in further development. Children early become sensitive to the relevant distinctions made in their native language. If language was merely mapped onto pre-existing perceptual concepts, one would expect children to make uniform extensions and errors irrespective of the language being learned. However, it has been found that children over-extend (and under-extend) use of spatial terms in language-specific ways, not in a universal way across languages (Bowerman, 1996a; Bowerman & Choi, 2001, 2003). Using a preferential looking paradigm, Choi, McDonough, Bowerman, and Mandler (1999) found that children learning English and Korean had started becoming sensitive to language-specific categories for tight/loose fit and containment/support by the age of 18 to 23 months. They argue that language learners home in on principles for spatial categorization specific to the language learnt very early on. This, they say, is evidence that learning spatial language does not simply entail mapping spatial terms onto pre-linguistic spatial concepts. Rather, spatial concepts themselves are shaped by language. The underlying implication is that language restructures speakers' conceptualization of space, influencing also their non-linguistic representation. Bowerman (1996a) reports studies using children's linguistic production to investigate their underlying semantic representations. The idea is of course a valid one:

Space and language

Scenes for which children use similar spatial terms are treated as representing an underlying conceptual similarity the child has noticed and thus expresses. The flaw is that what is reflected in the child's usage of spatial terms, may not be her spatial perceptual categories, but rather her negotiation of the meaning of the spatial term itself, i.e., the mental representation for the spatial term, rather than the representation of an underlying spatial concept (Malt, Ameel, Gennari, Imai, & Majid, 2011). Whereas the argument in Bowerman (1996a) is based on the linguistic production of children belonging to two language communities, English and Korean, and therefore can be argued to say very little about *non*-linguistic spatial representations, other studies have tried to get at the relationship between linguistic and non-linguistic representations of space by looking at both linguistic and non-linguistic tasks.

Some of the most compelling evidence for the influence of language on non-linguistic spatial representations comes from studies of how languages use reference frames (see section 3.1.1). There is evidence that speakers of languages where the absolute reference frame is the only one available tend to organize objects according to this type of arrangement also in non-linguistic spatial tasks (Haun, Rapold, Janzen, & Levinson, 2011; Levinson, 2003; Levinson et al., 2002; Majid et al., 2004). P. Brown and Levinson (1993a) showed that speakers of Dutch tended to use an egocentric reference frame when sitting at a table looking at objects in a spatial array, and then turned 180 degrees to a different table and asked to reproduce the same spatial array. The result was a spatial array that rotated with the speaker. Speakers of Tenejapan Tzeltal, on the other hand, tended to use an absolute reference frame, reproducing the spatial array with the objects in the same axial positions. The results indicate, the authors claim, that that the language spoken strongly influences spatial memory and non-linguistic spatial categorization (see also Levinson et al., 2002). Similarly, Haun et al. (2011) found that preferred language strategies and preferred strategies in non-linguistic cognitive tasks align. They maintain that the dominant strategy for expressing location in language correlates with the preferred strategy for processing spatial relations non-linguistically, and that this correlation is stable by age 8. However, in their view, this is not a matter of absolute capacity, as speakers are able to represent all three types of frames of reference. Still, the results from this body of research show that strategies for reasoning about space covary with the way space is habitually expressed in language, suggesting that there is a causal relationship between language and thought. However, within the debate on linguistic relativity, a number of studies trying to dissociate language from conceptual representations have shown that speakers of typologically different languages performed identically in non-linguistic tasks while differing significantly in performance on linguistic tasks (Goldin-Meadow, So, Özyürek, & Mylander, 2008; Papafragou, Hulbert, & Trueswell, 2008; Papafragou, Massey, & Gleitman, 2002). Such findings have been taken as evidence that the particular patterns of linguistic encoding offered by language do not shape conceptual representations, i.e., that conceptual and linguistic representations are independent.

There are, however, weaker versions of the relativist claim. Perhaps the most well-known of these is Slobin's *Thinking for Speaking Hypothesis* (Slobin, 1996). This theory constitutes a shift from the relationship between language and thought to the relationship between two dynamic processes: thinking and speaking. Rather than claiming that language has a permanent effect on thought per se, Slobin (1996, 2003) considered the specialized type of thought which is recruited for communication one which is influenced by language. The thinking for speaking hypothesis states that the kind of thinking recruited for linguistic production and reception "involves picking those characteristics of objects and events that (a) fit some conceptualization of the event, and (b) are readily encodable in the language." (Slobin, 1996, p. 76). According to this theory, the habitual distinctions that the speaker's language make in grammar and lexicon drive the speaker's attention to specific dimensions of experience in such a way that the language user will become particularly attuned to these distinctions (Cadierno, 2008). During "thinking for speaking", then, the distinctions obligatorily encoded in the language interferes with thought in a nontrivial way. Event construal has to be adapted to the available linguistic options for encoding semantic content in a given language, thus the language itself constrains on-line event representation for the purpose of expressing them linguistically. Thus, the language we speak filters our experiences of the world into verbalized events (Slobin, 2000). Furthermore, Slobin argues that in acquiring language, children learn the language-specific ways of thinking for speaking (Slobin, 1996). The thinking-for-speaking hypothesis has been studied by looking at languages which typically encode path and motion in different ways, i.e., verb framed vs satellite framed languages[1]. Data predominantly consist of elicited narratives based on the so-called "frog story". Results have shown that users of satellite framed and verb framed languages attend to the components of a motion event in different ways. Speakers of verb framed languages focus their attention on changes of location and the settings of the motion event during verbalizations, whereas speakers of satellite framed languages attend more to manner of motion (Slobin, 2003, 2008). Eye-tracking studies have shown that people allocate visual attention to those aspects of a scene that are relevant for sentence planning when they prepare to speak (Gleitman, January, Nappa, & Trueswell, 2007; Papafragou et al., 2008). Furthermore, children have been found to display language-specific patterns at young ages, around three to five years of age (Slobin, 1996, 2000, 2008). In Slobin's (2003) terms thinking for speaking is involved also in mental processes such as understanding, imaging and remembering. However, evidence for any effects of thinking-for-speaking on such mental processes seems scarce. Coventry, Valdés, and Guijarro-Fuentes (2010), for instance, failed to find differences in immediate recognition of the spatial relations of containment and support in L1 speakers of English and Spanish, despite differences in how these relations are encoded linguistically in the two languages. The time course of the study was short not leaving the participants time to verbally encode scenes. This may explain why there was no effect of language-specific patterns of

[1] See section 3.1.4 for a brief description of this distinction.

thinking-for-speaking on memory for spatial scenes. Moreover, the authors argue, the absence of language effects in a short time course makes strong claims about linguistic determinism implausible. This is in line with other recent findings in the field which do not support a strong Whorfian claim about how language structures thought (e.g., Haun et al., 2011).

3.3.3 Common constraints underlie both spatial perception and spatial language

A more nuanced view of the relationship between spatial perception and spatial language has recently emerged; namely that a set of common constraints underlie both. When it comes to spatial representations, both language and memory may independently draw on the same set of spatial properties (Crawford et al., 2000; Landau, Dessalegn, & Goldberg, 2010; Landau & Lakusta, 2006; Munnich, Landau, & Dosher, 2001). The view that perceptual and linguistic knowledge interact in the process of category and concept formation, for instance by integrating information from one system with the output of another, is also known from other domains, such as for instance object categorization and object naming (Imai & Gentner, 1997; Malt et al., 2003; Smith, 2003, 2009; Son, Smith, & Goldstone, 2008), naming of human locomotion (Malt, Gennari, & Mutsumi, 2010), naming of body parts (Majid, 2010), and naming in the colour domain (Khetarpal, Majid, & Regier, 2009; Regier, Kay, Gilbert, & Ivry, 2010).

Following up on the studies by Levinson and colleagues (see previous section), Li and Gleitman (2002) investigated the relationship between habitual use of reference frames in language and memory for object positions. They tested native speakers of English, a language where the relative reference frame is predominantly used, on different strategies for remembering spatial arrays after rotation. They found that when a salient landmark was present in a scene, also speakers of English, where the absolute reference frame is not used in small-scale space, switched to an absolute reference frame in their reproduction of a spatial array after rotation. Furthermore, these findings were compared to previous results on spatial problem solving in pre-linguistic infants and animals showing that spatial strategies depended on availability of cues such as landmarks and their suitability for the task at hand. Li and Gleitman (2002) concluded that speakers of different languages do rely on habitual spatial representations in their native language, but that perceptually salient perceptual cues can override such linguistic preferences. They maintained that effects of language found in previous studies could stem form pragmatics and habitual style of spatial problem solving in the language community rather than from linguistic effects on non-linguistic spatial representations, i.e., that the effects found of language on thought could rather be "effects of language on language" (Li & Gleitman, 2002, p. 286; see also Papafragou et al., 2002, p. 216). Thus, they questioned the implied causal relationship between language and non-linguistic spatial representations. Li, Abarbanell, Gleitman, and Papafragou (2011) found that when speakers were given clear instructions for correct solutions when solving a frames of reference task, they performed equally well in language congruent and language in-congruent conditions. Furthermore, in more complex tasks, speakers of geocentric languages

(languages using absolute reference frames) relied on an egocentric frame of reference, indicating that task complexity is of importance when assessing the interface between linguistic background and spatial reasoning. Complex tasks are more difficult to encode linguistically, therefore humans are less likely to use language when solving such tasks. Li et al. (2011) argue that increasing task complexity may in fact reveal underlying commonalities in the way we represent space which criss-cross linguistic preferences.

The relationship between perception and pre-linguistic spatial categories on the one hand and spatial terms on the other need not be a one-way relationship, and the correspondence does not need to be a one-to-one correspondence. Crawford et al. (2000) point out that the prediction of both the universalist and the relativist view is that the structure of one system should be mirrored in the other, although they differ on the direction of effect between language and thought. The universalist view predicts that the structure of non-linguistic representations leads to a corresponding structure in linguistic representations, whereas in the relativist view the structure of non-linguistic spatial representations are predicted by the structure of linguistic representations. Comparing linguistic and non-linguistic responses to the same stimuli, a black dot located relative to a box, Crawford et al. (2000) found that the cardinal axes served as boundaries between non-linguistic spatial categories, and as prototypes in linguistic categories (e.g. for the preposition *above*). The authors claimed this is evidence that the same underlying structures are at play in both linguistic and non-linguistic category formation, but that these structures play different roles in linguistic and non-linguistic representations for space. Casasola (2008) maintained that both the view that spatial terms are mapped to perceptual spatial concepts and the view that the language learned shapes spatial concepts are in fact accurate, however, they may not pertain to the same spatial categories. Her results showed that infants' perceptual and cognitive abilities are sufficient for forming conceptual representations for some types of spatial relationships, whereas emerging spatial language assists the infants in forming other types of spatial categories. In Casasola's account, spatial language learning is a developmental process scaffolded both by perceptual categories and by language. Choi and Hattrup (2012) hypothesized that while perceptual (universal) input is indispensable for categorizing spatial relationships, language serves to guide spatial cognition in areas where perceptual information is diverse and several salient perceptual features compete. In this view, both linguistic and perceptual resources are exploited in spatial category formation, but they may be allocated different strengths depending on the type of spatial relationship involved. Furthermore, the authors hypothesized that degree of perceptual coherence may differ from one spatial relationship to another. For instance, containment constitutes a perceptually coherent category whereas support does not. The support category needs language for the various types of support to be conceptualized as a single category. In other words, a preposition like *on* contributes to the uniformity of the support category in English. In comparison, in Dutch, the same category is divided into two depending on type of support, *aan* for support where there is pull towards

separation (e.g., picture on wall), *op* for support where there is no pull towards separation (e.g., cup on table).

Other evidence for the view that non-linguistic representations for space interface with linguistic spatial representations comes from work with spatial descriptions in persons with Williams syndrome (Landau & Lakusta, 2006). Williams syndrome (WS) is a developmental disorder caused by genetic deficit. WS individuals tend to have language abilities which are delayed relative to chronological age but better than can be expected for their mental age. While their capacity for spatial language is relatively intact, WS individuals display severe deficits in visuospatial abilities and non-linguistic spatial organization. For instance, copying figures, i.e., drawing a figure in a blank space next to the model figure, is distorted. Such copying requires that one imposes a reference system, for instance cardinal axes, onto the model and carries this over into the blank space where the figure is to be copied. Landau and Lakusta (2006) found that, for both linguistic and non-linguistic tasks, children and adults with Williams syndrome did in fact recruit information about cardinal axes, for instance in using spatial terms such as *over*, *under* and *next to*. Landau and Lakusta (2006, p. 330) conclude that spatial language can emerge in Williams syndrome because spatial language is not parasitic on spatial perception per se, but rather engages such spatial systems, drawing on some of the properties but representing them in a different system. In other words, linguistic and non-linguistic systems for spatial representation are autonomous, yet interact. Such dissociations between linguistic and perceptual processing of spatial relations have also been found in neuropsychological studies (Kemmerer & Tranel, 2000; Tranel & Kemmerer, 2004). These findings suggest that while visuospatial and linguistic spatial representations are mediated by anatomically close neural clusters, these are not identical. Still, perceptual and linguistic representations are generally thought to have a parallel structure (Chatterjee, 2008; see also Crawford et al., 2000; Kemmerer, 2010).

Overall, the evidence that the answer to the question of whether language affects thought is not a simple *yes* or *no*, is growing (Wolff & Malt, 2010). The precise nature of the interrelationship between language and thought is yet to be determined. However, there is a growing body of research which supports an interface between linguistic and non-linguistic representations for space which is flexible and bidirectional, and where the two types of representations share parallel structures in the sense that there are at least a set of common constraints operating on both, accounting both for the variation across languages and for the constraints on this variation. The Functional Geometric Framework predicts a flexible interface between conceptual representation and spatial representation (Coventry & Garrod, 2004, p. 161). I take this to mean that language users can draw both upon knowledge of the language system and the habitual way space is expressed in the language in question, and on perceptual information about spatial relations, i.e., non-linguistic spatial representations. Forming a situation model onto which a spatial term can be mapped consists of a negotiation of meaning stemming from both systems, integrating information from linguistic and non-

linguistic spatial representation in order to arrive at the most informative situation model for the purpose at hand. Furthermore, I assume that L2 learners can exploit the same sources of information to build semantic representations for L2 spatial prepositions.

4 Second language acquisition

The acquisition of a second language both resembles and differs from the acquisition of the first (Chenu & Jisa, 2009; Cook, 2010; Meisel, 2011). On the surface, learning one's native language seems to be an effortless process. All normally developing children do it, are all successful at it, and end up with similar native speaker competencies. Learning to speak a second language, however, is quite a different task. It is an arduous process, and very rarely successful to the same extent first language learning is; individual variation in attainment is much more common in second language acquisition (SLA) than in first language acquisition. Still, L2 users do develop grammatical and pragmatic skills in their second language and many learn to use it for communicative purposes in similar ways as in their first language. In a world where a growing population speaks more than one language, either as a consequence of multilingual communities or of the growing globalization, and where bilingualism has become the norm rather than an exception, the study of the underlying factors relevant for this achievement is important indeed. The questions studied in SLA may in turn tell us more about human cognition in general and the human capacity for learning languages in particular.

Multiple factors influence second language acquisition including age of onset, context, type of input, amount of input, language aptitude, motivation, social situation, language status, experience, knowledge of other languages etc. The concern in the present study is the development of L2 lexical knowledge. My focus in the present section will therefore first and foremost be on theories regarding the nature of the bilingual mental lexicon, L2 lexical networks, and attainment in the L2. Before going into these areas in more detail, I provide a brief definition of some key terms in SLA, and give a short introduction to SLA as a scientific discipline.

4.1 Terminology in SLA

The language which is learned from birth is a persons' native or first language, usually referred to as the *L1*. A *second language*, i.e., *L2*, is one that is learned subsequent to the first language. Second language acquisition differs from simultaneous acquisition, or 2L1. In simultaneous acquisition, two languages are acquired from birth, resulting in an individual with two first languages. *Child L2* is a term used for the acquisition of a second language from approximately the age of 4. The term *second language* or *L2* has been used for the first language to be acquired after the native one(s) as well as to any other subsequently acquired languages. The argument has been that learning a third or fourth language is a process which is similar to acquiring a second language. It follows that a person can have more than one second language, and that the definition of a second language is really about the time-course of acquisition – L2s are acquired subsequently to the native language(s). However, there is a growing body of research looking at acquisition of more than one second language, especially to investigate whether the acquisition of a third language really does constitute the same type of process or leads to the same type of knowledge as the acquisition of a second language (see Falk & Bardel,

2010 for an overview). In such contexts, *L3* is a term conventionally used for all languages acquired after the L2, without any further distinction in order of acquisition. Finally, a distinction is sometimes made between second language acquisition and *foreign language acquisition* (FLA), the difference being that FLA takes place in an instruction or class-room setting in a country where the target language is not in use, whereas SLA is used to refer to natural language learning in an immersion setting.

The term *bilingual(ism)* is elusive. A bilingual is someone who speaks more than one language[1], but how fluent does she have to be in each of these languages to qualify as a bilingual? At one end of the spectrum are definitions of bilingualism which assume native-like proficiency in both languages. As a consequence, the term has often been reserved only to cases of simultaneously acquired languages, meaning that a bilingual is someone who has two first languages. Such definitions are often found in dictionaries. At the other end of the spectrum are definitions in which bilingualism involves the use in real life of more than one language at any level of proficiency (Bassetti & Cook, 2011; Grosjean, 2010). There is a tendency in the literature today to use the term bilingualism also in cases of sequential acquisition. Most definitions, however, include an aspect of fluency, for instance that a bilingual is someone who speaks two languages on a regular basis, or that she is able to produce meaningful utterances in both languages. Few definitions seem to distinguish between types of linguistic competence and take into account the fact that language users may have different levels of productive and receptive competence in their languages.

In the present thesis, I follow the convention of using *L2* to refer to all languages acquired after the first. However, all L2 French participants in the present study had knowledge of English before they started learning French, so in terms of numbers, French is effectively the L3 of the participants. I consider the term *bilingual(ism)* to be appropriate also in the case of sequential acquisition, but assume that some level communicative skills in the L2 are necessary for a person to be called a bilingual. This means that I consider most participants in the present study to be French-Norwegian bilinguals, although I hesitate to use the term for some of the participants who are in their first semester of academic French studies and who have so low L2 proficiency scores that they may have difficulties producing meaningful utterances. I make no systematic distinction between L2 user and L2 learner. Finally, I do not make a distinction between second and foreign language acquisition. I therefore refer to the acquisition of French by the participants in the present study as second language acquisition, despite the fact that this acquisition has (mainly) taken place in an instructed setting in Norway.

[1] *Multilingualism* is often used in cases where one person speaks more than two languages.

4.2 Theoretical stand-points and areas of inquiry in SLA

The study of second language acquisition is the study of the human capacity for learning more than one language and of the nature of L2 knowledge. In particular, studies in SLA concern languages learned subsequent to the first language; the process can take place during childhood, adolescence or adult life, however, child SLA is less studied than late L2 acquisition. As a discipline, SLA has its roots in language teaching, L1 acquisition, linguistics, and psychology, but it developed as separate field in the late1960s and 1970s. Particularly, during this time, there was a shift in focus from how languages are taught to how languages are learned (Gass, Fleck, Leder, & Svetics, 1998; Ritchie & Bhatia, 1996). Since the 1980s, research within SLA has grown in scope, established itself as theory-driven, and developed increasingly sophisticated methods for addressing empirical questions. Having developed from a pedagogic and classroom-oriented field, SLA has come to ask questions pertaining to the underlying factors determining the acquisition of more than one language, to the L2 knowledge system, and to explanations for the differences in L2 attainment (Doughty & Long, 2003; Larsen-Freeman, 2000; Ortega, 2009). However, while SLA has become an established discipline, it remains a field encompassing a large number of theories, some of which are complementary, others are in competition.

Since research in SLA is conducted within a range of theoretical approaches, the type of questions asked and the phenomena studied are necessarily influenced by the general assumptions and domains of inquiry of the particular theoretical stances. As a consequence, the answers, too, may be theory-specific. Still, many of the central questions in SLA are studied within several approaches and with differing methodologies. The advantage is that SLA phenomena are elucidated from more than one angle, and that the field feeds from a multi-disciplinary base. One of the important questions in SLA concerns the relationship between input and the type of knowledge the learner brings to the task of language acquisition. This is often seen in relation to another important issue in SLA, namely the relative difference in first and second language ultimate attainment. While a broad account of how these questions have been studied in SLA is outside the scope of the present work, a brief look at two major and opposing theoretical stances may serve as an illustration: UG-based and "usage-based" approaches to SLA.

A major concern for UG-based approaches has been whether L2 learners have access to a posited abstract innate linguistic system, i.e., Universal Grammar (UG), or not. Predictably, UG-based approaches have looked at the development of syntax in L2 and asked to what extent this development is similar to or different from L1 acquisition. Bley-Vroman (1990) argues for a fundamental difference between first and second language acquisition. In his terms, the innate system, i.e., UG, which guides first language acquisition, is not available in second language acquisition, and this accounts for the difference in attainment in the two processes. Adult language learners, he claims,

rely on general problem-solving systems rather than UG when learning a language (See also Bley-Vroman, 2009 for an account of the Fundamental Difference Hypothesis). The opposite view, still within a generative framework, is the full transfer/full access hypothesis (Schwartz & Sprouse, 1996) which states that the initial state of L2 acquisition is the entirety of L1 grammar. This system can be restructured during L2 acquisition using UG, to which the user has full access. Thus, while the Fundamental Difference Hypothesis assumes no direct access to UG, the full transfer/full access hypothesis does assume that the L2 learner has direct access to UG. More recently, focus within the generative framework has shifted from a focus on initial state to other areas, such as constraints on interlanguage grammars, i.e., grammars constructed during L2 acquisition (Selinker, 1972), on the interface between various sub-components of interlanguage grammars (White, 2003, 2009), and to the more fine-grained properties of syntax in L2 development, for instance the assembly of functional features on lexical heads in the L2 (Lardiere, 2009).

While hypotheses like the Fundamental Difference Hypothesis assume different learning mechanisms in first and second language acquisition, thereby accounting for the differences in attainment, cognitive linguistic theories maintain that language acquisition is no different from other cognitive learning mechanisms in humans. Usage-based theories of language acquisition hold that language is learned from usage, grounded in and interacting with other cognitive systems, such as perception, categorization, attention, and memory (Geeraerts & Cuyckens, 2007). Such a view also entails similar mechanisms for acquiring both the first and subsequent languages. A challenge, therefore, is to account for the differences in attainment in L2 compared to L1, and the different levels of attainment among L2 learners. However, claiming that similar general learning mechanisms are involved in both L1 and L2 acquisition does not necessarily mean that nothing is different in the two processes (Ellis, 2008a). Several models have shown that language learning can take place using statistical, usage-based, bottom-up mechanisms. Emergentist and constructionist views (Ellis, 2006, 2008a, 2013; Ellis & Cadierno, 2009; O'Grady, 2008) hold that there are no innate linguistic constraints on the computational system for language. Rather, exposure to input and an innate general learning mechanism which extracts statistical regularities in this input are sufficient for complex constructions to emerge. In this view all grammatical learning can be understood as form-meaning mappings driven from input. In fact, a recent study has shown that even classroom L2 learners can extract form-meaning patterns in the target language from statistical information in the input (Treffers-Daller & Xu, in press). L2 acquisition is different from L1 acquisition in that L2 learners have already attuned to the characteristics of their L1. This may hamper their attention to and bias their estimation of aspects of the target language in use. Second language acquisition, in this view, involves processes of both construction, i.e., entrenchment of form-meaning mappings, and *re*construction, i.e., a revision of the semantic and pragmatic meaning mapped to a form. Reconstructing a second language is perhaps more complex than constructing a first language as L2 constructions are in competition with already

existing L1 constructions throughout the acquisition process. The difference between first and second language acquisition in this model is first and foremost the linguistic experiences the L2 learner already has and therefore brings to the acquisition process, as these lead to interference and transfer. Usage-based approaches also consider explicit awareness of L2 construction forms likely to be needed for L2 acquisition to be successful; particularly, such "focus on form" may facilitate the acquisition of construction forms which have low perceptual salience (Ellis, 2005) or help adult L2 learners discover cues in the target-language input their L1 processing strategies may lead them to overlook (Doughty, 2003). A meta-analysis by Norris and Ortega (2000) showed that instruction does indeed have an effect on the acquisition of targeted language forms.

Not only is research on SLA conducted within various theoretical frameworks, but the range of phenomena studied is also wide. Second language acquisition covers a multitude of factors involved in the acquisition process and in the development of L2 linguistic competence. Important areas of study have been age effects on acquisition and its final state, the end-state of L2 knowledge systems, and ultimate attainment, i.e., the degree to which L2 learners can obtain near-native competency in the target language (e.g. Abrahamsson & Hyltenstam, 2008, 2009; Hyltenstam & Abrahamsson, 2000, 2003). Others areas studied concern the degree to which L2 learners draw on L1 knowledge, i.e., types of transfer, how L2 words enter the mental lexicon and the relationship between conceptual representations and L2 words (e.g. Cook, Bassetti, Kasai, Sasaki, & Takahashi, 2006; Dong, Gui, & MacWhinney, 2005), and how this relationship may develop with increasing proficiency in the L2. Moreover, a growing body of research looks at the nature of multilingual lexicons, and the extent to which they differ from bilingual ones (Cenoz, Hufeisen, & Jessner, 2003b; de Bot, 2004; Lemhöfer, Dijkstra, & Michel, 2004). Studies from neuroscience have dealt with the question of processing in the L2, processing costs, and language inhibition and control (e.g. Perani & Abutalebi, 2005; M. T. Ullman, 2001). The monolingual speaker and her native-speaker competence and intuitions about language use hold a special status in most linguistic disciplines. However, researchers within SLA have started to question the established assumption that the monolingual speaker is the norm against which bilingual and multilingual competence should be measured (Birdsong, 2005; Cook, 1997; Grosjean, 1985; Ortega, 2014). In addition to these "internal" factors, various societal factors in SLA are studied: status of the L1 and L2 languages, social factors, motivation for and attitude towards language learning, language learning environment etc. Furthermore, research on SLA still includes applied and pedagogical issues.

The approach to second language acquisition in the present thesis is usage-based. The study deals with the acquisition of spatial prepositions and their semantic content in a second language. While prepositions make up a mixed category and can be seen as either functional words or lexical words (or as semi-lexical words), they are treated as lexical items in the present study (see Section 3.1.2). Thus, the focus of the present study is word learning, i.e., lexical development, in the second language. It is

assumed that lexical knowledge develops in depth with exposure to the target language, and with target-language use. In the next section, theories about the development of L2 lexical knowledge are discussed.

4.3 The development of lexical knowledge in the L2

Knowing and using a second language involves multiple factors such as implicit and explicit knowledge of syntactic properties, syntactic processing, pragmatic skills, inferencing, and knowledge of cultural and social communication practices. A prerequisite for all these, however, is knowledge of a certain amount of lexical items, i.e., words, in the second language. However, the concept of L2 lexical knowledge is not straight forward. What does it mean to know a word in a second language? How do words in the L2 relate to words in the L1? In the following, the study of these questions in SLA is addressed. First, I will briefly present some of the models of the bilingual lexicon that have been proposed over the last 20 years and discuss what implications these models have for the understanding of the bilingual lexicon, as well as some of the criticism that has been raised against them. Furthermore, I will try to sketch some implications for a model of the bilingual lexicon if one assumes an embodied and situated theory of language. In the second half of this section, I will discuss some of the properties of (bilingual) lexicons which have been under investigation within the linguistic community, such as the size and depth of the lexicon, and models for the establishment of words in the lexicon.

4.3.1 Models of the bilingual lexicon

The nature of the bilingual lexicon has been of interest in second language acquisition research over the past two decades. One of the discussions has been whether the L1 and the L2 lexicons are separate, or whether L1 and L2 words all belong to one, shared lexicon. Also the question of whether bilinguals can "switch off" one of their languages while using the other, i.e., have so-called selective access, or whether both languages are active simultaneously, often labelled non-selective access, has been investigated. Furthermore, the relationship between words and conceptual representation has been addressed. One question has been the degree to which L2 users have direct conceptual access in the L2 or whether this access is mediated by the L1. The linguistic community now widely holds that both languages in a bilingual's brain are activated simultaneously (see for instance Duyck, Assche, Drieghe, & Hartsuiker, 2007; van Hell & Kroll., 2012)[1] and that this accounts for findings that bilinguals, because of the constant inhibition and control of these active language systems, are better at filtering out noise (Bialystok, Craik, Klein, & Viswanathan, 2004). Several models for the bilingual lexicon have been proposed. Common to them all is the need to account for a well-developed knowledge of L1 words and their meanings in combination with the emerging L2 lexicon and how L2

[1] Costa, Heij, and Navarrete (2006), however, argue that the experimental evidence supporting this assumption is non-conclusive, at least with regards to speech production.

words are mapped to meaning. The differences between models are linked to the notions of "concept" and "conceptual representation", to what assumptions they make about selectivity or non-selectivity in lexical access, and to the extent to which they incorporate a development in L2 proficiency. None of the models have been specifically developed with a multilingual speaker in mind. While there is increasing interest in the organization of multilingual lexicons and the ways in which they may differ from mono- and bilingual lexicons, multilingualism still tends to be subsumed under bilingualism (Cenoz, Hufeisen, & Jessner, 2003a). Here, four models of the bilingual lexicon are discussed. The first three models presented are concerned with the relationship between L1 and L2 lexical knowledge, whereas the fourth is a model of bilingual word recognition.

An influential model in second language research is the *Revised Hierarchical Model (RHM)* (Kroll & Stewart, 1994; Kroll, van Hell, Tokowicz, & Green, 2010), which is a model both of lexical representation in the L2 and of processing in the L2, primarily aimed at modelling L2 word production. A property of the RHM is that it assumes separate (hierarchical) levels for lexical and conceptual information. Furthermore, it assumes that conceptual representations are shared in the L1 and the L2, whereas lexical representations in the two languages are not. Implicitly, therefore, L1 and L2 lexicons are treated as separate, and selective lexical access is assumed (Brysbaert & Duyck, 2010). The model is shown in Figure 7. According to the RHM, memory for lexical items in the L1 is linked to conceptual memory. In the initial stages of second language (word) learning, the learner relies heavily on the L1 lexicon, and access to conceptual representation is mediated uniquely via the L1.The learner first maps words in the L2 onto words in the L1 and conceptual representation is therefore identical to the L1 representation.

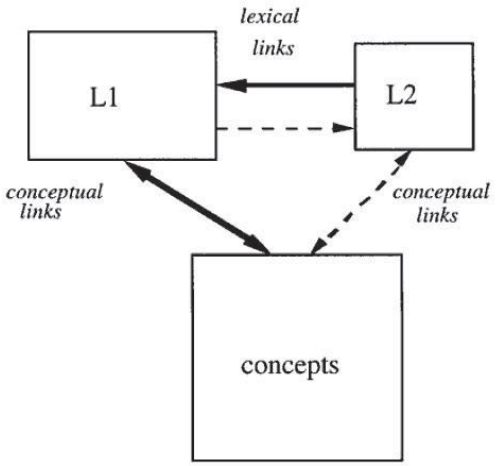

Figure 7 The Revised Hierarchical Model. From Kroll and Stewart (1994).

With increasing exposure, direct connections between L2 words and conceptual representation are established, ultimately becoming strong enough that conceptual knowledge can be accessed directly via L2 words, either in immediate activation and retrieval for comprehension or in retrieval for the construction of a meaning representation for production. However, links via the L1 lexicon subside. Lexical links from L1 to L2 also emerge, but these are considered to be weaker than links in the opposite direction. Similarly, links from L2 words to the conceptual level are considered to be weaker than those from L1 words to the conceptual level.

Support for the model comes from asymmetries in translation speed. It has been found that translating from the L2 to the L1, which is assumed to rely on lexical memory, is fast, whereas translating from the L1 to the L2, assumed to rely on conceptual processing, takes longer, particularly in less fluent bilinguals (Kroll, Michael, Tokowicz, & Dufour, 2002; Kroll & Stewart, 1994). Evidence of a shift from lexical to conceptual mediation with increasing proficiency in the L2 comes from a study of trilinguals; de Groot and Hoeks (1995) found that translation was conceptually mediated in the L2 in which the trilinguals were most proficient whereas it was lexically mediated in the other L2. One of the advantages of the RHM is that it takes proficiency in the L2 into consideration for processing speed. It does, however, claim that L2 and L1 processing is qualitatively different. For this reason, the model has been criticized (Brysbaert & Duyck, 2010). Duyck and Brysbaert (2004, 2008) showed that translation in both directions could be semantically mediated, also in speakers with low proficiency in the L2. These studies suggest early links between L2 words and conceptual representation, i.e., that L2 words are mapped onto sematic content directly, not only to L1 words. Furthermore, studies showing that concrete words are easier to learn in an L2 than abstract words contradict the assumption that L2 words are simply linked to L1 words and their meanings (de Groot, 2011, p. 142).

While advantages of the RHM have been the separation of lexical and conceptual knowledge and the inclusion of a developmental view of L2 proficiency into the model, one of its flaws is the underlying assumption of the conceptual store as a stable entity where conceptual representations are treated as holistic packages; each L1 word corresponds to a concept. Furthermore, cross-linguistic lexical equivalence is assumed; L2 words are treated as one-to-one translations of L1 words. However, in reality, cross-linguistic diversity in lexicalization patterns within semantic domains is prevalent. While words in two languages may share some meaning components, they may differ in others. Moreover, L1 lexicalization patterns are not impervious to L2 lexicalization patterns (Ameel, Malt, Storms, & Van Assche, 2009). Rather than the acquisition of mappings between concepts and L2 words, Pavlenko (2009) and Jarvis and Pavlenko (2008) argue that L2 word learning entails conceptual restructuring and conceptual development, whereby the L2 learner readjusts category structure and develops new category representations to which L2 words can be mapped. Furthermore, new conceptual representations for categories not present in the L1 may be established. In cases where categories completely overlap in the L1 and the L2, i.e., where there is conceptual equivalence,

L2 learners have little difficulty in acquiring L2 words, even if they are of a different grammatical category than L1 words. In cases where categories partially overlap, what Pavlenko (2009) calls conceptual non-equivalence, L2 learners need to adjust the boundaries of their linguistic categories to correctly map between the L2 word form and conceptual representation. This is relatively easy when the L2 merges two categories in the L1, whereas it represents more of a challenge if the L2 splits categories in the L1 (Cadierno, 2008; Jiang, 2002; Stockwell, Bowen, & Martin, 1965). Conceptual reconstruction, according to Pavlenko (2009), takes time and is dependent on a multitude of factors, including proficiency in the L2. The notion of conceptual reconstruction is consistent with the Semantic Features Hypothesis in first language acquisition. The Semantic Features Hypothesis states that when children first learn a word they do not know its entire meaning. Rather, the child only has partial knowledge of word meaning, and through development adds subsequent semantic features to the semantic representation for the word (E. V. Clark, 1973). As we can see, the RHM has been criticized for its cursory presentation of conceptual structure. Still, Kroll et al. (2010) argue that while the structure of semantic representations was not discussed when the RHM was originally proposed 20 years ago, the model can easily be adapted to account for the more fine-grained featural make-up of sematic representations widely assumed today.

A model which leaves more room for cross-linguistic differences in semantic representations is the *Distributed Features Model (DFM)* (de Groot, 1992, 2011; van Hell & De Groot, 1998) which assumes that the meaning of words is distributed over a number of elementary meaning components in conceptual memory. In this model, conceptual representations are assumed to consist of constellations of semantic features. These features, i.e., the conceptual level, are available in both L1 and L2. Words in two different languages may share some of these semantic features, but not others. Furthermore, the model assumes a distinction in the representations for concrete and abstract words. Concrete words and cognates are assumed to subsume the same meaning components in the different languages, i.e., the words share meaning (more or less) completely, whereas the overlap of semantic features between languages may be smaller for abstract words. See Figure 8 for an illustration.

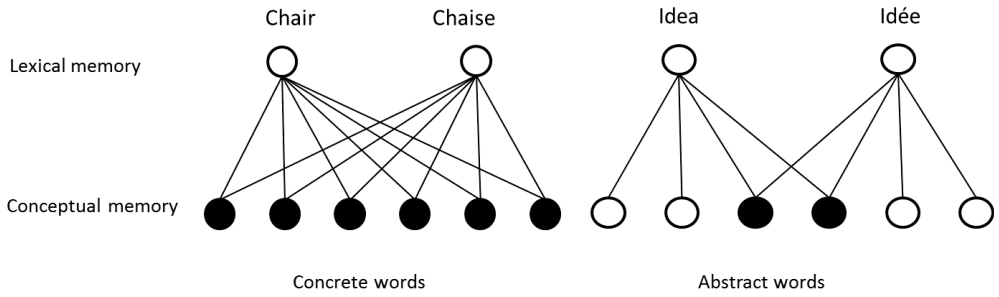

Figure 8 The Distributed Features Model. Adapted from de Groot (1992, 2011). *Chaise* and *idée* are French for *chair* and *idea*.

A basic assumption of the DFM is therefore that conceptual representations can be graded, and that the number of semantic features shared between languages form a continuum (van Hell & Poarch, 2012). Moreover, the set of semantic features activated by a lexical form is not treated as stable, but assumed to vary according to linguistic context as well as situational context (van Hell, 2002). This view is compatible with embodied and situated theories of language (see section 3.2.2.4). However, the model does not include a role for development to account for changes in L2 proficiency.

The *Shared (Distributed) Asymmetrical Model* (Dong et al., 2005) combines aspects from both the Revised Hierarchical Model and the Distributed Features Model. As the name indicates, the model assumes that bilinguals have shared conceptual representations for their two languages. Dong et al. (2005) found cross-language priming indicating a shared conceptual system for translational equivalents for the two languages in bilinguals. Moreover, they found longer reaction times in the L2 than in the L1. Furthermore, priming effects from L1 to L2 are larger than priming effects from L2 to L1. The authors argue that these findings are indicative of a representational asymmetry in the two languages, where links between L1 words and conceptual representations are stronger than links between L2 words and conceptual representations. According to this model, L2 learners integrate conceptual differences in the two languages, identifying common elements (convergence), yet preserving their L1 conceptual system for L1 words and adopting the L2 conceptual system for representations for L2 words (a separatist tendency). The model then assumes a dynamic coordination of shared and separate conceptual representations. Shared or common conceptual components are equivalent across the languages, whereas separate elements are language and culture specific. The shared conceptual components outnumber the separate ones. Initially, an L2 word is linked to the L1-specific elements and the common elements, whereas with increasing proficiency a word will increasingly be mapped onto the L2 specific elements and links to L1 specific elements will weaken.

Whereas the three models presented above deal with the relationship between L1 and L2 lexical knowledge, the *Bilingual Interactive Activation + model (BIA+)* (Brysbaert & Duyck, 2010; Dijkstra & Van Heuven, 2002) is an extension of the Interactive Activation Model (McClelland & Rumelhart, 1981) and the Bilingual Interactive Activation Model (Dijkstra & Van Heuven, 1998), which were primarily concerned with visual word recognition in monolingual and bilingual subjects, respectively. The BIA + model has primarily dealt with visual word recognition in bilinguals, but is argued to also account for auditory word recognition, and the model includes phonological and semantic information components (Dijkstra & Van Heuven, 2002). Evidence for the BIA+ comes from a number of experimental studies using primarily lexical decision tasks and masked priming tasks. Interlingual homographs, i.e. words which are spelled in the same way in two languages but have different semantic content (false friends), and cognates have been of particular interest to these studies. The model assumes non-selective lexical access and an integrated bilingual lexicon, and extends these assumptions also to phonological and semantic representations. When a person reads (or hears) a

word, all words starting with the same letters (or sounds) will be activated simultaneously. Thus, multiple items compete until disambiguation. Activation of candidates depends on the frequency of the target word, and its neighbourhood density, i.e., the number of words which are similar to the target word. Non-selective lexical access means that neighbours from both languages are activated simultaneously, thus affecting target word recognition. This also means that the model can be extended to include more than two languages; with the addition of a new language, the number of words in the lexicon increases (Dijkstra, 2003). The model incorporates an aspect of L2 proficiency in the form of an assumption: the "temporal delay assumption" (Dijkstra & Van Heuven, 2002). Once orthographic representations become activated from input, they further activate phonological and semantic representations. Because L2 users have less experience with their L2 than their L1, yielding a difference in subjective frequency for word forms in the two languages, L2 representations will be activated later than L1 representations. According to Dijkstra and Van Heuven (2002), the temporal delay assumption can account for larger cross-linguistic effects from the L1 to the L2 than vice versa. However, the model does not seem to address aspects of development in L2 proficiency (Kroll et al., 2010).

The BIA+ model further distinguishes between the word identification system as such, and a task decision system which accounts for effects of the context of language processing on the output from the bilingual word recognition system. For instance, the task decision system can account for differences in results from experiments where participants have been asked to identify which language words belong to and experiments where participants have been asked only to indicate whether the word they are presented with is a word or a non-word, irrespective of language. While the BIA+ model primarily deals with word processing in bilinguals, it does not explicitly deal with the relationship between lexical representations (word forms) and semantic representations, i.e. representations on the conceptual level, other than in relation to interlingual homographs and cognates. Word recognition, with which the BIA+ deals, is driven by bottom-up activation of orthographic or acoustic features and their neighbours, i.e. lexical form. This activation includes forms in both the L1 and the L2. Word production, which is the concern of the RHM, may instead rely on top-down activation of semantic neighbours. Consequently, the time course of processing may be different in the two processes, as may the type of cross-linguistic activation. This can account for differences between the two models with respect to selective vs non-selective access (Kroll et al., 2010).

Neither the RHM nor the BIA+ discuss in detail the nature of conceptual/semantic representations, even though this level is incorporated into both of the models. The Distributed Features Model and the Shared Asymmetrical Model go some way in describing semantic representations as "nodes" or clusters of features. In section 3.2.2 the nature of semantic representations according to embodied and situated theories of language was discussed. It was argued that embodied and situated theories hold

word meaning to be distributed over modality-specific systems (Barsalou, 1999; Glenberg & Gallese, 2012; Glenberg & Kaschak, 2002). One question arises, therefore, as to whether semantic representations for words in the second language show the same type of neural activations as words in the native language, i.e., whether meaning in the L2 is also grounded. While brain-imaging studies of linguistic processing in the L1 have shown that word comprehension reactivates sensory-motor neural networks involved in experiencing the referents of the words (see for instance Hauk, Johnsrude, & Pulvermüller, 2004; Kiefer & Pulvermüller, 2012), such studies concerning L2 word comprehension are very few. Recently, however, a small number of studies have addressed this question. In a study investigating basic associations between L2 words and the sensorimotor system, Dudschig, de la Vega, and Kaup (2014) found that native speakers of German who had learned English as an L2 in school, but never lived in an English-speaking country at the time of the study, displayed reaction times similar to those of L1 speakers when presented with L2 words referring to entities in the world with different stereotypical locations (e.g., *bird* vs *shoe*) in a vertical Stroop paradigm. Critically, the task was to press a button either at the top of or at the bottom of a vertically positioned keyboard depending on the colour in which the word was presented. Results showed shorter reaction times when the direction of the motor response was congruent with the typical location of the word. For instance, responses requiring downward motion were faster when the word was *shoe* than when it was *bird*. The results were taken to indicate a strong and automated connection between linguistic representations and the sensorimotor system. The question remains, however, whether the facilitation for congruent motor responses stems directly from the L2 words or whether it is mediated by L1 translation equivalents. The latter interpretation is the one that would be predicted by both the RHM and the BIA+. However, the study included L1 words with the same meanings as the L2 words. If reaction times for L2 words were generally longer than reaction times for L1 words, this would be an indication that the facilitation in L2 words occurs only after translation into the L1 (Dudschig et al., 2014). However, no such difference in reaction time for L1 and L2 words was found, indicating that no translation takes place and that L2 semantic representations are accessed directly.

In an fMRI-study De Grauwe, Willems, Rüschemeyer, Lemhöfer, and Schriefers (2014) asked whether L2 semantic representations can be rich enough to activate sensory and motor neural systems in the brain. In the study, advanced German L2 learners of Dutch and a native Dutch control group made lexical decisions on motor and non-motor verbs which were presented visually. The study included simple Dutch-German cognates and non-cognates, and morphologically complex verbs with an opaque motor stem. Results revealed similar sensory-motor activations for simple verbs in both participant groups; simple motor verbs yielded higher activations in sensory-motor brain regions than simple non-motor verbs. Critically, this increased activation did not only emerge in cognates, but also in non-cognate words, something the authors take as an indication that the effects are not only due to transfer from L1 in the L2 participants. De Grauwe et al. (2014) conclude that L2 representations are

indeed rich enough to lead to activation in sensory and motor systems in the brain. Furthermore, they argue that these findings are consistent with models of the bilingual lexicon which assume shared semantic representations in L1 and L2, such as the RHM and the BIA+. The temporal resolution of the fMRI technique did not allow for an investigation of a possible delay in motor activation in L2 compared to L1 if semantic representations are mediated via L1, which would be predicted in the RHM.

While such studies are still very few, they do indicate that semantic representations in the second language can be embodied in nature. However, the question remains whether these effects are L1 mediated. Furthermore, what their role in L2 acquisition might be is still not clear.

The models discussed here continue to influence theories about the organization of the bilingual lexicon decades after they were first introduced. Recent theoretical approaches to the bilingual lexicon, however, tend to assume non-selective lexical access, consistent with the BIA+, to treat lexical representations as constellations of semantic features, consistent with the DFM, and to include an aspect of development in word knowledge with increasing L2 proficiency, as does the RHM. These are also the theoretical assumptions in the present study.

4.3.2 Vocabulary breadth and depth

It is impossible to know a language without knowing words of that language. Words carry meaning; no sentence can be understood if the words in that sentence are not understood. Vocabulary is therefore an important area of investigation in SLA. Knowing a word entails more than having stored it in long term memory. Also, knowledge of different word forms and links to other words in the vocabulary are important features of word knowledge. While the previous section dealt with the relationship between the L2 and the L1 lexicon and the link between L2 words and semantic representations, the present section deals with the internal organization of the L2 lexicon and properties of L2 word knowledge. L2 word knowledge can be investigated in several dimensions, including the number of words an L2 user knows, the type of knowledge the L2 user has about particular words, or whether the L2 user only recognizes a word or is able to use the word in freely produced sentences.

A distinction which is often made in SLA is the one between receptive and productive vocabulary. Receptive vocabulary refers to the words an L2 user can recognize passively. Productive vocabulary, on the other hand, is used for the words an L2 user can produce actively. Receptive knowledge of words is linked to reading and listening, i.e., to comprehension of input, whereas productive word knowledge implies that the L2 user can retrieve the word from memory and use it in speaking or writing to express an intended meaning (Laufer & Goldstein, 2004). L2 users are typically found to have larger receptive vocabularies than productive vocabularies, i.e., they understand more words

than they are able to produce actively (Fan, 2000; Laufer & Paribakht, 1998; Webb, 2008). This dimension of word knowledge is also referred to as *vocabulary strength* (Laufer, Elder, Hill, & Congdon, 2004). Passive recognition is easier than active recall, thus, this dimension of word knowledge relates to how automatic activation and retrieval of the word from long term memory is.

The correlation between vocabulary size and proficiency in L1 development is well-known (Bates & Goodman, 1997) and this relationship is also studied in L2 research. Researchers usually distinguish between two related aspects of word knowledge: *vocabulary breadth* (size) and *vocabulary depth* (Meara, 2010; Vermeer, 2001). Vocabulary breadth involves lexical diversity in a person's lexicon, i.e., the number of different words a person knows. Vocabulary depth refers to how well each of the words are known and involves a range of phenomena, such as knowledge of the number of meanings a word has, what its antonyms are, knowledge of how the word can be used, what register it belongs to, how it relates to other words, what is likely to precede or follow the word, etc. If a word is seen as a node in a network, vocabulary breadth relates to the number of nodes in the network whereas vocabulary depth relates to the interconnections between nodes, i.e. the density of the network (Meara, 2006). In fact, the very notion of vocabulary depth implicates meaning- and form-based networks for representations in the mental lexicon. However, the split between vocabulary breadth and depth may be an artificial one. In fact, measures of vocabulary breadth and vocabulary depth have been found to correlate highly in both monolinguals and bilinguals (Schmitt & Meara, 1997; Vermeer, 2001). This is hardly surprising. The denser a network around a word, the more links that word has with other words and the more possibilities there are for deepening word knowledge. The more words known, the more possible links between words there are. That is, the more words you know the more you are likely to know about each word. Vocabularies grow as a consequence of exposure to input. Input affects both vocabulary breadth, by exposing language users to new words which can be picked up, and vocabulary depth, by repeatedly exposing language users to words in familiar and new contexts; words used in combination with new words, in new situations of usage and in new forms.

Vocabulary size is an important measure of linguistic competence, both in the L1 and the L2. It has been found to correlate with a number of language skills such as reading, writing, grammatical knowledge, and lexical inferencing (Albrechtsen, Haastrup, & Henriksen, 2008; Laufer, 1992; Laufer & Ravenhost-Kalovski, 2010; Schmitt, 2010). In English, around 8,000- 9,000 words[1] are needed to read novels and newspapers whereas about 6,000-7,000 words are needed to follow a conversation (Nation, 2006). A university level L1 English speaker has a vocabulary of about 17,000 word families (Goulden, Nation, & Read, 1990). Adequate reading comprehension, i.e., a level at which the reader understands the majority of the words in a text and can infer the meaning of remaining ones, in L2

[1] Nation uses the term *word-families*. Word-families include paradigmatic variation over a word stem and as such contain inflected words (*work – works – working*) and derivations (*nation – nationally - nationalism*), an aspect of knowledge which in other accounts may rather be assumed an aspect of vocabulary depth.

English has a threshold of around 4,000-5,000 words (Laufer & Ravenhost-Kalovski, 2010). The French B1-level (Common European Framework, CEFR) includes approximately 2000 words (David, 2008; Milton, 2006). Vocabulary breadth is closely related to word frequency. High-frequency words are learned earlier than low-frequency words as they are encountered more often. As it is impossible to test all the words a speaker knows, tests for vocabulary size are typically designed to give a gauge of overall vocabulary size on the basis of a selection of test items. One much used test for vocabulary size is *Nation's Vocabulary Levels Test* (Nation, 1983), which tests receptive vocabulary. In this test, the format is based on a series of levels determined by word frequency. The levels, or frequency bands, consist of groups of 1000 words, where the first level contains the 1000 most frequent words, the second level the next most frequent 1000 words etc. A limited number of words which are claimed to be representative of each of the frequency bands are sampled in the test. In this way, overall vocabulary size can be estimated. Similar tests for productive vocabulary also exist (Laufer & Nation, 1995, 1999). The *Computer Adaptive Test of Size and Strengh* (Laufer et al., 2004; Laufer & Goldstein, 2004) is another which in addition includes the receptive vs productive vocabulary dimension. In the early stages of L2 acquisition, vocabulary breadth seems to be a critical factor in how L2 users perform, however, at later stages, when the L2 user has developed increased proficiency and already possesses a vocabulary of a certain size, a further increase in vocabulary does not affect performance to the same extent (Meara, 2010). In similar lines, Laufer (1991) found that in advanced L2 learners, receptive vocabulary continued to grow whereas productive vocabulary did not after a certain "active vocabulary threshold" was reached. David (2008) studied the development of receptive vocabulary in English learners of L2 French. An interesting finding in her study, was that students in their second and fourth year of learning French had a lexical profile that differed from those of more advanced learners; they knew relatively many low-frequency words compared to high-frequency words. According to David (2008), a possible explanation is that the thematic structure of teaching materials leaves the students with skewed input profiles; while high-frequency words such as prepositions and verbs were poorly mastered, the students typically knew the names of fruits and vegetables, which are words of substantially lower frequency.

Vocabulary depth may be even more difficult to test than vocabulary size. Tests for vocabulary depth typically include only a limited number of test items. The most common method for assessing depth of lexical knowledge is using word-association paradigms (e.g., Vermeer, 2001). Participants are given a prompt word and respond by saying the first words or words that come to mind. Word-associations, thus, reveal how words are linked in a person's mind. Associations can be made along several dimensions, such as semantic associations (*dog-cat-rabbit* etc.) or sound-similarity associations (*reflect-effect-affect*). In L2 research word-association tests have been used to examine how lexical knowledge is structured in L2 users compared to native speakers. For instance, L2 users have been found to make more associations on the basis of sound-similarity than native speakers,

furthermore, L2 associations based on meaning are often quite different from those of native speakers and reveal incomplete knowledge of a word's meaning (Schmitt & Meara, 1997). But vocabulary depth develops over time, and L2 users' performance on word-association tasks changes as a function of L2 proficiency. Studies by Zareva (2007) and Zareva, Schwanenflugel, and Nikolova (2005) show that with increasing proficiency, L2 users get word-association results which resemble those of L1 speakers. Zareva (2007) found that while at intermediate levels of proficiency L2 users produced fewer and less diverse word associations than native speakers, advanced L2 users produced word associations which were equal in size to those of native speakers, but with slightly more variation in responses. Intermediate level L2 users also displayed considerable within-group variation in responses, while advanced users were more consistent in their responses. Such findings are indicative of a gradual structuring of semantic representations in L2 users.

A notion which is linked to vocabulary depth is *entrenchment*. Entrenchment refers to the process by which a word becomes consolidated and so deeply rooted in long term memory that it can effortlessly and reliably be retrieved and activated (Langacker, 1987; Schmid, 2007). Consolidation of linguistic knowledge happens over different timeframes. The initial entry of a word into the lexicon happens over a matter of hours. However, there is evidence that a certain amount of off-line integration is necessary. In spoken word recognition, multiple lexical candidates compete for activation as the acoustic signal unfolds and until one word can be uniquely identified. A possible measure for the establishment of a novel word into the mental lexicon is therefore the point at which it shows sign of lexical competition with other items in the lexicon (Lindsay & Gaskell, 2010). A number of studies have shown that a novel word can be recognized immediately after initial exposure, indicating that some types of word knowledge can be learned swiftly, however, the novel word does not engage in lexical competition until one to four days after initial exposure, indicating that integration into a lexicon of already existing items takes longer (Davis, Di Betta, Macdonald, & Gaskell, 2009; Gaskell & Dumay, 2003). Moreover, the establishment of stable lexical representations in the neocortical systems of the brain has been found to be impacted by sleep (Dumay & Gaskell, 2007; Lindsay & Gaskell, 2010). The same effect of sleep has been found also for the establishment of L2 words into the lexicon (Gais, Lucas, & Born, 2006). Overnight consolidation thus ensures the rapid establishment of a novel word into long-term memory so that it becomes part of the mental lexicon. Such an establishment is of course crucial for retrieval and activation of the item and for further consolidation and integration into semantic lexical networks. In a study measuring event-related potentials (ERPs), McLaughlin, Osterhout, and Kim (2004) found that adult second-language learners' brain responses were sensitive to the difference between a word and a pseudo-word (nonword) in the target language after only a limited number of hours of L2 instruction. When the same participants were asked to make lexical decisions (word/nonword) no such difference was found. This indicates that certain types of word knowledge develop very quickly, even in adult L2 learners. McLaughlin et al. (2004)

argue that this kind of knowledge *about* word forms may serve as a prerequisite for further development of the word forms themselves, and for their integration into the mental lexicon. This growing knowledge further affects the ability to develop new knowledge, as the already established knowledge is exploited in subsequent learning processes (Kuhl & Rivera-Gaxiola, 2008; Mather, 2013; McMurray, 2007; McMurray, Horst, & Samuelson, 2012). Entrenchment, however, is a type of consolidation that works over a long timeframe, possibly years. It develops as a consequence of repetition of cognitive events; the degree to which a linguistic unit is entrenched depends on its frequency of use. Repeated exposure to and use of a linguistic unit leads to routinized activation of the unit in long term memory. Thus, well-entrenched lexical units are more easily selected for activation in lexical retrieval than other word candidates (Schmid, 2007). It follows from this that entrenchment is an aspect both of vocabulary strength, i.e., receptive vs productive word knowledge, and of vocabulary depth. Entrenched linguistic knowledge may facilitate the establishment of new words in the lexicon, serving as scaffolding for the new words, however, they may also inhibit new structures from becoming established (Schmid, 2007). In L2 acquisition, there is a considerable asymmetry between the well-entrenched L1 lexicon and the developing L2 lexicon. According to Ellis (2008b), L1 entrenchment is a source for transfer from the L1 to the L2, limiting the end-state of L2 acquisition, particularly in the absence of form-focused instruction. This is due to the fact that L2 learners come to the language learning task with a neural state which is marked by their L1 experience.

In section 4.3.1 we saw that the Revised Hierarchical Model assumed links between L2 words and conceptual representations which develop with increasing L2 proficiency. The development of these links can be accounted for in terms of entrenchment; with growing proficiency, L2 word forms become so well established in the mental lexicon that semantic knowledge is activated directly via the L2. While the Distributed Features Model is primarily concerned with L2 word knowledge at a set time in L2 development, it is possible to think of entrenchment as a process by which L2 users readjust their mappings of L2 words to constellations of semantic features as a consequence of repeated exposure to and use of the L2 words. This is for instance compatible with feature-assembly approaches to L2 acquisition (Stringer, 2011) and with theories of conceptual restructuring (Jarvis & Pavlenko, 2008; Pavlenko, 2009). All in all, the acquisition of words in the L2 must be understood as dynamic process where lexical knowledge develops and stabilizes over time. As L2 proficiency increases, an initially sparse lexical network in the L2 develops into a denser, more structured one where words can be reliably activated and retrieved, and where semantic representations for the L2 words grow rich enough that meaning can, possibly, be embodied.

4.4 Theoretical background – a brief summary

Spatial language and second language acquisition are both important fields of study with extensive research literatures. Sections 3 and 4 have provided an overview of the theoretical background for the present study from both fields. First, spatial expressions in Norwegian and French, theories about the semantics of spatial prepositions, and the Functional Geometric Framework (FGF) were discussed. Then views on the relationship between spatial language and spatial thought were introduced. In the FGF, the meaning of spatial prepositions is seen as deriving from the integration of multiple constraints: geometric routines, dynamic-kinematic routines, and object knowledge. The model predicts a flexible relationship between conceptual representations and semantic representations for prepositions. In the next section, central theoretical points of view and areas of inquiry in SLA were introduced. The main focus was on word learning in the L2; models of the bilingual lexicon and theories about lexical size and strength were discussed.

In the present thesis, a link between theories about the semantics of prepositions and theories about the development of lexical knowledge in the L2 is drawn. The acquisition of spatial prepositions in the L2 is seen as a specific type of L2 word learning. Spatial prepositions are treated as lexical items which have to be stored in the L2 user's mental lexicon and become entrenched enough for routinized receptive and productive retrieval. Furthermore, the assumption is that L2 preposition knowledge develops in depth during the process of entrenchment. In the present study, a model of the bilingual lexicon where conceptual representations consist of semantic features which are largely shared across the languages but may differ in how they are bundled on lexical heads is assumed. With this approach to the nature of semantic representations, the FGF represents a fruitful framework for the study of L2 spatial prepositions as is assumes the meaning of spatial prepositions to stem from the integration of multiple constraints, both perceptual routines and stored language-specific lexical knowledge.

The next section, Section 5, provides a thorough description of the test material used in the experiments which are presented in the three papers and the methods used to analyse the data. In Section 6, the main findings of the three papers and their implications are presented and discussed. An overall conclusion is found in Section 7.

5 Material and methods

In the present thesis, data consists of acceptability judgements and preposition production. Both types of data were elicited using the same sets of visual and linguistic stimuli. Papers I and II deal with acceptability ratings for prepositions used to describe static spatial scenes where the geometric and functional relationships between the located object and the reference object are systematically changed. Acceptability ratings were collected from three groups of participants. Paper I deals with acceptability ratings from two groups of native speakers: 24 L1 speakers of French and 26 L1 speakers of Norwegian. In Paper II, data comes from acceptability ratings from 28 Norwegian L2 speakers of French. Furthermore, these data are compared to data from the same two native-speaker groups as in Paper I. Paper III deals with prepositions used to describe the same static spatial scenes by two groups of Norwegian L2 speakers of French, namely 22 students who had just begun their first semester of French studies at university level and 23 students who were approaching the end of their second semester of French studies. In addition, Paper III looks at acceptability judgments from the same 28 L2 participants as in Paper II, but now from an L2 proficiency perspective.

Test material end experimental designs are described in each paper. In this section, I provide a more thorough description of the test material and the design of the experiments than the article format allows for. Theoretical and practical considerations and concerns are discussed. The section ends with a description of statistical methods and a discussion of considerations regarding selection of data for analysis.

5.1 Ethics

The project, methods for recruitment of subjects, information to participants and questionnaires eliciting background data about them, as well as the procedures for handling participant data and subsequent anonymization of these were approved by the Norwegian Social Science Data Services (Norsk samfunnsvitenskapelig datatjeneste). A total of 123 subjects participated; all were over 18 years old at the time of the study. Prior to participation, all subjects gave written informed consent. Information was given in each participant's native language. Information and consent forms in both Norwegian and French are included in the appendix, section 9.4.1.

5.2 Test material and design

I am grateful to Kenny Coventry for the use of the pictures in the experiments presented in this thesis. The pictures were originally used in AHRC grant number 112211 awarded to Kenny Coventry and Pedro Guijarro-Fuentes, for a large scale study of the knowledge of spatial preposition meaning in L2 Spanish and L2 English. Copyrights to all the images belong to Kenny Coventry.

The test material used in the present project consisted of eight picture series comprising a total of 120 pictures. The picture series targeted different types of spatial relationships where geometric and

functional properties were systematically changed. Each picture was accompanied by a sentence of the form *The located object is _____ the reference object*. One French and one Norwegian version of the test material were used, the only difference between the two being the language used in the sentences. An example of the stimuli is shown in Figure 9.

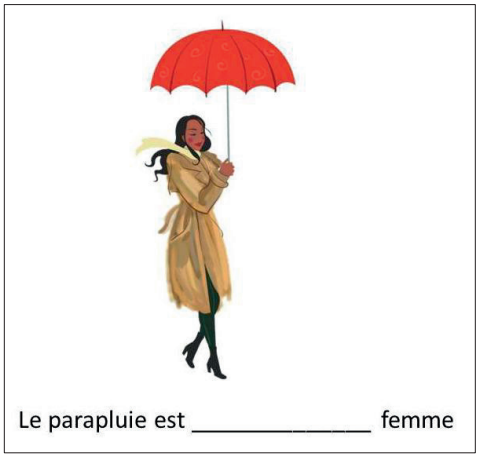

Figure 9 Example of stimuli, French version.

The type of test material used in the present thesis, where a depiction of a spatial scene is linked to a linguistic description of that scene, is widely used in research on spatial language. In fact, using a combination of visual and linguistic stimuli is the established research paradigm within the spatial language domain. Such test material encompasses types of spatial situations studied both theoretically and experimentally from the mid-1980s to the present. Many of the spatial scenes which have been studied in the domain can be recognized from Vandeloise's (1986) and Herskovits' (1986) early work on spatial preposition meaning in French and English, respectively. Also other types of research on spatial language, such as research on variation in the linguistic encoding of space across languages, have used pictures either in eliciting spatial descriptions or as cloze tests. The Topological Relations Picture Series (BowPed) (Bowerman & Pederson, 1992) is perhaps the most well-known type of stimuli in the domain. The type of images used in the present thesis, where systematic changes to geometry and object functionality are shown in a series of pictures, is established as a paradigm for research on spatial prepositions. Such images have been used primarily for research on English spatial language, but to an increasing extent also for research on spatial expressions in other languages[1] (Carlson-Radvansky et al., 1999; Carlson-Radvansky & Radvansky, 1996; Coventry et al., 1994; Coventry & Garrod, 2005; Coventry & Mather, 2002; Coventry & Prat-Sala, 2001; Coventry et al.,

[1] Here I have listed only studies of static spatial language, but the combination of visual and linguistic stimuli is also frequently used for research on the expression of motion events or cutting and breaking events across languages (A. Brown & Gullberg, 2011; Jessen, 2014; Majid, Gullberg, Staden Miriam, & Bowerman, 2007; Malt et al., 2008; Vulchanova, Martinez, & Vulchanov, 2013).

2001; Feist, 2008a, 2008b; Feist & Gentner, 2003; S. Garrod et al., 1999; Hörberg, 2008; Richards, 2001; Richards et al., 2004).

In the present thesis, data from four of the eight picture series included in the test material was analyzed. These picture series were: a) Series I: Lady – umbrella, 18 pictures, b) Series II: Bowl – box, 12 pictures, c) Series III: Apple – bowl – plate, 24 pictures, and d) Series IV: Hand/dish – fly/lock, 12 pictures, 66 pictures in total. Series I and II involve spatial relations along the vertical axis, whereas Series III and IV involve topological spatial relations. These spatial scenes can typically be described by topological spatial prepositions, such as *in* and *on*, and projective prepositions, such as *over* or *under*. Paper I gives a full description of the systematic changes to geometry and function over the pictures in each of the four picture series, and examples of the pictures and manipulations are shown in the appendix of the paper. I will therefore not go into the details of the manipulations here. The remaining four picture series, containing a total of 54 pictures, served as fillers in the experiments eliciting acceptability judgments. These four series were: a) Filler Series I: a postman located relative to a post box, 8 pictures, b) Filler Series II: a ball located relative to a car, 8 pictures, c) Filler Series III: a dot located relative to a circle or an arrow, 26 pictures, and d) Filler Series IV: 12 pictures of the BowPed type. Filler Series I, II and III involve spatial scenes where at least two types of reference framing can be felicitously used for the description of the spatial relationships. Such scenes are usually described with prepositions like *left of, right of, next to, in front of, behind*. Filler Series IV included various pictures showing spatial situations inspired by the Topological Relations Picture Series, such as flowers in a vase, an owl in a tree, a cat on a mat, and a handle on a door.

To sum up, the same visual and linguistic stimuli were used both for the experiments eliciting acceptability judgments (henceforth *rating experiments*) and for the experiment eliciting preposition production (*production experiment*). However, the test setup and procedures were different for the two types of experiments; the rating experiments were web based with participants logging in from their home computers whereas the production experiment was paper-and-pen based and conducted in a classroom with the experimenter present. Before I go on to describe these two procedures in more detail, I will give an account of how the linguistic stimuli were adopted to Norwegian and French. This section is followed by a discussion of the test which was used to measure French proficiency in the L2 participants.

5.3 Adaptation of the test material to Norwegian and French – a pilot study

Whereas the visual stimuli were left unchanged from Coventry and Guijarro-Fuentes' study, the linguistic stimuli had to be adapted to Norwegian and French. This was done in two stages. First, the sentences used to describe the spatial scene in the pictures were translated from the original test

material, which was in English and Spanish[1]. As a native speaker of Norwegian I did the translation into Norwegian myself, before discussing the translation with native Norwegian colleagues. Norwegian has two written standards, *bokmål* and *nynorsk*. Here, *bokmål* was chosen as it is the most widely used standard. I also did the initial translation into French. This translation was subsequently checked by two native speakers of French with knowledge of both English and Norwegian.

Translations had to take into consideration the characteristics of the depicted objects as discrepancies between the label used for an object and the visual stimuli could affect acceptability ratings. The labels used in Norwegian for the reference and located objects were kept as close to the original English labels as possible; *box* was translated as *boks*, *bowl* as *bolle*. The same applies to the French version. However, following feedback from the native speakers I consulted, some of the French labels are more specific than the original English ones. For instance, whereas *box* was translated as *boîte*, *bowl* was translated as *saladier*. There is a French noun *bol* which could potentially have been used, but according to the native French speakers, *saladier* was a better match to the visual stimuli. As we saw in section 3.2.2.3, the label itself, particularly for the reference object, influences the choice of spatial preposition. In cases where the object label entered into the experimental conditions, i.e., where the label used could influence preposition choice, Norwegian and French labels which displayed the same properties in terms of combining with prepositions as labels used in the original English study were chosen as far as possible. The label *dish*, for instance, was translated as *skål* in Norwegian and *assiette* in French since they can combine both with prepositions denoting containment (*in*) and prepositions denoting support (*on*) depending on the shape of the object. Copula sentences were retained in both the Norwegian and the French translation of the linguistic stimuli in order to avoid any influence from the verb on the choice of preposition (see also section 3.1.4). The resulting French and Norwegian sentences are shown in the appendix (section 9.1)

In French certain prepositions coalesce with the definite article of their complement noun. This varies depending on the gender of the noun. The preposition *de* followed by the masculine article *le* becomes *du*, whereas *de* followed by the feminine article *la* remains *de la*. Thus, there is a difference in form between *La boîte est au-dessus **du** saladier* and *Le saladier est en dessous **de la** boîte*. In the French version of the test, therefore, the definite article of the second NP was left out (see Figure 9 above). Rather, prepositions were presented with the appropriate article, and in the appropriate form, i.e., participants rated expressions such as *au-dessus du* and *sous la*. This was done in order to prevent any interference from grammaticality judgment on the acceptability judgments in the rating experiments and in order not to impose preference for certain prepositions or induce grammatical errors in the production experiment. In Norwegian, definite articles are realized as suffixes: *-en* in the masculine, *-a* in the feminine, and *–et* in the neuter. Presenting expressions combining the prepositions and the

[1] Translations were based on the English version only.

definite article for rating was thus impossible in the Norwegian version of the test. Linguistic stimuli had the form *Dam**a** er ____ paraply**en*** (Lady-DEF is _____ umbrella-DEF) and the prepositions alone were presented for rating.

Simply "translating" prepositions which had been used in the English/Spanish version of the study into Norwegian and French proved difficult, primarily because the prepositional inventories of these languages differ from those of English and Spanish. The second stage of the adaptation, therefore, consisted of a pilot study with the aim of identifying which prepositions native speakers of Norwegian and French may use to describe the spatial relations depicted. 6 L1 Norwegian and 6 L1 French participants were recruited for the pilot study among colleagues at NTNU and from extended acquaintances. These participants were not systematically screened for other native languages, dialect background or knowledge of other languages, but, to the best of my knowledge, none of the participants had more than one native language whereas all had knowledge of English as a second language. Some participants were formally trained in linguistics, but the majority were not.

Participants in the pilot study were presented with the entire test material of 120 pictures, either as an electronic document (Adobe Acrobat pdf – schema version, or Microsoft PowerPoint), or on paper. The pictures were semi-randomized so that pictures from the same series did not immediately follow each other. Participants were asked to fill in a preposition of their choice in the incomplete sentences. There were no restrictions on preposition usage. In both languages both complex and simple prepositions were produced. Participants were asked not to go back in the document to check their previous answers, but nothing more was done to prevent this. The results from this pilot study served as a basis for the selection of prepositions to be included for rating in the main study.

5.4 Measures of proficiency in L2 French

A total of 73 L2 French participants took part in the main study in the present thesis. They were former and current students of French at university level. They were at different stages in their French studies, from first-year bachelors' students to participants who had completed their masters' degree in French. Participants' proficiency in L2 French was measured in two ways: using participants' answers to a self-evaluation questionnaire and their score from a placement test.

The self-evaluation questionnaire asked participants to indicate their level of proficiency in French for each of the domains *reading*, *writing*, *speaking* and *listening*, as well as their *overall proficiency*. They did this by ticking boxes marked *grunnleggende* (basic), *middels* (intermediate), *avansert* (advanced) or *flytende* (fluent)[1]. This self-evaluation was included in the background information questionnaire all participants had to fill in.

[1] The questionnaire can be seen in the appendix, section 0.

The second measure of proficiency was a placement test for French courses, an online test used at the Oxford University Language Centre - http://www.lang.ox.ac.uk/courses/tst_placement_french.html. This test contains 50 sentences of increasing difficulty. The sentences test for both grammatical and lexical knowledge. They cover subject-verb agreement, tense (*présent, imparfait, passé composé, futur, conditionnel*), mode, pronouns, clitic placement, negation, past participle agreement, and lexical knowledge. The test is a cloze test with a multiple choice setup. Participants select one of four given answers for each sentence. There is one point for each of the 50 sentences, and one point is lost for each error. The online test is auto-correcting and gives the obtained score once it has been completed. Participants in the rating experiments (see section 5.5.1) were provided with the link to the test, completed it at home and only reported the score they achieved. The participants in the production study (see section 5.6.1) completed a paper-and-pen version of the test. I scored the test manually. The participants were told their result if they provided an e-mail address to which it could be sent; this was however optional.

The purpose of the proficiency measure for the present study was not to sort participants into experimental groups based on their test score, but to establish that participants had a sufficiently high proficiency level in the L2 to be able to understand the tasks and answer the questionnaires adequately. Furthermore, the test was used as a background measure for proficiency levels in two groups of L2 users who were thought at the outset to differ in proficiency levels, given that they were tested at two ends of the academic school year. However, in Paper III, I do argue that there is a reliable difference in proficiency level between the two L2 groups on the basis of this test. In the same paper, I go on to grouping the L2 participants from the rating study into two different groups based (mainly) on their results on this proficiency test. The validity of such a grouping based only on self-evaluation reports and this proficiency test alone can of course be discussed. In Paper III, the (upper) intermediate group and the advanced group differ only in how consistent ratings are within each group, not in how their acceptability ratings are affected by the experimental manipulations, i.e., changes to geometry and functionality. Thus, one could ask whether this particular proficiency test is sufficiently powerful to correctly detect and distinguish between proficiency levels.

There are a number of issues connected to this test as a measure of proficiency in French for L2 French Norwegian users. One issue is that the test is short, thus only testing a limited number of linguistic constructions. Moreover, the multiple choice setup with four alternatives means participants can guess and still have a 25 % chance of getting the answer correct. Indeed, some of my colleagues in linguistics with little knowledge of French took the test and came out with a score in the intermediate level range (20-30 points). Clearly, formal linguistic training combined with some knowledge of French may contribute towards relatively high scores on this test. Still, the range of scores obtained by the participants on the proficiency test does not indicate that scores are inflated. The lowest score obtained by any of the participants was 15 out of 50, a score which is only slightly

above chance. The highest score obtained was 48. As mentioned above, the sentences in the placement test are presented with increasing complexity and difficulty. The first few questions deal with the present tense, as in *Mes parents* ***écoutent*** *la radio tous les matins*, typical beginner-level expressions such as *J'****ai*** *18 ans*, and *J'habite* ***à*** *Paris,* ***en*** *France*, and the passé composé-imparfait distinction, as in *Je regardais la télévision depuis une heure quand il* ***est arrivé***. The last questions in the test deal with far more complex sentence structures and topics which are typically covered only later in FLE[1] classes: past participle agreement, as in *Elles se sont* ***acheté*** *une maison*, the use of the subjunctive in specific constructions, for instance *C'est vraiment dommage qu'il* ***n'ait pas pu*** *venir*, *Elle se lamentait sans cesse pour qu'on la* ***plaigne***, and the use of the passe simple, as in *Napoléon 1*^{er} ***fut*** *proclamé empereur en 1804* (where options were *fit, fuit, fut*, and *eut*).

A look at the distribution of scores over the first and second half of the proficiency test for participants obtaining less than 20 points (N=13), shows that they get an average of 79,3 % of their points on the first 25 question and only 20,7% on the subsequent 25 questions. The distribution of scores for all these participants is shown in Table 1.

Table 1 Distribution of scores in first and second half of placement test for participants with a total score below 20

Participant	Question 1-25 Score	%	Question 25-50 Score	%	Total score
1	11	68,8	5	31,3	16
2	15	83,3	3	16,7	18
3	15	78,9	4	21,1	19
4	12	66,7	6	33,3	18
5	12	80,0	3	20,0	15
6	13	76,5	4	23,5	17
7	16	88,9	2	11,1	18
8	15	78,9	4	21,1	19
9	12	66,7	6	33,3	18
10	14	73,7	5	26,3	19
11	17	89,5	2	10,5	19
12	17	100,0	0	0,0	17
13	15	78,9	4	21,1	19
Average	14,2	79,3	3,7	20,7	17,8

This indicates that the proficiency test does indeed measure some aspects of competence in French rather than mere guess work. Furthermore, results on the proficiency test are mirrored in results from the self-evaluation questionnaire. Of these 13 participants, 7 have rated their competence in French to be "basic" and 6 have rated their competence to be "intermediate", however, of these 6, 3 have ticked

[1] Français langue étrangère = French as a foreign language.

the line between the box for "basic" and the box for "intermediate". See paper III for a presentation of these results for the L2 group as a whole.

Another issue is that the test is designed for English learners of French. It does, for instance, contain sentences targeting English and French faux amis, such as *similaire* vs *similar*. These do not represent faux amis in French and Norwegian. Although Norwegian learners of French are likely to take advantage of their knowledge of English, particularly in the domain of vocabulary, they may be less inclined than native speakers of English to select English-French cognate terms. On the other hand, other choices of vocabulary are presented alongside the cognate, most often with overlapping semantic content, and as such these sentences still test for overall knowledge of French vocabulary. Even though the test has not been tailored to particular Norwegian – French differences in vocabulary, it does include expressions which are problematic for Norwegian L2 learners of French: *tout droit* vs *à droite*, the difference between *beaucoup, trop, très*, and *tellement*, etc.

There is a trade-off between a comprehensive test of participants' L2 proficiency, and the need for a test which is not too long or tedious for participants to complete. If collection of background measures is so extensive it causes fatigue in participants, there is a risk that participants give up or that they are not really attending to the task during in the experimental phase of the study. Aspects of experimental design such as the medium of testing and the setting in which participants are tested also needs to be taken into consideration. Although the test used here has limitations like those mentioned above, it was still thought to be sufficient for the purposes of the present study. The nature of the design of the present study, where the majority of experiments were web based, determined not only the setup of the experiment proper, but also placed demands on the set up of the proficiency test. It too had to be web based, so that participants could easily click through the test at home. It also had to be automatically scored so that participants could report their result on the test. As the analyses above show, the test does tap into L2 French proficiency. As these results are also mirrored in the self-evaluation reports, maintaining that the proficiency test has been sufficient for the purposes of the present studies does not seem unwarranted. Still, these proficiency measures should of course be used with caution.

5.5 Experiments collecting acceptability judgment data

5.5.1 Participants in the rating studies (Paper I and Paper II)

Participants in the experiments eliciting acceptability judgments, i.e, the rating studies reported in Paper I and Paper II, were recruited in the following way: L1 Norwegian participants (N=26) were recruited mainly among students and staff at NTNU. L2 French participants (N=28), who were all native speakers of Norwegian, were recruited among past and present students of French at NTNU. L1 French participants (N=24) were recruited at the Université de Caen Basse Normandie and among

French exchange students at NTNU. The exchange students completed the experiment only a few weeks after their arrival in Norway. They had no knowledge of Norwegian at the time of the study.

Participants were asked about additional L1s, and anyone indicating more L1s or other L1s than Norwegian or French was excluded from the study. Furthermore, participants were asked about their knowledge of other languages. All participants knew English as a second language, whereas some had additional knowledge of Spanish or German. Norwegian participants were asked about their dialectal background. Among participants dialectal background varies, with no dialect being especially prominent. Thus, L1 Norwegian results should not be influenced by a particular regional choice in preposition usage.

5.5.2 Test setup and procedures

The experiment collecting acceptability judgments was web based. A normal format in this type of study is to invite participants to a specific location, either all at the same time or individually, and have them respond to a questionnaire by hand or on a computer in a lab. The web based solution used in the present study was chosen primarily for practical reasons. Participants in the present study had to be recruited from two different countries and from different locations. Having to come to the lab at a scheduled time would constitute an inconvenience to potential participants which could deter them from participating at all. Setting up test locations near the participants would also have been impractical. In addition, digitalizing experiments simplified data collection and retrieval, and reduced possible errors in data registration.

Because the rating experiments were set up to be web based, the format of the experiment had to fit that medium. A type of format suitable for testing in a laboratory supervised by experimenters would not be equally suitable for a web-based format where participants log in from wherever they may have access to a computer and an internet link, at whatever time of day. A main objective in setting up the test was therefore to avoid boredom and fatigue, which would severely affect the quality of answers and set the scene for too much uncontrolled error.

The 120 pictures in the test material were therefore divided into three different parts of approximately the same size, called Test A, Test B, and Test C. The three test parts are shown in the appendix (section 9.3). Test A included the pictures in Series I: Lady - umbrella, Filler Series I: Postman – post box, and half of Filler Series III: Dot – circle - arrow. It contained a total of 39 pictures. Test B included pictures from Series II: Box - bowl, Series IV: Hand/dish – fly/lock, and the other half of the pictures in Filler Series III: Dot –circle - arrow. A total of 37 pictures were included in Test B. Test C, which consisted of 44 pictures, contained pictures in Series III: Apple – bowl - plate, pictures from Filler Series II: Ball - car, and Filler Series IV which contained pictures inspired by the Topological Relations Picture Series (BowPed). None of the test parts contained more than one picture series

relating to the same type of spatial relationship. Filler Series III: Dot – circle - arrow was divided over two test parts depending on the reference object involved: pictures with arrows in Test B and pictures with circles in Test A. The purpose was both to avoid fatigue in participants and to ensure that the three test parts were of equal length.

Each part was estimated to take between 30 and 45 minutes for the participants to complete. This was considered close to the upper limit of time one can expect participants to stay attentive in an unsupervised experimental setting. Therefore the different picture series in the three parts acted as fillers for each other, with no other types of fillers included. It was a deliberate consideration to keep entire series in the same test part rather than spreading pictures randomly over the three parts. In cases where participants failed to complete all three parts, data for individual picture series might still be used as long as the participant had rated all the pictures in that series. This design therefore led to less loss of data in cases of discontinuation than what would be expected of a fully randomized partition of the pictures.

Within each part, pictures were completely randomized. This was an automatic feature of the web based design. No participant therefore got to see the pictures in the same order. If a participant left the experiment before one part was finished, and started the same part at a later time, he or she would get the images in that particular part in a different order form the first time. In theory, a participant could get all the pictures from one series consecutively. Given that there were approximately 40 pictures in each test part, this is however unlikely. Participants could complete one part at a time, or, if they preferred, go through all three parts consecutively. If they stopped before a part was completely finished, they had to start that particular part over again when they continued the experiment. Participants were informed of this when they received their participant code, link to the experiment and instructions.

For each picture, a set of 8-11 prepositions were presented for rating. The prepositions were the same for all the pictures in one picture series. They differed, however, from one series to another. With each picture series, only prepositions relevant to the type of spatial relationship were included. An overview of prepositions per picture series can be found in the appendix, section 9.2. The order in which the prepositions were presented for rating was completely randomized. For each picture in a series, then, prepositions appeared in different orders. This was also an automatic feature of the design. Together, the two randomization features ensured that no participant saw the pictures in the same order, nor the same picture with the prepositions in the same order.

In the test setup, the image and the sentence appeared in the upper half of the screen, whereas prepositions appeared below the image, in the lower half of the screen. Above the image was a field indicating the progression through the three parts of the experiment (Test A, B or C) and the

progression through the images in each part (image number x of 39). Figure 10 shows how the test appeared to the participants.

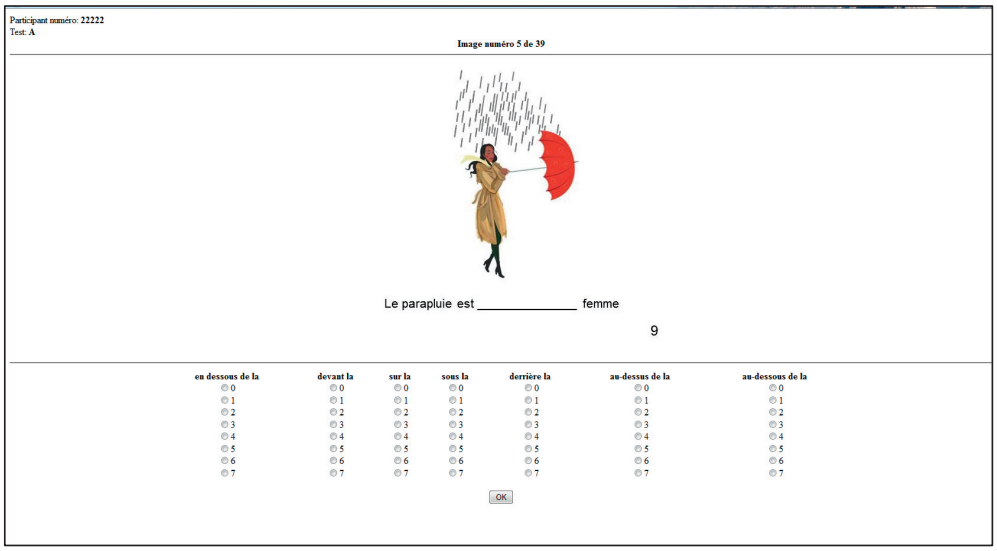

Figure 10 Screenshot of test layout in the L1 French version of the test.

In order to progress to the next image, participants had to rate all of the given prepositions. If they did not, they were given an error-warning and then returned to the same image. The layout of the test itself did not allow participants to go back to look at previous answers. It was, however, possible to do so using the browser back and forward buttons.

The experimenter had access to an administration page where the progress of each participant could be followed. It gave the following information about progression: Not started, Test A completed, Test B completed, Test C completed. When participants signed up for the experiment, they were given a deadline for completing all three parts of the test. However, no participant was excluded from the experiment for failing to meet the deadline, and participants were given extra time if needed. Participants had different strategies for completing the experiment. Some went through all three parts consecutively, whereas the majority of participants completed the parts on different days. Some participants needed prompts or reminders so that they would complete all parts of the study. Still, a number of participants never completed more than one or two parts of the experiment.

Participants logged in using a ten-digit participant code provided by the experimenter. In the beginning of each part, an instruction page told the participants what to do. The instruction page contained a description of the task, detailed information about the rating scale, and an example. The L1 French group was given instructions in French. The L1 Norwegian and the L2 French group were given instruction in Norwegian. The language of instruction may affect the outcomes of these types of

task, priming the participant for thinking in a way consistent with the language used in the task instruction (Boroditsky, Ham, & Ramscar, 2002). The decision to provide instructions in Norwegian for the L2 French group was made on the basis that participants needed to fully understand what the task was and how the rating scale worked. Given that the level of proficiency in French might vary in the L2 group, it was decided that Norwegian was the best suited language for instruction. Still, the task example was provided in French for the L2 French participants. Note, however, that all other aspects of the test were identical for L1 French and L2 French participants. The lay-out of the instruction page was identical in the two languages, as was the example given. The instruction page for L2 French participants is shown in Figure 11.

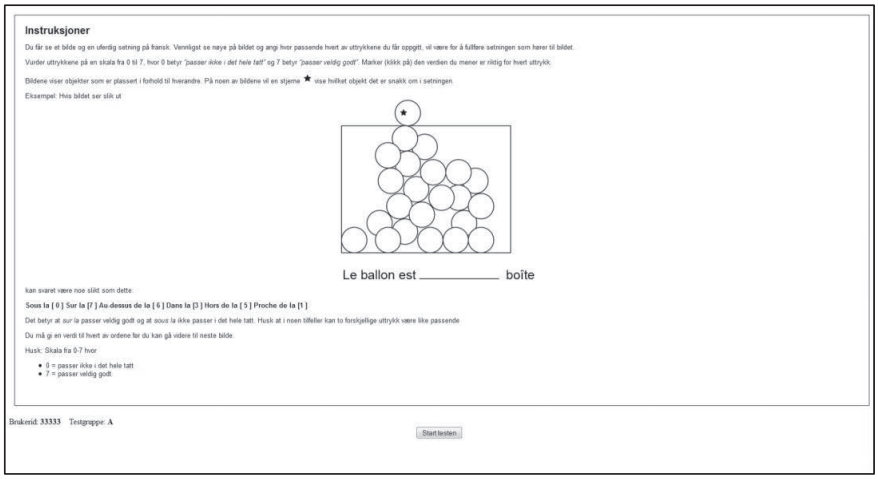

Figure 11 Screenshot of instructions for the L2 French group. The text is in Norwegian whereas the example, with accompanying prepositions, is given in French.

The instructions told participants they would get to see a number of pictures and incomplete sentences. The L2 French users were told the sentences would be in French. They were told that the task was to look at the picture and evaluate each of the given expressions as to how well they would fit to complete the sentence so that the sentence and the picture corresponded. They were told to rate the expressions on a scale from 0 through 7, where 0 means "does not fit at all" and 7 means "fits perfectly". The rating scale was the same as in the original study by Coventry and Guijarro-Fuentes (Coventry et al., 2011). Participants were reminded that several expressions might be equally good, and that all expressions had to be rated before they would be able to proceed to the next image.

The system logged the ratings for each preposition with each picture, as well as the date and time at which rating for each picture was completed. It was therefore possible to identify cases of double rating, i.e., cases where the participant had rated the same image twice (typically using the back

button in the browser or restarting a test part). There were very few instances of this, and the times used to proceed through the questionnaire indicate that very few participants went back to look at previous answers. In the cases where the same picture had been rated twice, the first rating was used in the analyses, except in a few rare cases where the participant clearly had been mistaken in which of the objects in the scene was the located object and the reference object and gone back to correct his or her rating (see also section 5.8).

5.6 Experiment collecting production data (Paper III)

5.6.1 Participants in the production study

All participants in the production study (Paper III) were Norwegian learners of L2 French. They were recruited among first-year students of French at NTNU. One group (N=22) was recruited among first-semester students and tested in the autumn term. The other group (N=23) was recruited among second-semester students and tested in the spring term. The study is not longitudinal, thus the two groups do not contain any of the same subjects.

No data identifying the participant were collected (e.g., name), however, some data on participants' linguistic backgrounds were. This included native language. Participants indicating having more than one native language or another native language than Norwegian were excluded from the study. Furthermore, information about dialect background and knowledge of second languages was collected. Finally, the participants were asked to self-evaluate their proficiency level in French. The background information questionnaire is included in the Appendix, section 9.4.3. At the end of the experiment, participants also completed the French proficiency test (see section 5.4). Participants who wanted to know their score on the proficiency test provided their email address; this was however optional.

5.6.2 Test set up and procedure

For the experiment collecting production data, a booklet containing the pictures from Series I-IV, i.e., 66 pictures, was produced. The booklet was in A4 format and had 4 pictures on each page. The order in which the pictures were presented was semi-randomized. Ideally, there should be one picture from each picture series on the same page in the booklet. This was not entirely possible as the picture series did not include the same number of pictures. However, to the extent that pictures from the same picture series appeared on the same page, they were kept as different as possible. For instance, if two pictures from Series III: Apple – plate – bowl appeared on the same page, one or more of the factors geometric manipulations, functional manipulations and reference object were not the same in the two pictures. Participants were told not to go back to look at previous answers, but this was not further controlled during the experiment.

There were short written instructions in Norwegian on the front page of the booklet (see section 9.4.3.). The same instructions were provided orally by the experimenter, also in Norwegian. Participants were told to complete the sentence under each picture so that it corresponded to the depicted scene by filling in a French preposition of their choice. Participants were given 30 minutes to complete the experiment. A deliberate choice was made to put the proficiency test in the booklet after the experiment proper. This was done to prevent participant fatigue.

At least one participant in each group asked for translations of some of the labels, therefore Norwegian translations of *boîte = boks* (box), *saladier = bolle* (bowl), *cadenas = hengelås* (padlock) and *mouche = flue* (fly) were provided on the blackboard in the classroom where the experiment took place for both groups. In picture series I and II, which target spatial relations on the vertical axis, which object was the reference object and which was the located object could be swapped; the sentences identified either a superior relationship (the box is over the bowl) or an inferior relationship (the bowl is under the box). It was thus deemed essential that the participants knew the words *boîte* and *saladier* in order for preposition production to be meaningful at all. Translations of or comments about prepositions were not provided. In the sentences the definite article for the noun referring to the reference object was not included: *La femme est _____ parapluie* (see also section 5.3). Participants were told that providing the definite article was optional, and that if they did, any errors in gender would be disregarded. The vast majority of participants did not provide the article.

5.7 Statistical methods

All statistical analyses were performed using StatSoft Statistica 12.0.

Data from the acceptability rating studies were analyzed using repeated measures and mixed model ANOVAs. Each particular picture series was treated separately in the statistical analyses, as they included not only different types of spatial scenes which would be described using different prepositions, but also varying numbers of functional and geometric manipulations, i.e., they contained different numbers of independent variables. Fruitful statistical comparison across picture series was therefore not possible. A full account of the independent variables and their levels for each of the picture series can be found in Paper I.

In the rating experiments, acceptability was measured on an eight-point lickert scale where 0 = totally unacceptable and 7 = totally acceptable. In order to avoid calculating variance around zero, the scale was transposed to 1- 8 for the purpose of statistical analysis. All descriptive statistics, all analyses and all graphs based on acceptability rating data in the present thesis are therefore presented based on a scale where 1 = totally unacceptable and 8 = totally acceptable.

Sphericity was assessed using Mauchly's test. Adjusted degrees of freedom resulting from the Greenhouse-Geisser correction were reported whenever the assumption of sphericity was not met. The

Greenhouse-Geisser correction may be prone to making Type I errors. In the present study, figures from the Huyn-Feldt correction were therefore also consulted in all cases of sphericity. In no instances did the two corrections yield different results in terms of overall significance ($p \leq .05$).

Overall results from the ANOVA were mainly broken down using Tukey HSD post hoc tests. Planned contrasts were used in cases where differences in modulation of acceptability rating following geometric or dynamic-kinematic changes between participant groups were assessed, such as in Paper II, where it was hypothesized that Norwegian L2 users of French would differ from native speakers of French in the degree of adjustment to changes to geometrical and dynamic-kinematic aspects of the spatial scenes.

"Language group" was used as a between-group factor in a number of the analyses in the present thesis. This factor refers to test language, i.e., Norwegian vs. French, in Paper I where acceptability ratings from L1 Norwegian and L1 French participants are analysed. In Paper II, the factor refers either to language status, i.e. L1 vs. L2, when acceptability ratings from L1 and L2 French participants are analyzed, or to a combination of test language and language status when ratings from L2 French participants are compared to those of L1 Norwegian participants. Acceptability ratings provide a means for moving beyond a study of production data to a more fine-grained account of underlying semantic features affecting representations for L2 spatial prepositions. In Paper II, acceptability ratings for French prepositions by the L1 French and L2 French participants were compared to reveal to what extent the L2 users had developed target-like intuitions about these features. L2 French participants' acceptability ratings were subsequently compared to those of L1 Norwegian participants to investigate whether intuitions about these features were merely adapted from Norwegian, the L1. In Paper I, acceptability ratings of the L1 Norwegian and L1 French participants were compared in order to establish differences and similarities in how fine-grained semantic features affect preposition usage in the two languages. If one looks for influences from the L1 in the comprehension of L2 prepositions, as measured by acceptability ratings, one needs to know to what extent prepositions are equally affected by geometry and function in the two languages in question. Furthermore, comparisons of the L2 users' results to those of the native speaker control group from the source language as well as to the results of the target language control group are in order.

What was compared in these between-groups analyses was the degree to which changes to the geometric and functional relationship between objects in the spatial scenes affected the acceptability of a set of prepositions in the two languages in the same way. The prepositions included in the analyses were only those which were systematically produced by native speakers in the pilot study for the scenes in question. For example, the pilot study established that speakers of Norwegian used *over* to describe the relationship between the woman and the umbrella. Native speakers of French used *au-*

dessus de to describe the same spatial relationship. Given this, when the geometric and functional relationships between the woman and the umbrella were changed, the question was whether speakers of Norwegian modulated their use of *over* following these changes in the same way that speakers of French modulated their use of *au-dessus de*. The prepositions were assessed in relation to a constrained type of linguistic context which was held as similar as possible in the two languages (copula sentences, Basic Locative Construction). Furthermore, the prepositions were assessed in relation to a constrained type of visual stimuli which were identical for all participants in the study. While a comparison of prepositions across two languages might be seen to imply an assumption from the outset that the prepositions compared are equivalent, i.e., that pairs of prepositions in the two languages "mean" exactly the same and are used in exactly the same situations, I would argue that such an assumption clearly does not pertain to the analyses in the present study. Rather, the constraints built into the experiments, where features affecting language use are stripped down to (what we think are) the core ones, served to reveal fine-grained differences in the semantic representation for prepositions in the two languages, thus licensing this type of cross-linguistic comparisons.

Data from the experiment eliciting production data was explored using cluster analyses. Cluster analyses are similar to sorting tasks, i.e., tasks where objects are grouped together based on how similar participants think they are. However, in cluster analyses, the similarity between objects is calculated using various algorithms. Thus, cluster analyses are used to group objects (data) together based on how similar or dissimilar they are. The method is explorative, and serves to establish underlying similarities and structures in data without having explanatory force. It is not, therefore, suitable for specific hypothesis testing. Rather, it can be used to explore how data can be organized into meaningful structures and to discover underlying similarity patterns in the data (Field, 2000; Mooi & Sarstedt, 2011). In linguistics, cluster analysis has been used to explore patterns of lexicalization in various domains (see Paper III). Both joining cluster analyses, such as the ones in the present study, and more complex types of analyses of multi-dimensional similarity spaces have been used to explore lexicalization patterns within and across languages (Feist, 2008b; Jessen & Cadierno, 2013; Majid, Bowerman, van Staden, & Boster, 2007; Majid, Gullberg, et al., 2007; Vulchanova et al., 2013; Öztürk, Vulchanova, Tumyr, Martinez, & Kabath, 2011).

A matrix was created with the 66 pictures as rows and the 24 elicited prepositions/answer categories as columns. The answer categories were *dans, sur, à, sous, derrière, devant, avant, arrière, après, dessous, dessus, dedans, au-dessus de, au-dessous de, en dessous de, à gauche de, à droite de, à côté de, de, près de, loin de*, PP-DP-PP (eg. *en face de*), other, and 0-answers. The coding scheme and the rationale for these answer categories are described in Paper III. The cells in the matrix were filled in to indicate the number of times the term heading the column was used to describe the picture heading the row. So if 10 participants used *dans* to describe the relationships between the objects in picture

number 1, the *dans*/picture 1 cell in the matrix was given the value 10. Only one answer per participant per picture was counted. If no participant produced the preposition heading the column to describe the picture heading the row, the cell was given a value of 0. The matrix was then used as input for the cluster analysis.

Cluster analysis was performed on raw data (number of times each preposition was used with each spatial scene). The method chosen was hierarchical agglomerative clustering (tree clustering) using Euclidian distances. The linking rule used was Un-Weighted Pair-Group Average (UPGMA). In the data set used in the present study, pictures from Series I and II show spatial relationships on the vertical axis, whereas pictures from Series III and IV show scenes of containment and support. Thus, pictures in the study fall into natural groups. The UPGMA linking rule is efficient when objects form natural groups (StatSoft, 2014). Furthermore, Euclidean distances and Average linking have been found particularly suitable for representing underlying similarities and for visualizing the structure of the semantic field in linguistic data compared to other distance and linking methods (Öztürk et al., 2011). Each picture starts as a cluster of itself. In the first step, pictures which are described with similar prepositions are joined. The criterion for joining pictures together is gradually relaxed, so that pictures described with increasingly more dissimilar prepositions are linked, until, finally, all the pictures are linked together in one, large cluster. In this way, a hierarchy of similar pictures is created from the bottom up. The result of the analysis is shown in a *dendrogram* (tree or icicle plot) where similar pictures are linked with short lines, whereas long lines link dissimilar pictures (see Paper III).

In the present study, clusters from two different groups of participants were compared. As clustering is affected by how many times a specific preposition has been used to describe each picture, differences in group size could potentially influence the representation of similarity so that pictures would be represented as more similar in a group with more participants than in a group with fewer participants. Group sizes in the present study were N=23 and N=22. These were considered sufficiently similar for the clustering to be carried out on the raw data in the matrix described above. Results from the two groups were analyzed separately, i.e., not entered into the same matrix, hence this small discrepancy in participant number does not affect the cluster analyses themselves. Still, there is reason for caution with respect to the direct comparison of the resulting linkage distances, especially if these are not very different. However, the overall picture emerging from the cluster analyses was confirmed in calculated percentages of answer types per participant group, indicating that a comparison of the two cluster analyses is not unwarranted.

5.8 Data included in the analyses

In the present thesis, acceptability rating results for the following prepositions were analyzed and discussed: *i, på, over* and *under* in Norwegian and *dans, sur, au-dessus de, sous, en dessous de* and *au-dessous de* in French. We saw in section 5.5.2 that between eight and eleven prepositions were

presented for rating with each picture series in the experiment. For Series I and II, 6 Norwegian prepositions were included: *over, under, foran, bak, ovenfor*, and *nedenfor*. For the same two picture series, 7 French prepositions were presented for rating: *au-dessus de, sous, au-dessous de, en dessous de, devant, derrière*, and *sur.* For Series III and IV, 7 Norwegian prepositions: *over, på, i, oppi, oppå, nedpå,* and *nedi*, and 5 French prepositions: *au-dessus de, sur, dans, à l'intérieur de*, and *en haut de* were presented for rating. Theoretical considerations about the semantic make-up of preposition types as well as considerations about possible extra-geometric routines relevant to preposition meaning were the reasons why only a subset of the prepositions included in the experimental design were analyzed in the present study.

As the primary focus of the present thesis is the acquisition of prepositions in the L2 and the extent to which semantic features are transferred from the L1, looking at pairs of prepositions which can be used to describe the same spatial scenes in the L1 and the target language was the main concern. The prepositions which were retained for analysis in the present study were the prepositions which were most frequently produced by the native-speaker participants in the pilot study. These prepositions were also reliably used for the same types of spatial scenes by both the L1 Norwegian and L1 French participants in the pilot study. Second, these prepositions are also the ones which are most comparable (i.e., they are often considered translation equivalents) to English prepositions for which a large number of studies exist.

The Norwegian prepositions *ovenfor, nedenfor, oppi, oppå, nedpå*, and *nedi* are compound prepositions, a type of complex preposition which does not exist in French (see section 3.1.3). Their meaning is more specific than that of simple prepositions, as it is made up of a combination of the semantics of the first and second component in the complex (Bakken & Vikør, 2011). Both Norwegian and French have complex prepositions of the PP-NP-PP-type. These, too, serve to express more fine-grained spatial information. The French complex prepositions *à l'intérieur de* and *en haut de* identify a particular region within a container or on a supporting surface, thus having a more specific meaning than simple prepositions. One might expect compound and complex prepositions to be influenced by other properties of spatial scenes than simple prepositions. While this is interesting in its' own right and analyses of underlying geometric and extra-geometric routines for such prepositions would bring new knowledge about the semantics of complex prepositions, this was outside the scope of the present thesis. With the exception of *au-dessus de* (and to a lesser degree *au-dessous de*, and *en dessous de)*, only acceptability ratings for simple prepositions were analyzed in the present study (see section 3.1.3 for a discussion of *au-dessus de*). Whereas the semantic underpinnings of *over/under*, *above/below*, *in,* and *on* have been extensively studied, not many studies of complex prepositions exist. This means that findings for complex prepositions could not have been compared to or supported by relevant findings for English. The current experimental material does not include varied spatial situations using varied types of interacting objects, and as such, results

concerning these prepositions would have been less generalizable than results from studies on simple prepositions.

The pilot study also showed that both L1 Norwegian and L1 French speakers produced 'in front of' (Norwegian *foran*, French *devant*) and 'behind' (Norwegian *bak*, French *derrière*) to describe the relative position of the woman and the umbrella in Series I: Lady - umbrella when the umbrella was tilted away from the gravitational plane. Norwegian participants produced *foran* and *bak* consistently, the only exceptions being a few instances of *til venstre for* 'left of' for and *til høyre for* 'right of' and *bakenfor*, which is a complex preposition made up of *bak* and *for*, meaning 'behind'. Among the French participants, two produced *devant* and *derrière* consistently while the remaining participants produced *à côté de*. As a consequence, prepositions *foran, bak, devant* and *derrière* were included for rating in picture series I and II. Prepositions meaning 'in front of' and 'behind' are only acceptable if the reference object (or the located object) can be said to have some sort of intrinsic orientation with a canonical front and back side, like the woman in Series I: Lady - umbrella[1]. Neither the box nor the bowl in Series II: Box – bowl has any natural front or back sides (the depicted box is round). These prepositions were therefore not produced by any of the participants in the pilot study with the pictures from the box and bowl picture series. Still, the same set of prepositions was included for rating in both picture series targeting location on the vertical axis, i.e., Series I and II[2].

In line with what was found in the pilot study, acceptability ratings from both native speakers of French and native speakers of Norwegian show that 'in front of' and 'behind' are acceptable when the umbrella is tilted away from the gravitational plane. In fact, the ratings show that 'over'/'under' and 'in front of'/'behind' are in complementary distribution in Series I: Lady - umbrella. Ratings were submitted to a 3 (geometry: canonical, 45 degrees, 90 degrees) x 3 (function: control, functional, non-functional) x 2 (superiority/inferiority: superior, inferior) x 2 (preposition pair: 'over'/'under", 'in front of'/'behind') mixed model ANOVA with language group (L1 Norwegian, L1 French) as the between groups factor. The analysis revealed a significant interaction of geometry and preposition, $F(1.63, 78.31)=1098$, $p<0.00001$, partial $\eta^2=0.96$ (Greenhouse-Geisser correction). The interaction was not modulated by language group. The interaction is shown in Figure 12.

[1] *In front of/behind* can also be used if the speaker applies an egocentric reference frame to the scene. An egocentric reference frame was not applicable in this case because of the configuration of the objects in the visual stimuli.

[2] Similarly, one set of prepositions was included for rating with the two picture series targeting topological spatial relationships.

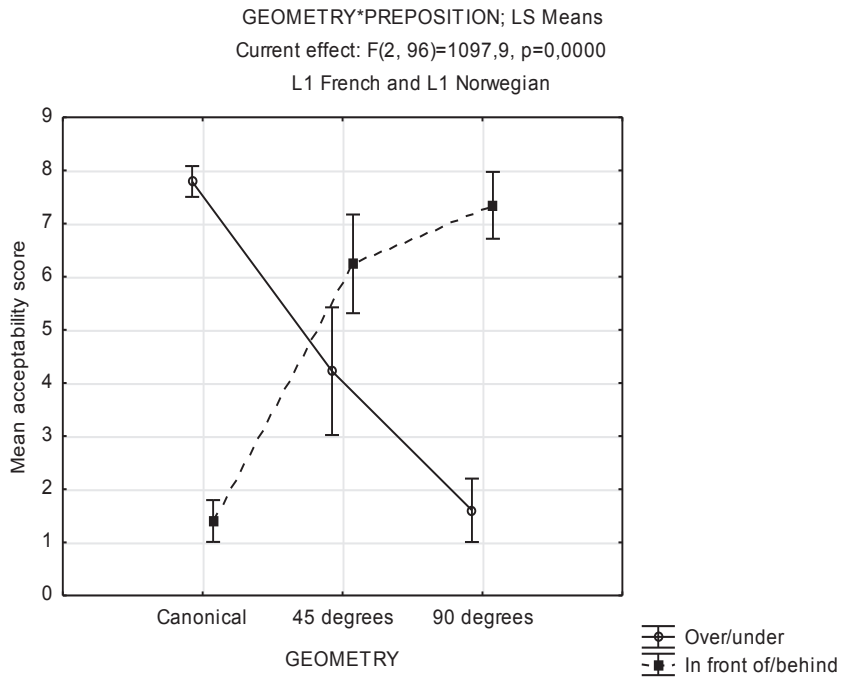

Figure 12 Lady and umbrella. Interaction of geometry and preposition. L1 French and L1 Norwegian. Vertical bars denote 95% confidence intervals

As can be seen from Figure 12, the acceptability for *over/under* in Norwegian and *au-dessus de/sous* in French declines as the umbrella is tilted away from the gravitational plane. Conversely, the acceptability for *foran/bak* in Norwegian and *devant/derrière* in French increases as the umbrella is tilted away from the gravitational plane. For reasons of space, the graph is presented here for both languages together since, as already mentioned, the interaction was not modulated by language group. This means that the solid line represents results for *over* and *under* as well as *au-dessus de* and *sous*, whereas the broken line represents results for *foran* and *bak* as well as *devant* and *derrière*.

The interaction is interesting, as it has never been reported for analyses of English preposition usage. It also serves as an important backdrop for the analyses in Paper III where L2 learners' production of spatial prepositions in French shows the same type of pattern. L2 learners clearly distinguish pictures in Series I: Lady – umbrella from those in Series II: Box – bowl, producing *devant/derrière* for pictures in the first but not for pictures in the latter series.

However, in an analysis looking at the importance of both geometrical and functional (dynamic-kinematic) factors underlying preposition comprehension and production in the L2, *devant, derrière*, *foran*, and *bak* still have to be left out of the analyses of the types of spatial scenes involved in Series I: Lady - umbrella. The reason is that while the dynamic-kinematic routine of "threatening/blocking

contact" (see section 3.2.2.2 and Paper I) has been thoroughly established for prepositions expressing location on the vertical axis, such as *over, under, above, below*, prepositions expressing location on the *horizontal* axis, such as *in front of* and *behind* are not influenced by the same dynamic-kinematic routine. A physical force such as gravity has very different consequences for the relative position over time of objects on the vertical axis and for the relative position over time of objects on the horizontal axis. The appropriateness of *in front of/behind* has been found to depend on the extent to which the located object and the reference object are in a position to interact (Carlson-Radvansky & Radvansky, 1996; Coventry & Garrod, 2005; Richards, 2001). How appropriate *The postman is **in front of** the post box* is depends on whether the postman is facing the post box or has his back turned to it. Contextual factors also affect the use of *in front of/behind*. However, these are not the type of functional properties targeted in Series I: Lady – umbrella.

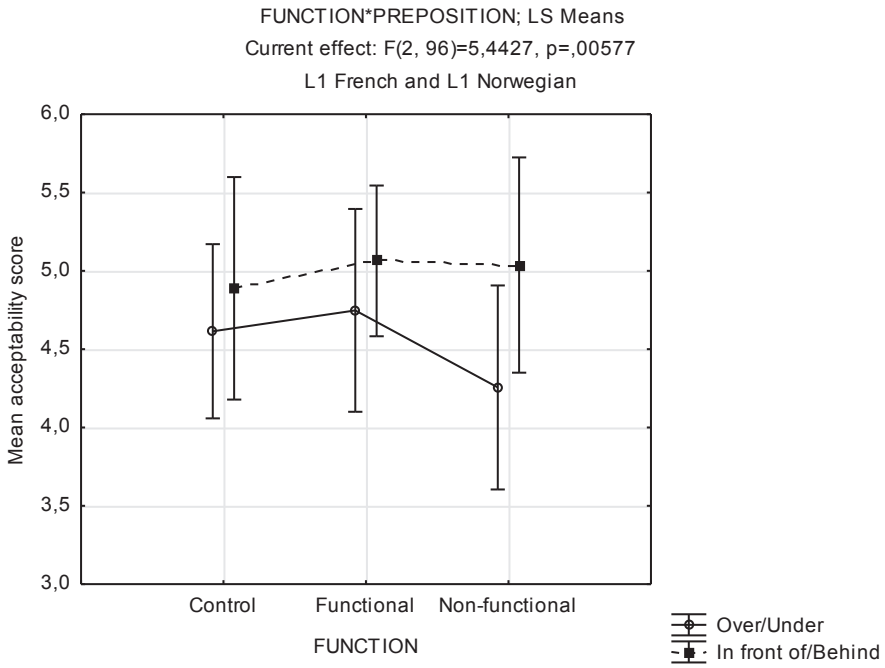

Figure 13 Lady and umbrella. Interaction of function and preposition. L1 French and L1 Norwegian. Vertical bars denote 95% confidence intervals

This is evident also in the results of the ANOVA mentioned above. The analysis yielded an interaction effect of function and preposition, $F(1.56, 75.04)=5.44$, $p=0.01$, partial $\eta^2=0.1$. The interaction is shown in Figure 13. The interaction was not modulated by language group, hence the data are presented in one graph regrouping both language groups. Tukey HSD post-hocs reveal that while the prepositions *over, under, au-dessus de* and *sous* are significantly less acceptable in the non-functional condition than in the control condition ($p=0.04$) and the functional condition ($p=0.001$),

there are no significant differences in ratings for *foran, bak, devant* and *derrière* across the three levels of function[1]. This indicates that the type of dynamic-kinematic routine targeted in the visual stimuli here, namely threatening or blocking contact from falling objects, is not the type of dynamic-kinematic routine underlying 'in front of' or 'behind'. It would therefore not be relevant to include these prepositions in an analysis of underlying functional properties reflected in the use and comprehension of spatial prepositions in the L2. The type of dynamic-kinematic routine targeted by the stimuli would not in any way predict behaviour in L2 (or in L1, for that matter) for these prepositions.

In the pilot study, the preposition *sous* was the most frequently produced preposition to describe the woman to be under the umbrella in Series I: Lady - umbrella, and the box in Series II Box - bowl to be under the bowl by native speakers of French. The second most frequent, but far less used, preposition was *en dessous de*. One participant used *au-dessous de* in Series II, none in Series I. *Sous* was therefore selected for the majority of the analyses here (such as in Paper I).

5.9 L2 user errors

A common method in L2 research is to look at the errors which L2 users make. *Error* is usually taken to mean any instance of overt production which is thought to be non-idiomatic by native speakers of the target language. In the present thesis, errors have not been analyzed separately for a number of reasons. In Paper III, errors which were systematically made by the participants were coded into the matrix serving as input to the cluster analysis. Such errors included transitive uses of intransitive prepositions (*dessus, dessous, dedans*), and uses of prepositions which strictly speaking are temporal (*avant, après*), other types of prepositions (*malgré*), or adverbs (*bas*) in the place of spatial prepositions. As a consequence, the patterns of errors contributed towards the similarity/dissimilarity of the data in the analyses. The nature of these errors, however, was not discussed and no attempts were made at a more qualitative analysis of error patterns. In Paper I it was found that L1 French participants preferred *dans* to *sur* when the reference object was flat and labelled *plat*, and that neither *dans* nor *sur* got a high mean acceptability score. For the same type of scenes, L1 Norwegian participants found *på* (on) highly acceptable and *i* (in) inacceptable. In Paper III, it is pointed out that the L2 learners produced *sur* in these cases and that within-group variation diminished with increasing proficiency, i.e., the participants with the higher L2 proficiency had converged on the "wrong" preposition. This is a typical case of transfer.

In the rating data, an analysis of L2 errors is difficult due to the test design itself. As mentioned in section 5.5.2, only prepositions relevant to the type of spatial relationship targeted in a picture series

[1] The same results were found when data form the two participant groups were submitted to separate analyses, and when data for the two preposition pairs *over/under* or *foran/bak* (alternatively *au-dessus de/sous* or *devant/derrière*) were analyzed separately.

were included for rating with that same picture series. For instance, with picture series I: Lady – umbrella, only projective prepositions denoting location on the vertical axis were included (plus 'in front of/behind', cf. the previous section). This means that in the experiment eliciting acceptability ratings, it was not possible for participants to make substantial qualitative errors. In Paper II, differences between the acceptability ratings of L2 French users and those of the L1 French users were discussed. However, these differences were not treated as errors; rather they were treated as differences of degree.

Participants occasionally misread the sentence and confused located object and reference object, rating *under/sous* (=under) unacceptable and *over/au-dessus de* (=over) perfectly acceptable when the sentence read *The lady is _____ the umbrella*. This, however, was the case both for the two native speaker groups and the L2 French group. Such mix ups were therefore not treated as a feature of L2 lexical knowledge. Rather, these errors were considered a result of a lack of attention to the combination of linguistic and visual stimuli during the experiments. They were never systematic, i.e., they never occurred with all the stimuli of one type. Errors of this type were not removed from the data prior to analysis. However, if the participant had rated prepositions for the same picture twice and it was clear from the data that this was done in order to correct previous answers, the corrected ratings were retained. An example of this would be if, for a picture where the sentence indicated an inferior relationship (as in *The lady is _____ the umbrella*), all prepositions denoting superior relationships (*over, foran, ovenfor*) were given a high score in the first response and in the second response these were all given a low score whereas prepositions denoting an inferior relationship (*under, bak, nedenfor*) were given a high score instead.

5.10 Limitations of the present study

From a methodological point of view, the present study has some limitations.

First, the test material only includes one set of objects per picture series. An argument throughout this thesis has been that the nature of an object influences how we talk about where it is located. Therefore, generalizations about the relative importance of each of the components of the FGF for individual prepositions in the L1 can hardly be made on the basis of the limited diversity of the objects included in the test material. This issue is discussed both in Paper I and in Section 6.1.1. On a similar note, the relatively limited amount of data for the analyses in Paper II is discussed in Section 6.1.2.1. Second, while one of the research questions is how lexical knowledge changes as a function of increasing L2 proficiency, the present study is cross-sectional rather than longitudinal. In Paper III, results from two groups of participants in two different experiments are compared, but in neither case have the same participants been tested twice on the same measures. Generalizations about development of L2 lexical knowledge can be made from cross-sectional analyses; however, it is important to bear in mind that the experiments in the present study do not measure development of

lexical knowledge within the same individual over time. Finally, the question of the French proficiency test used in the present study and whether it is sufficiently powerful in discriminating between proficiency levels has been discussed in both Section 5.4 above and in Paper III.

6 Main findings and implications

The topic of this thesis is the semantics of spatial prepositions in Norwegian and French, and semantic representations of spatial prepositions in the L2 French of native speakers of Norwegian. Findings in the papers in the present thesis contribute to our knowledge of which of the aspects of the semantic meaning of prepositions (cf. FGF) mainly influence preposition choice in Norwegian and French, two languages which are typologically relatively similar but with some key differences. They also contribute to our knowledge of factors influencing lexical choice in L2, i.e, L1 knowledge vs. other factors, and to our knowledge about the relationship between spatial representations and linguistic encoding.

There is a natural progression in the topics covered in the three papers; from comprehension of spatial prepositions in the L1 in Paper I, via comprehension of spatial prepositions in the L2 in Paper II, to effects of L2 proficiency on preposition production and comprehension in Paper III. Common to all three papers is that they study preposition usage in copula sentences describing concrete, static spatial situations accompanied by images where properties of the spatial scenes are systematically manipulated. All papers are concerned with situations of either containment and support or position on a vertical axis, or both of these. In the present thesis, spatial prepositions are treated as lexical items (see Section 3.1.2). They are therefore assumed to be part of the mental lexicon and to carry semantic features. Under this assumption, acquisition of spatial prepositions entails that they are stored as lexical items in long term memory and that they become entrenched with repeated exposure and usage. Furthermore, the assumption is that this characterizes acquisition of lexical items in both L1 and L2.

The main research questions addressing the overall objective of the present thesis were listed in Section 1.1, and are repeated here:

1. Can the semantics of spatial prepositions in Norwegian and French be described in terms of the FGF?
2. Where do difficulties in preposition usage in the L2 stem from – geometric or functional information?
3. Do L2 learners rely on L1 intuitions about preposition usage?
4. Does proficiency play a role in the use and comprehension of L2 spatial prepositions?

The three papers contribute to the overall research objectives in the following way:

Paper I, which is entitled “Les prepositions spatiales en français et en norvégien: une étude expérimentale et comparative”, addresses the question of the semantics of spatial prepositions in Norwegian and French and whether spatial preposition meaning in the two languages can be described as an interaction of the components of the FGF, i.e., geometrical routines, dynamic-

kinematic routines, and object knowledge. To the best of my knowledge, this is the first experimental study addressing this issue in either of the two languages. The study establishes that these components are considered for spatial preposition meaning in similar ways in the two languages. As a consequence, Norwegian L2 learners of French should be able to rely on L1 intuitions and still be successful in their use of L2 spatial prepositions. In addition to providing information about the components underlying spatial prepositional meaning in the two languages, the study in Paper I therefore constitutes an important starting point for the studies reported in Paper II and Paper III. Without data about the comprehension of these prepositions in L1 Norwegian and French, data and results from the L2 users would lack an important background reference.

As papers II and III investigated lexical knowledge at different stages in the L2 acquisition process, the two papers complement each other. Paper II, entitled "Spatial prepositions in the L2: Geometry vs function", addresses the question of the origin of difficulties in L2 preposition acquisition and the question of whether L2 participants rely on their L1 intuitions about how such features affect preposition usage in the target language. It deals with how the same parameters as those investigated in Paper I underlie spatial preposition comprehension in mid- to high-proficiency L2 users of French. An important aspect of the study is that it uses rating data to tap into intuitions about L2 preposition meaning rather than studying production data. This allows for a break-down of spatial preposition semantics into its sub-components in order for a more fine-grained study of preposition meaning in the L2, including the extent to which there is native-like mastery of the underlying parameters and whether L2 users rely on L1 intuitions about these parameters.

Paper III, "Spatial prepositions in the L2: Does proficiency have a role?", addresses the role of proficiency for the use and comprehension of L2 spatial prepositions. The paper reports on two experiments. The first experiment explored patterns in the production of L2 prepositions in two groups of L2 learners with different levels of proficiency, showing that preposition production was more consistent in the group with the highest L2 proficiency. The second experiment looked at rating data from the same participants as in Paper II, but this time divided into two groups based on proficiency level. While the two groups' acceptability judgments did not differ significantly as a function of changes to geometric or functional aspects of spatial scenes, acceptability judgments were invariably more consistent in the group with the highest proficiency level. Together, the two experiments in Paper III show that the semantic network for spatial prepositions undergoes structuring and tightening as proficiency in the L2 increases, and indicate that lexical knowledge continues to develop in depth also after an item has entered into the L2 user's productive vocabulary.

An important contribution of the present thesis is its comparison of the expression of location in two languages which are typologically different with respect to the expression of space, yet culturally similar. We saw in Section 3.3 that cross-linguistic investigations of spatial language usually sample

from languages where the encoding of spatial relationships is known to differ, i.e. the languages involved are often typologically quite distant and may also use different linguistic means for expressing spatial relationships (verbs, particles, prepositions, etc.). French and Norwegian are typologically different in certain respects; French is a Romance language, Norwegian is a Germanic language, French is usually considered a verb-framed language, Norwegian is a satellite-framed language, etc. However, the two languages are typologically similar in other respects; they are both Indo-European languages, they are spoken in culturally similar societies, and they both express location using prepositions. When trying to establish the nature of human mental representations for space and what the nature of the relationship between mental representations for space and spatial language is, it is necessary to investigate this relationship in many and typologically diverse languages. However, moving forward and gaining knowledge based on *different* languages, also entails that we need to know how the matter at hand is represented in *less different/similar* languages. Knowledge must accumulate on a number of different languages and language combinations, in order for a fuller, richer and more correct picture of what properties are typically encoded in human languages to develop. Generalizations based on the expression of space across typologically diverse languages would surely benefit from knowledge of the variability with which the phenomenon is represented within a group of related languages.

Even closely related and mutually intelligible languages, such as the Nordic ones, may differ considerably in preposition usage. For example, the renowned Esso slogan *Put a tiger in your tank*! translated as *Putt en tiger på tanken!* ('put a tiger **on** the tank') in Norwegian, as *Kom en tiger i tanken!* ('put a tiger **in** the tank') in Danish, and as *In med en tiger i tanken*! ('put a tiger **in** the tank') in Swedish[1]. Recently, a study of the semantic categories of cutting and breaking in four Germanic languages showed that although categorization of these events is largely shared among typologically and culturally diverse languages, even similar languages show considerable variation within this shared similarity space (Majid, Gullberg, et al., 2007). Such findings underline my point here; it is important for our understanding of categorization and semantic representation in human language that we look at both typologically distinct and typologically related languages. This has already happened in the domain of motion encoding in languages, where Talmy's distinction between verb-framed and satellite-framed languages (see Section 3.1.4) has been leading for years. While this distinction still holds an important place in the field of motion encoding, researchers have begun investigating variation within each of the two categories. Many interesting results have emerged where distinctions between languages within each category are found (e.g., Dimitrova-Vulchanova et al., 2012; Ibarretxe-Antuñano, 2004; Ragnarsdóttir & Strömqvist, 2004). There now is a tendency to regard languages as ranging along a continuum in the degree to which they use verbs or satellites to express path of motion. Furthermore, the fact that most languages have at their disposal several linguistic tools

[1] In French the slogan was *Mettez un tigre dans votre moteur!* ('Put a tiger **in** your engine').

for encoding complex events has been highlighted (Croft, Barðal, Hollmann, Sotirova, & Taoka, 2010). Only by accumulating knowledge about the linguistic encoding of space from a variety of languages, typologically different *and* similar, will we be able to develop more precise knowledge of cross-linguistic overlap in the clustering of semantic features for spatial prepositions.

With respect to second language acquisition, it is important to bear in mind that learning a language which is typologically relatively similar to one's native language also constitutes a challenging task. Even when two languages use the same type of lexical items to express location, for instance prepositions, L2 learners may find it difficult to use these items correctly. It is quite common for learners of a second language to express uncertainty about preposition usage in the language being learnt. Knowledge of how the same class of lexical items is used to encode spatial situations in two languages may reveal differences within a shared similarity space which in turn may prove difficult for learners of a second language to fully master. At the present, English is a default language in almost any study, and particularly so in studies involving second language acquisition. However, English may not be representative of all Germanic languages (Evans & Levinson, 2009), and important insights about the L2 acquisition of spatial expressions might be missed if English remains the reference language in (SLA) research. What properties of spatial language cause problems for L2 learners may be less constrained by universal properties than by the differences and similarities between the actual languages involved. Therefore, a study of L2 acquisition where English is not one of the languages may further contribute to our understanding of the difficulties faced by L2 learners in the acquisition process. The present thesis adds to the already existing research on the acquisition of spatial language in an L2 in this respect.

Another important aspect of the thesis is that it investigates both L2 users' intuitions about the meaning of spatial prepositions in the target language and L2 preposition production. The thesis contributes to our knowledge about the development of semantic representations for prepositions in the L2. Importantly, it moves beyond an analysis of L2 production errors by looking at how L2 judgments about preposition acceptability are affected by different sources of information which have been found to be important for the comprehension of spatial prepositions. This allows for a more fine-grained investigation of the development of semantic representations for spatial prepositions than can be attained from production data alone. On the other hand, the study of L2 production data in the present thesis contributes to our knowledge about the order of acquisition of prepositions in the L2 and explores how these become an increasingly stable part of the L2 users' productive vocabulary.

In the following, findings from the three papers and implications of these are discussed in more detail.

6.1 Lessons learned from the three papers

6.1.1 Spatial prepositions in L1 Norwegian and L1 French

The first paper, "Les prepositions spatiales en français et norvégien: une étude expérimentale et comparative", investigated the interrelationship of functional and geometrical factors affecting spatial preposition usage in L1 French and L1 Norwegian. To the best of my knowledge, this is the first experimental study to investigate the influence of these parameters for spatial prepositions in these two langauges. In Section 3.2.2 the Functional Geometric Framework, FGF, (Coventry & Garrod, 2004) was introduced and a number of studies on which the FGF builds were discussed. The study in Paper I is based on previous findings about the influence of geometric and dynamic-cinematic information for the acceptability of spatial prepositions in English (Coventry & Garrod, 2004; Coventry & Mather, 2002; Coventry & Prat-Sala, 2001; Coventry et al., 2001), and similar methods and visual and linguistic materials as in these studies were used. Here, it was asked whether native speakers of French and Norwegian attend to the same changes to geometric and dynamic-kinematic information between objects in a spatial scene when they rate the acceptability of a spatial preposition to refer to the relationship between the objects. Furthermore, it was asked whether acceptability ratings for spatial prepositions in Norwegian and French were influenced by such changes in analogous ways. A first finding to point out which perhaps may seem trivial, is that the study confirmed that native speakers of both Norwegian and French do indeed take into account the properties of spatial scenes identified by the FGF when they are making judgments about preposition usage. Paper I extended the findings for English to the Norwegian topological prepositions *i* and *på,* and to two prepositions denoting location on the vertical axis, *over* and *under*, as well as to their French counterparts, *dans, sur, au-dessus de*, and *sous*. Therefore, the study adds to the evidence that the FGF is a fruitful framework for the study of perceptual, situational and linguistic information underlying the comprehension of spatial prepositions across languages. Furthermore, some of the constraints on spatial preposition usage in French proposed in theoretical studies by Vandeloise (1986, 2004), were shown to influence native speaker judgments about preposition usage in this experimental study.

In Paper I, native-speaker acceptability ratings for prepositions which are usually considered translation equivalents in French and Norwegian were compared over a number of manipulations. The consistent absence of significant differences between L1 Norwegian and L1 French acceptability ratings suggests that underlying factors for preposition comprehension are similar across the two languages. There is a difference between topological prepositions, such as *in* and *on*, on the one hand, and projective prepositions, such as *over* and *above*, on the other hand, in that geometry alone is more informative for the projective prepositions whereas there is a tighter link between geometric and functional information associated with the topological terms. Cross-linguistically, the topological

domain displays great variation in lexicalization patterns (Levinson & Meira, 2003) and there is substantial diversity across languages as to how objects are typically conceptualized, and, therefore, with which prepositions object labels co-occur. The language-specific conceptualization is at times rather arbitrary, as for instance indicated by the distinction between "in a car" and "on a bus". It was argued in Paper I that differences in acceptability judgments for French and Norwegian prepositions were less likely to occur with projective prepositions for location on the vertical axis than with topological prepositions denoting containment and support. These predictions were borne out. Overall, the experiment showed that native speakers of Norwegian and French did not differ significantly in how geometric and functional properties of spatial situations affected acceptability ratings for the prepositions and the situation types studied. Moreover, acceptability ratings were affected by changes to geometric and functional properties of the spatial scenes in analogous ways in the two languages, suggesting similarities in how these factors underlie preposition meaning in Norwegian and French. The differences which were found between acceptability ratings for Norwegian and French prepositions stemmed from language-specific conventions as to how objects are conceptualized rather than more fundamental differences in how geometric and dynamic-cinematic information affects the conceptualization of a spatial scene. The results showed that the major difference lies in how object labels, i.e., nouns, co-occur with spatial prepositions in the two languages, and, as hypothesized, this is first and foremost evident in the topological domain.

The study in Paper I clearly has limitations with respect to the generalizations which can be drawn from it. As only one object type for each of the spatial relationships was tested, it would be premature to draw conclusions about the exact weight of each of the components in the FGF for each of the prepositions tested. However, the results obtained for French can clearly be interpreted in light of Vandeloise's theoretical studies of French spatial prepositions (Vandeloise, 1986, 2004, 2008). The study confirms that the constraints, or "traits de famille de ressemblance", proposed by Vandeloise are indeed involved in native-speaker judgments about French preposition usage. Moreover, the results for both Norwegian and French can be compared to those which have emerged from studies on English prepositions. Coventry et al. (2001) showed that the effects found of both geometric and extra-geometric information were consistent across a wide range of object types, both when objects were used for their stereotypical functions and when they were used in non-typical ways, for instance if a suitcase was used instead of an umbrella as protection against rain. I do believe, therefore, that the results for the prepositions included in the present analyses would be obtained also if more object types were tested. However, only an extended study including a variety of objects for each of the situation types would reveal consistent patterns in the weighting for each of the components of the FGF.

In spite of these limitations, the study in Paper I was central to the other studies in the present thesis. Investigating the influence of geometric and functional information on L2 preposition acquisition and

comprehension would be impossible without the data from Paper I to which the L2 data could be compared. Furthermore, the direct comparison of data from native speakers of the two languages provided a basis for forming hypotheses about L2 acquisition. The findings in Paper I indicate that we can expect Norwegian L2 learners of French to be quite successful in using L2 spatial prepositions if they rely on their L1 intuitions about preposition usage. This is particularly true of prepositions denoting location on the vertical axis. During L2 acquisition, certain target language conventions simply have to be memorized and learned. However, the successful acquisition of such conventions hinges on input – either as sufficient language exposure to make generalizations about the construction or in the form of formal instruction. In the absence of sufficient input, the L2 learner may never learn to map spatial prepositions onto the correct spatial scenes, and eventually ends up having transferred her L1 preposition – object-label pairing to the L2 and with repeated use comes to have an incorrect construction entrenched. Results from Paper I lead to the hypothesis that Norwegian L2 learners of French are more likely to display overt transfer in the topological domain than in the case of prepositions denoting location on the vertical axis. Note, however, that the fact that much is similar in the two L1s doesn't necessarily mean that learning how to use prepositions in the L2 is going to be straightforward.

6.1.2 Spatial prepositions in the L2

The two studies in paper II and III deal with this establishment of L2 prepositions into the mental lexicon of second language learners. Together, the two papers trace the increasing stability of representations for L2 spatial prepositions, and look at what sub-components of spatial preposition meaning develop in stability first.

6.1.2.1 Geometric and functional information underlying L2 preposition comprehension

A question in the study of the acquisition of L2 spatial prepositions has been whether geometric or functional properties of preposition meaning are more difficult for the L2 learner (Coventry & Guijarro-Fuentes, 2008; Coventry et al., 2011; Munnich & Landau, 2010). In their study, which looked at preposition production in 60 learners of English as an L2 from two different L1 backgrounds, Munnich and Landau (2010) found that functional properties of spatial scenes are particularly hard to master in the second language. The conclusion in this study was based on the pattern of errors in overt preposition production by the L2 speakers. Paper II, "Spatial prepositions in the L2: Geometry vs function", reports on a study where rating data, i.e., acceptability judgments, were elicited in order to tap into L2 users' intuition about the meaning of prepositions denoting location on the vertical axis (*au-dessus de, sous, en dessous de,* and *au-dessous de*). The study investigated whether L2 users make the same meaning distinctions as native speakers on the basis of geometric and functional information underlying preposition meaning. The participants in the study had relatively high proficiency in French; most of them were (upper) intermediate to advanced speakers. It was therefore hypothesized that the L2 users would provide acceptability ratings which

were similar to those of the L1 speakers of French, i.e. there would not be a qualitative difference between the L2 users' acceptability ratings and ratings of the target-language speakers. A further hypothesis was that the L2 users would differ from the native speakers in the degree of adjustment to changes to geometric and functional aspects of the spatial scenes.

Contrary to the results in Munnich and Landau (2010), findings in Paper II are that the L2 users do not differ significantly from native speakers in how they modulate their acceptability judgments as a function of changes to functional information in the spatial scenes. This indicates that the L2 users weighed the importance of functional information for meaning distinctions in much the same way as native speakers. However, as Paper I showed, L1 acceptability judgments for French and Norwegian prepositions did not differ significantly. Therefore, it is impossible to say whether the L2 users simply rely in their L1 intuitions or have mastered fully those of the L2. On the other hand, with respect to how they modulate their acceptability judgments as a function of changes to geometric information, the L2 users do differ from the native speakers of French. The results show that L2 users discriminate less on the basis of geometric information than native speakers do. Furthermore, the L2 users' acceptability judgments differ from those made for Norwegian by native speakers of Norwegian in exactly the same way, indicating that a simple transfer of L1 intuitions to the L2 is not the cause of the difference.

While this study clearly has limitations, particularly concerning the number of object-types involved in the study, and, consequently, the rather limited data-size, the findings in Paper II are interesting from a theoretical point of view. First, the results replicate those in Coventry et al. (2011) in indicating that meaning distinctions based on geometric information are more problematic for the L2 user than those based on functional information. In doing so, the results also constitute further evidence of a similar trajectory for the development of semantic representations for spatial preposition in the L2 as in the L1 (Feist, 2008a, see also section 3.2.2.4). Coventry et al. (2011) conducted a large-scale study with L2 speakers of English and Spanish with varying proficiency levels. Their findings showed that L2 users at all proficiency levels were able to make native-like distinctions based on functional information. This indicates that meaning distinctions based on function are mastered early on in the acquisition process. However, their L2 participants differed from native speakers in the distinctions they made based on geometric information. Moreover, their results showed that with increasing proficiency, the L2 users made distinctions which resembled those of native speakers more and more. The study in Paper II only includes one group of L2 participants. However, considering also the results from Paper III, a picture where lexical knowledge for prepositions develops over time, and continues to do so also after a preposition has become established in productive vocabulary, emerges.

6.1.2.2 Development in the lexical knowledge for L2 spatial prepositions

Paper III, "Spatial prepositions in the L2: Does proficiency have a role?", deals with the consolidation of prepositions into the L2 lexicon. In two different experiments, it explores lexicalization patterns in the domain of static location in two groups with different proficiency levels and whether there are signs of continued structuring of semantic representations once spatial prepositions are part of the L2 users' productive lexicon.

Participants in the preposition production study were one group of students in their first semester of French studies, i.e., the first-semester group, and one group of students tested towards the end of their second semester of French studies, i.e., the second-semester group. The study was not longitudinal. Effect sizes from the analyses in Paper I show that geometry accounts for the main share of variation in acceptability ratings for the spatial prepositions studied, particularly so when location on the vertical axis is concerned. This is also evident in the lexicalization patterns of the L2 users in Paper III. The different clusters resulting from spatial preposition production in Paper III typically formed around particular types of reference objects and the geometric relationship between the reference object and the located object. Still, both Paper I and Paper II show that functional information is also an important component of preposition meaning in Norwegian L1 and French L1 and L2. Paper II showed that the L2 users made native-like discriminations on the basis of functional information. In fact, dynamic-kinematic information accounts for the lexicalization patterns displayed in both proficiency groups in one particular case in Paper III: In *Series I Lady and umbrella*, the functional image in the 45 degree rotation condition, i.e., the image where the umbrella is tilted 45 degrees away from the gravitational plane yet still shields the lady from the falling rain, is predominantly described by the preposition *sous*. The control and the non-functional image in the same condition are predominantly described by the preposition *derrière*. Zwarts (2008) uses optimality theory to account for the selection of a preposition in a given context. In his view, multiple cues compete to be selected for a preposition to be licenced. Cues are hierarchical where some cues take precedence over others. Here, functional information overrides geometric information when L2 users choose a preposition to describe the scene.

While the study of lexical production in Paper III is explorative, the results from the study can be interpreted in light of theories about lexical depth and breadth and so contribute to the formation of hypotheses and further testing of these. What can be hypothesized on the basis of these findings is that even at relatively low levels of L2 proficiency both geometrical and functional information support lexical choice in the L2, and that this will stabilize with increasing proficiency in the L2.

The production data from the two groups reveal an interesting pattern. While participants in the first-semester group reliably produced both *dans* and *sur* for scenes of containment and support, they regularly failed to produce prepositions denoting superior location, i.e., *au-dessus de*, and to a lesser

degree they also struggled to produce *sous, en dessous de* and *au-dessous de*. The second-semester group reliably produced both *au-dessus de* and *sous* in addition to *dans* and *sur*. The data in Paper III therefore indicate that *sur* and *dans* establish themselves in the L2 lexicon quite early on, while the prepositions denoting location on the vertical axis are acquired later.

Approximately 6 months of academic study of French separate the two participant groups, most of which took place in a non-immersion setting. However, a majority of the participants in the second-semester group had attained a five-week course at l'Office Franco-Norvégien d'Echanges et de Coopération (OFNEC) in Caen, France. While the proficiency level of the two groups differs significantly, there is considerable variation in proficiency scores within the two groups. Some of the participants in the second-semester group have proficiency scores which are in the lower range of the scores of the first-semester group. Still, these participants perform very similarly to participants in the second-semester group with much higher proficiency level scores in the production task. A hypothesis which can be drawn from the findings in paper III, thus, is that exposure to the target language more than proficiency level per se is important for prepositions to become entrenched enough for productive retrieval. A possible explanation for this is the fact that, even though this was never tested, it is likely that *au-dessus de* and *sous* were part of the receptive vocabulary of the first-semester group. After all, prepositions are high-frequency words. In their study of the acquisition of prepositions in L2 English by native speakers of Dutch, Lowie and Verspoor (2004) found effects of preposition frequency even in participants with low proficiency levels in the L2. They argued that this effect was due to the overall high frequency of prepositions. Furthermore, prepositions are part of the vocabulary usually taught in language class in schools. In a Norwegian school setting, French prepositions are taught relatively early on, often in specific lessons targeting certain preposition usages [1]. It is therefore likely that L2 learners at relatively low proficiency levels have had sufficient exposure to input for the prepositions to have become established in their receptive vocabulary. Furthermore, it seems that limited amounts of further input is enough for the prepositions to become so entrenched they can be retrieved for production. Still, it is likely that the L2 learner's knowledge of the meaning of the prepositions will develop with increasing exposure to the ways in which they are used in the target language, and not least, with increasing use by the L2 learner.

The most important finding in Paper III, however, is the fact that both production data and rating data show increasing within-group consistency with increasing proficiency in the L2. In the production data, this is indicated by the longer linkage distances between the overall clusters in the second-semester group compared to the first-semester group, and it is further corroborated from the differences in use in percent of the main contributing prepositions from each of the two groups (see

[1] For instance, in both *Formidable 1* (Brandelius, 2002) and *Rendez-vous 1* (Hønsi, Kjetland, & Liautaud, 2012), textbooks for beginners in year 8 and 13, respectively, prepositions (including spatial prepositons) are the target of one specific section.

Appendix, Paper III). The participants in the first-semester group use a greater variety of prepositions to describe the same picture than do the second-semester group. More participants in the second-semester group use the same preposition to describe each picture than in the first-semester group. This is consistent with findings from studies of the development lexical depth in the L2 (see Section 4.3.2). Using a word-association paradigm, Zareva (2007) found that intermediate level L2 users displayed considerable within-group variation in their responses, while advanced users were more consistent in theirs. She also found that advanced L2 users displayed more variation in their responses than native speakers did. The second experiment in Paper III shows the same decreasing variability with increasing proficiency. Experiment 2 in Paper III elicited rating data from two groups of participants with different L2 proficiency levels; intermediate and advanced. The main objective of the experiment was to look for differences between the two groups in how they modulated their acceptability ratings as a consequence of changes to geometric and functional information in spatial scenes in order to gain an indication of the development of knowledge for each of these components. No significant differences between the two groups were found. Several possible reasons for this missing effect of proficiency were discussed. However, Levene's test for homogeneity of variances was significant for a number of the variables in the analyses, indicating that acceptability ratings displayed more variation in one group than in the other. In fact, variation was always bigger in the intermediate group than the advanced group. It is clear from this experiment in Paper III that within-group variation diminishes with increasing proficiency. Interestingly, the same heterogeneity of variance was found between the ratings of L2 users and native speakers in Paper II. In this case there was more within-group variation in the ratings of L2 users than in those of native speakers.

In sum, Experiment 1 in Paper III shows that variation in preposition production diminishes with increasing proficiency. Experiment 2 shows that variation is still attested in intuitions about preposition meaning after prepositions are part of the L2 user's productive vocabulary, but that this variation diminishes with increasing levels of proficiency. The findings in Paper III indicate continued semantic restructuring for prepositions in the L2 also after they can be reliably retrieved for production. These findings are consistent with a view of lexical development according to which lexical knowledge consolidates over time and deepens in the process.

6.1.3 Implications for the acquisition of spatial prepositions in the L2

The Functional Geometric Framework proposes a flexible interface between linguistic and non-linguistic factors that are relevant for the meaning of spatial prepositions. Moreover, the framework's flexibility allows it to capture degrees of variation along its components. The routines of the FGF constitute processes that are relevant exactly for the on-line processing of prepositional meaning. Rather than specifying the generic "meaning" of prepositions, meaning in the FGF is construed on-line in the specific situation. The model proposed by the framework allows the language user to integrate information from its different subcomponents to build situation models which are the most

informative possible in terms of mapping to linguistic labels (prepositions), where the underlying variation is weighted for relevance in the communicative situation. The advantage of this model is that the polysemy of spatial prepositions can be captured without the need to posit several entries into the mental lexicon of the same lexical form (preposition). In second language acquisition this reduces the need for storing one L2 preposition with several possible L1 translations. In the L1, adult-like semantic representations for spatial prepositions take time to develop; it has been found that children's representations of spatial prepositions differ somewhat from those of adults (Richards & Coventry, 2005; Richards et al., 2004), that it is not until adolescence that children have acquired adult-like representations, and moreover, that it is typically adult-like distinctions based on functional information that takes time to develop (Feist, 2008a). Because learning the correct use of prepositions is notoriously difficult in a second language, a question about the L2 acquisition of spatial prepositions has been which of the underlying semantic components of spatial preposition meaning is the most difficult for L2 learners to acquire. Evidence from the literature so far (Coventry et al., 2011) suggests that in the case of projective prepositions denoting location on the vertical axis the ability to assign native-like weight to geometric routines develops with proficiency in the L2. The same trend was shown in Paper II. While the debate has been over whether native-like attainment of functional or geometric cues is the first to emerge and to be mastered by L2 learners, the answer to the question may be more complex than that. In fact, this may be a function of the degree of convergence and interdependency between geometry and function. I have already mentioned that geometric routines and dynamic-kinematic routines are more tightly linked for topological prepositions than for projective prepositions, where geometry alone is a strong cue for preposition validity.

In Section 4.3.1 models of the bilingual lexicon were discussed. Models which include an aspect of development in L2 proficiency typically assume that L2 words are first tightly linked to L1 properties, both syntactic and semantic/conceptual. In the Revised Hierarchical Model, for instance, links from L2 words to L1 words become weakened with increasing L2 proficiency, whereas links from L2 words to the conceptual representational level strengthen. Recent theories about conceptual representations treat these as consisting of bundles of semantic features.

A first step in the entry of an L2 preposition into the lexicon may be that all weightings for the components of the FGF associated with the corresponding L1 preposition are kept. The L2 preposition may therefore initially be mapped onto a situation model which is built on the basis of L1 knowledge. In his model, Jiang (2000) refers to this as the L1 lemma mediation stage, a stage where the L2 word does not contain any semantic information, but simply a pointer to its L1 translation equivalent. At this stage, he argues, the use of an L2 word involves lexical association from the L2 to the L1. This is also consistent with the Revised Hierarchical Model. Increasing experience with the L2 will further lead to adjustments of the weightings for the components of the FGF towards those displayed in native speakers of the target language. The L2 user must figure out how much weight each component

carries, i.e., how decisive that component is for the felicitous use of or a native-like comprehension of a particular preposition. Stringer (2011), who takes a generative approach, accounts for the variation in L2 users performance in terms of lexical feature reassembly (see also Lardiere, 2009). In his account, cross-linguistic variation is due to variation in the ways semantic features bundle on lexical heads. L2 learners transfer semantic features from their L1 and subsequently have to reassemble them on L2 lexical heads as they are exposed to target-language use. Stringer's account may be particularly relevant to the object knowledge component of the FGF, as this also relates to the habitual (and somewhat arbitrary) co-occurrence of prepositions and nouns in the target language. This particular property may be specifically difficult for L2 learners to acquire, and the typical way in which words co-occur is therefore the constraint that is the most common source of transfer in the acquisition process (Coventry et al., 2011). This particular type of lexical semantic feature, being arbitrary, takes repeated exposure and perhaps even specific attention to reassemble correctly.

For Norwegian L2 learners of French, what we have seen, is that overall not much conceptual restructuring is needed, at least when it comes to the prepositions studied in the present project. In many instances they can get away with relying on their L1 representations. What they have to learn is to reassemble some basic semantic features, in Stringer's terms, when specific objects and object labels are involved (for instance learning that it is ***dans*** *le plat* rather than ***sur*** *le plat* in French). But more than this, they have to fine-tune the strength of each of the sematic features, or the weight of each of the component parts of the FGF, to arrive at a more native-like comprehension of the prepositions. This is the case with respect to the preposition *au-dessous de*, where L2 users generalized meaning over the three prepositions denoting inferiority on the vertical axis, treating them as equally "good" to describe the spatial relationship. With respect to prepositions denoting location on the vertical axis in general, the L2 participants in the present study underestimated the effect of geometry on the acceptability of the prepositions, despite the fact that their native language makes the same marked gradedness along this continuum as does the target language.

6.1.4 Future research

Future research should include larger studies of the semantics of Norwegian and French prepositions. Including more and more varied object types, experimental studies can produce a more comprehensive picture of how spatial prepositions in Norwegian and French are comprehended and produced. Another interesting venue for research is to include participants from different age groups in order to establish if and how comprehension of spatial prepositions develops in L1 Norwegian and L1 French. This kind of experimental research could include comparisons of results for L1 French and L1 Norwegian to those of L1 English to give an indication of the similarities and differences found within European languages, and whether English really is a good candidate for cross-linguistic comparisons. Future research on the acquisition of French spatial prepositions by native speakers of Norwegian would do well to include learners at different levels of proficiency in the L2, from

beginners to advanced learners. Based on the FGF, fine-grained predictions about the developmental trajectory in L2 preposition acquisition can be investigated. A longitudinal study would be particularly powerful in this respect. Because acceptability ratings for L1 Norwegian and L1 French displayed analogous patterns, an extended study of the L2 acquisition of French prepositions by native speakers of Norwegian could provide more information about the nature of semantic transfer from the L1. Targeting situations where Norwegian and French differ in their preferred choice of preposition, such as *Det er vann på flaska* 'there is water **on** the bottle' vs *Il y a de l'eau dans la bouteille* 'there is water **in** the bottle', could give insights into the degree to which learners overcome overt transfer from the L1. A similar study of the acquisition of English prepositions by Norwegian learners can further contribute to our knowledge of lexical development in the L2, and particularly of how this development proceeds in young L2 learners.

7 Conclusion

The overall objective of the present project was to investigate the semantic underpinnings of a selection of spatial prepositions in Norwegian and French, to assess sources of difficulties for the use and comprehension of such prepositions in an L2, and to investigate how knowledge of the meaning of spatial preposition in a second language changes with increasing proficiency. This was studied within the Functional Geometric Framework, FGF, which permits for a fine-grained study of underlying semantic features relevant for spatial preposition usage; geometric routines, dynamic-kinematic routines and object knowledge.

One important finding in the present study is that geometric and functional information underlie comprehension prepositions in both Norwegian and French in similar ways to those theoretically studied by Vandeloise (1986) and to those established in a large body of experimental work for English prepositions (see Coventry & Garrod, 2004 for an overview). Despite some typological differences in the expression of space in Norwegian and French, native speakers of Norwegian and French make meaning distinctions based on geometry and function in analogous ways. Differences in preposition usage between the two languages stem primarily from language-specific ways of combining object labels and prepositions. Such combinations are sometimes arbitrary, and language conventions may override strong geometric or functional cues for preposition choice. An example of this is the Norwegian use of the preposition *på* ('on') with closed containers for liquids, i.e., jars, bottles, canteens etc. Some instances of preposition usage therefore simply have to be memorized in order to be mastered: "la mémorisation des conventions de la langue peut permettre de maîtriser les emplois des prépositions […] lorsqu'ils ne sont pas clairement prédits par leurs caractéristiques." (Vandeloise, 1986, p. 194). The consequence of the findings for L1 Norwegian and French is that Norwegian learners of L2 French should be able to rely on their intuitions about the semantics of preposition in Norwegian for a native-like comprehension of French prepositions. However, overt errors are likely to occur when language-specific conventions of mapping between object label and preposition differ.

Another important finding in the present project is that preposition learning in the L2 is a dynamic process which takes time and where semantic representations continue to develop in depth also after a preposition has become part of the L2 user's productive vocabulary. A first step in the acquisition of spatial preposition in the L2 may be that semantic representations are fully transferred from the L1. Entrenchment of the preposition subsequently happens over a long timeframe during which the learner continuously readjusts his or her initial idea of what the preposition means. I believe this process to involve continued readjustments of the weightings for the components in the FGF associated with that preposition. With respect to preposition production, the present project has shown that the topological prepositions *sur* and *dans* enter into productive vocabulary earlier than projective

prepositions *au-dessus de* and *sous*. Furthermore, the semantic network for L2 spatial prepositions undergoes structuring and tightening with increasing exposure to and use of the target language. This is indicated by the difference in consistency in preposition production in a group of students in their first semester of academic study of L2 French and a group of students at the end of their second semester. The present project also sheds light on the continued development of semantic representations for prepositions after they can be actively produced. The present study shows that L2 users with relatively high L2 proficiency are able to make native-like distinctions based on functional information for prepositions denoting location on the vertical axis, i.e. they have acquired the correct weightings for dynamic-kinematic routines for these. Still, the L2 users differ from native speakers in the meaning-distinctions they make based on geometrical information. These findings are directly comparable to findings from a large study of the L2 acquisition of prepositions in English and Spanish (Coventry et al., 2011). It is therefore likely that the weighting of geometric information for the meaning of spatial prepositions in the L2 takes longer to readjust than the weighting of functional information, at least for prepositions denoting location on the vertical axis.

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9 Appendix

9.1 Linguistic stimuli

The tables below show the linguistic stimuli in French and Norwegian for the picture series which have been treated in the present thesis (Table 2) and in the picture series which served as fillers in the experiment eliciting acceptability ratings (Table 3). Linguistic stimuli for Filler Series IV, which contained pictures inspired by the Topological Relations Picture Series (BowPed), were of the same format, but with individual sentences for each picture.

Table 2 Linguistic stimuli per Series

Series	**French**	**Norwegian**
I : Lady - umbrella	La femme est ____ parapluie.	Dama er ____ paraplyen.
	Le parapluie est _____femme.	Paraplyen er _____ dama.
II : Box- bowl	Le saladier est _____boîte.	Bollen er _____ boksen.
	La boîte est _____ saladier.	Boksen er _____ bollen.
III : Apple - bowl - plate	La pomme est _____ plat.	Eplet er _____ fatet.
	La pomme est _____ saladier.	Eplet er _____ bollen.
IV : Hand/dish – fly/lock	La mouche est _____ l'assiette.	Flua er _____ skåla.
	La mouche est _____ main.	Flua er _____ hånda.
	Le cadenas est _____ l'assiette.	Hengelåsen er _____ skåla.
	Le cadenas est _____ main.	Hengelåsen er _____ hånda.

Table 3 Linguistic stimuli per Filler Series

Filler Series	**French**	**Norwegian**
I : Postman – post box	Le facteur est _____ boîte à lettres.	Postmannen er _____ postkassa.
II: Ball - car	Le ballon est _____ voiture	Ballen er _____ bilen.
III: Dot – circle - arrow	Le point est _____ cercle.	Prikken er _____ sirkelen.
	Le point est _____ flèche	Prikken er _____ pila.

Appendix

9.2 Prepositions per picture series

Tables below show prepositions used with each picture series in the rating experiments. A total of 18 Norwegian and 19 French prepositions were included.

Table 4 Norwegian preposition per picture series in rating experiments

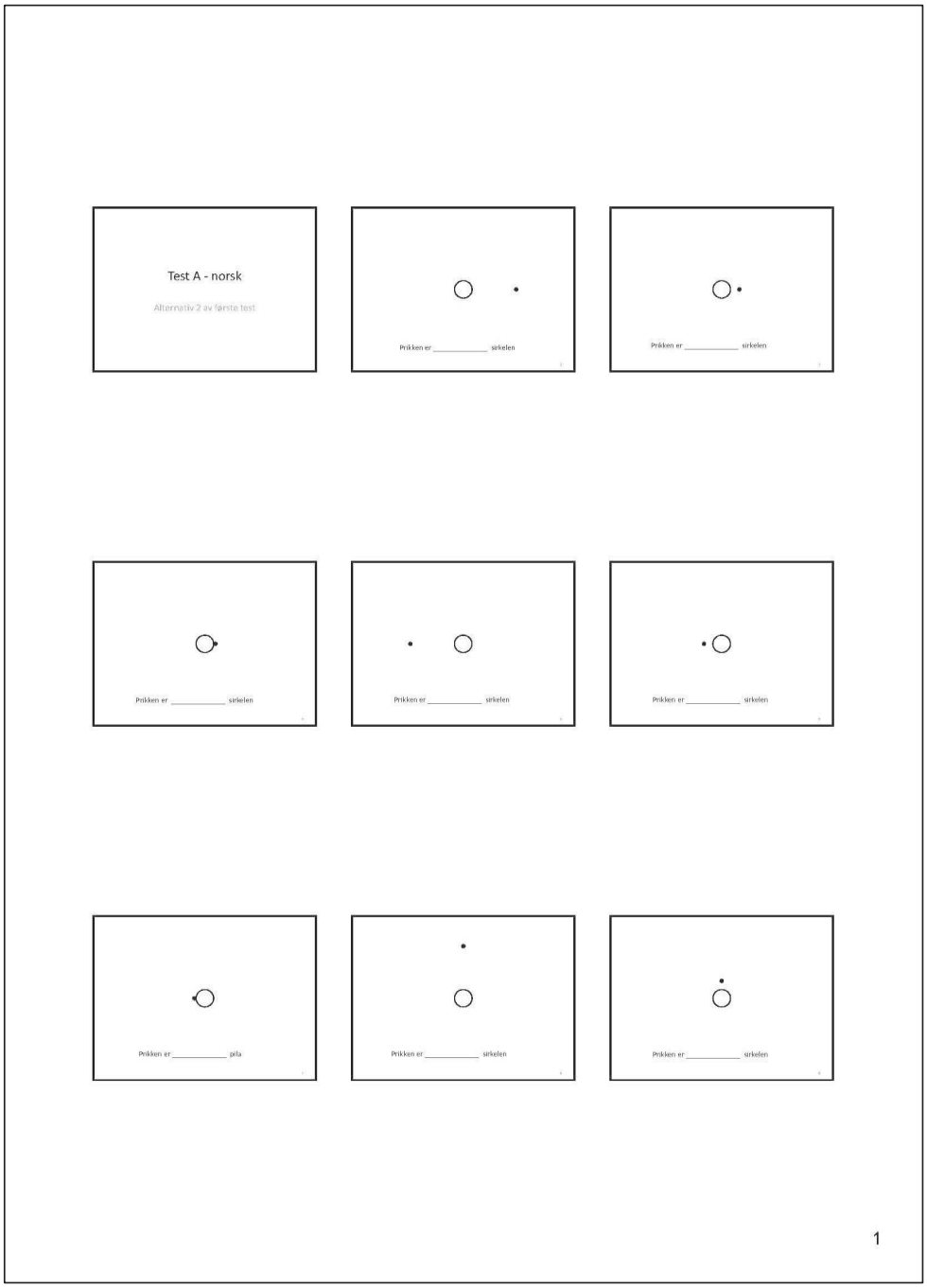
Norwegian prepositions											
Series I and II	Over	under	foran	bak	ovenfor	nedenfor					
Series III and IV	over	på	i	oppi	oppå	nedpå	nedi				
Fillers Series I and II	foran	bak	ved siden av	til høyre for	til venstre for	ved					
Fillers Series III	foran	bak	ved siden av	til høyre for	til venstre for	ved	over	under	på	i	inni
Filler Series IV	i	på	rundt	under	oppi						

In the French version, two sets of expressions (preposition + definite article) are provided. One was used when the noun referring to the reference object was masculine (preposition + *le*) the other when the noun referring to the reference object was feminine (preposition + *la*). However, when the noun referring to the reference object began with a vowel, so that the definite article in French is reduced to *l',* the article was kept with the noun (*l'assiette*) and only the prepositions were presented for rating.

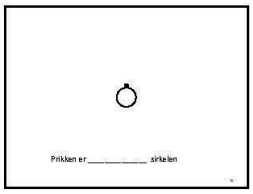
Table 5 French expressions per picture series in rating experiments

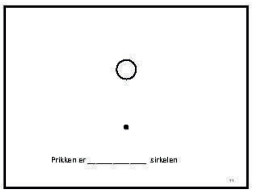
French prepositions + definite articles											
Series I and II	au-dessus du	sous le	devant le	derrière le	au-dessous du	en dessous du	sur le				
	au-dessus de la	sous la	devant la	derrière la	au-dessous de la	en dessous de la	sur la				
Series III	au-dessus du	sur le	dans le	à l'intérieur du	en haut du						
	au-dessus de la	sur la	dans la	à l'intérieur de la	en haut de la						
Series IV	au-dessus de	sur	dans	à l'intérieur de	en haut de						
Filler Series I and II	devant la	derrière la	à côté de la	à droite de la	à gauche de la	à la	loin de la	près de la	face à la		
Filler Series III	devant le	derrière le	à côté du	à droite du	à gauche du	au-dessus du	sous le	sur le	dans le	en dessous du	contre le
	devant la	derrière la	à côté de la	à droite de la	à gauche de la	au-dessus de la	sous la	sur la	dans la	en dessous de la	contre la
Filler Series IV	dans le	sur le	autour du	sous le	au	en dessous du					
	dans la	sur la	autour de la	sous la	à la	en dessous de la					
	dans	sur	autour de	sous	à	en dessous de					

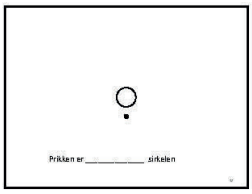
9.3 Test parts – rating experiment

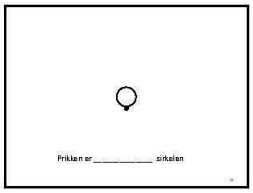


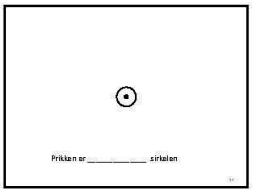
Appendix


Prikken er _____ sirkelen


Prikken er _____ sirkelen


Prikken er _____ sirkelen


Prikken er _____ sirkelen


Prikken er _____ sirkelen


Dama er _____ paraplyen


Dama er _____ paraplyen


Dama er _____ paraplyen

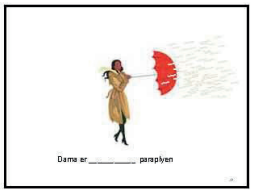

Dama er _____ paraplyen

2


Dama er _____ paraplyen


Dama er _____ paraplyen


Dama er _____ paraplyen


Dama er _____ paraplyen


Dama er _____ paraplyen


Paraplyen er _____ dama


Paraplyen er _____ dama

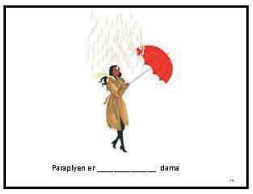

Paraplyen er _____ dama

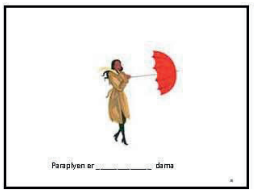

Paraplyen er _____ dama

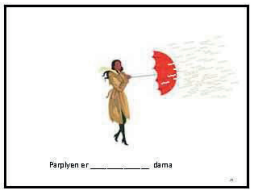
3

Appendix


Paraplyen er _____ dama


Paraplyen er _____ dama

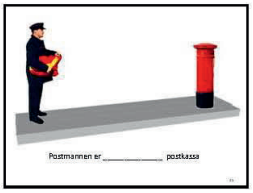

Paraplyen er _____ dama


Paraplyen er _____ dama


Paraplyen er _____ dama


Postmannen er _____ postkassa


Postmannen er _____ postkassa

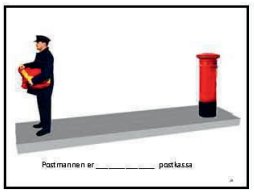

Postmannen er _____ postkassa

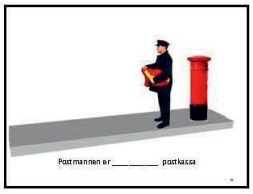

Postmannen er _____ postkassa

4


Postmannen er _____ postkassa

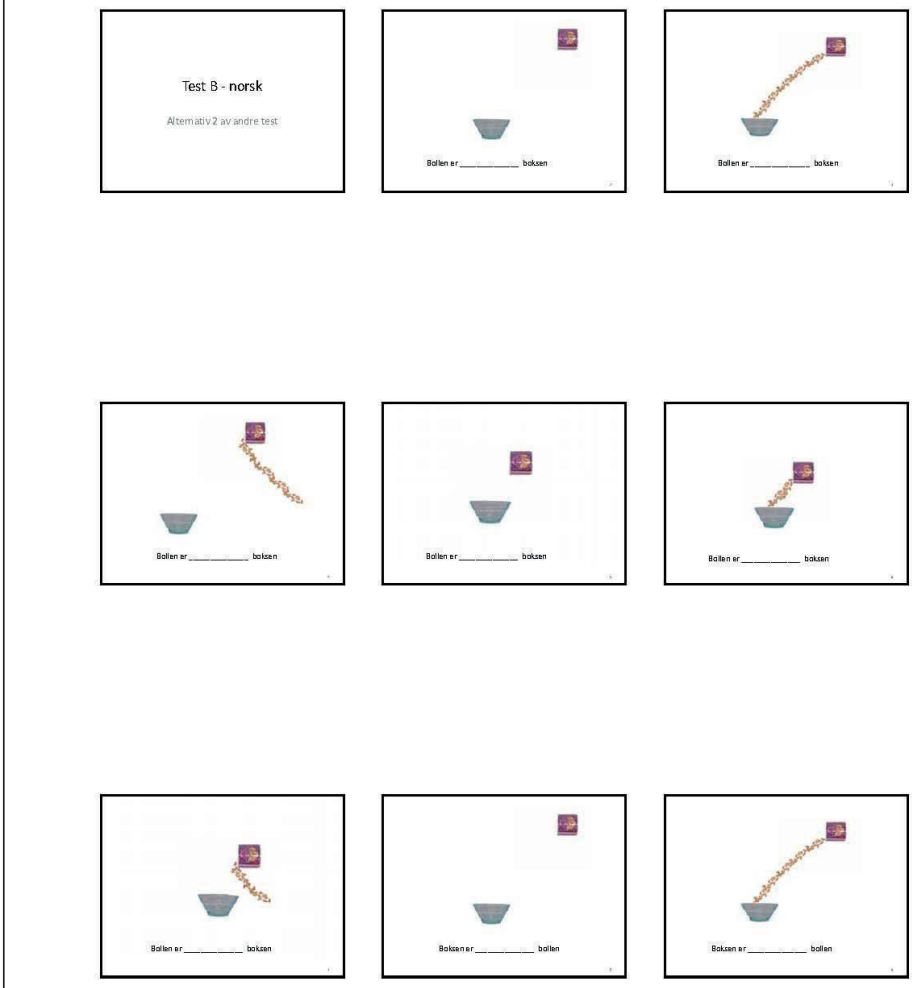

Postmannen er _____ postkassa


Postmannen er _____ postkassa


Postmannen er _____ postkassa

5

Appendix


Test B - norsk
Alternativ 2 av andre test
Ballen er _____ boksen
Ballen er _____ boksen
Ballen er _____ boksen
Ballen er _____ boksen
Ballen er _____ boksen
Ballen er _____ boksen
Ballen er _____ boksen
Boksen er _____ ballen
Boksen er _____ ballen
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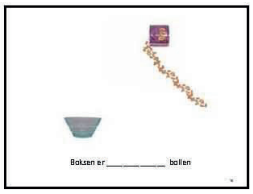
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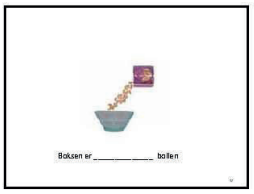
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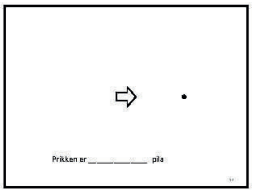
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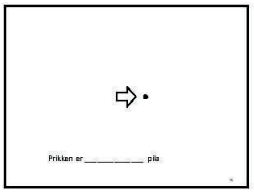
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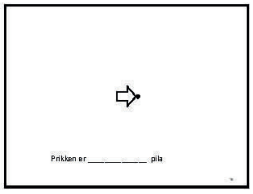
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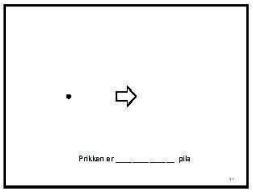
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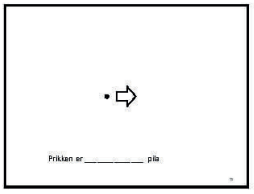
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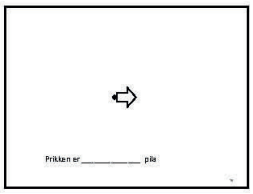
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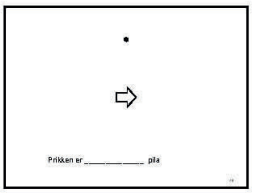
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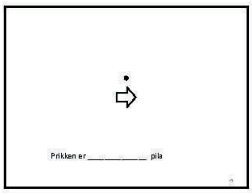
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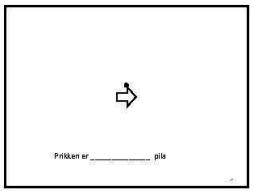
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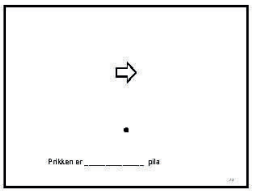
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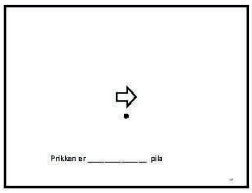
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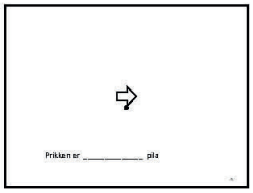
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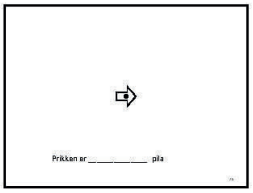
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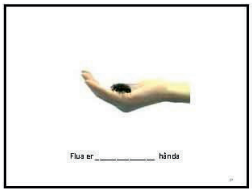
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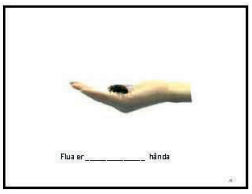
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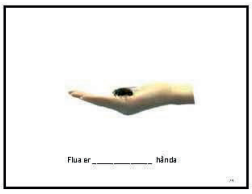
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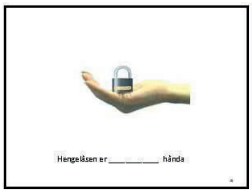
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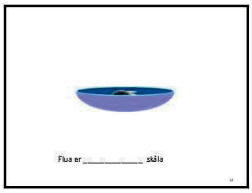
Hengelåsen er _____ hända


Hengelåsen er _____ hända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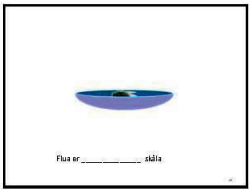
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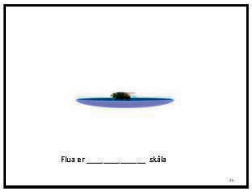
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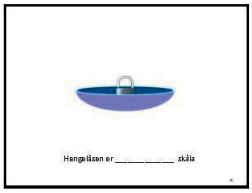
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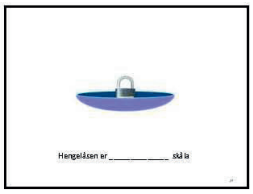
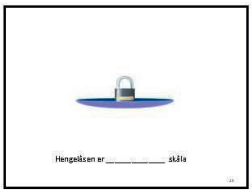




5

Test C

Alternativ 2 for tredje test

Ballen er _____ bilen

Ballen er _____ bilen

Ballen er _____ bilen

Ballen er _____ bilen

Ballen er _____ bilen

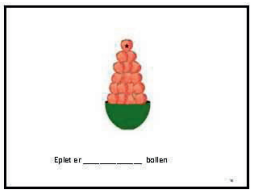
Ballen er _____ bilen

Ballen er _____ bilen

Ballen er _____ bilen

1

Appendix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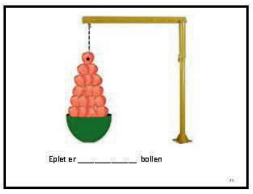
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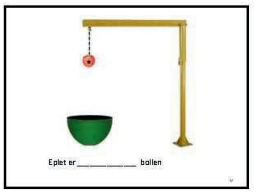
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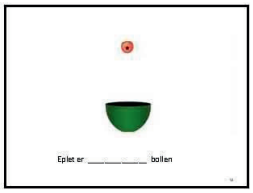
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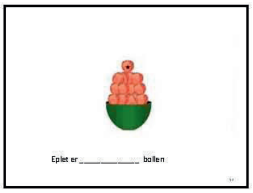
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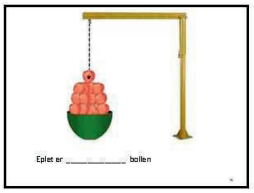
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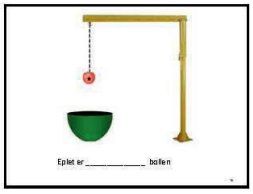
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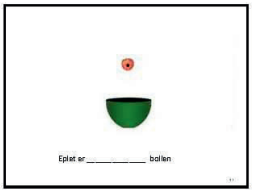
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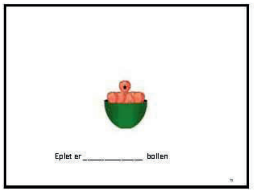
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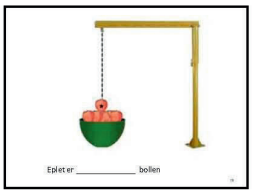
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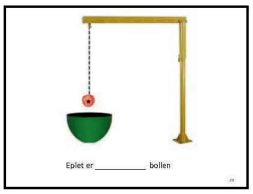
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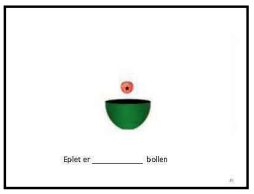
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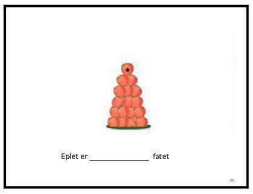
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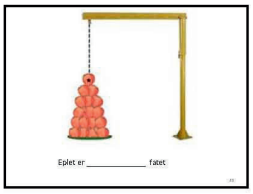
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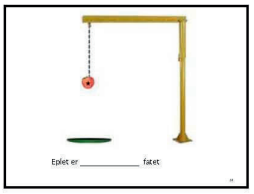
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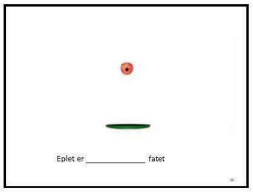
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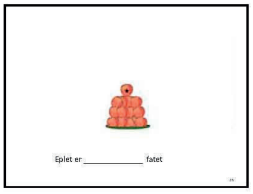
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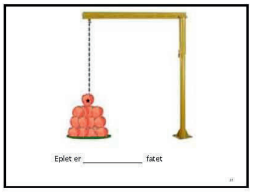
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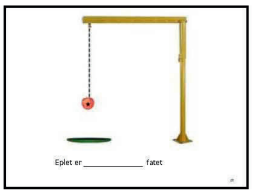
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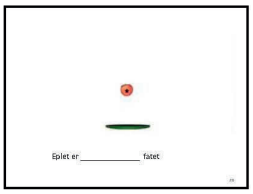
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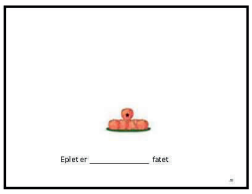
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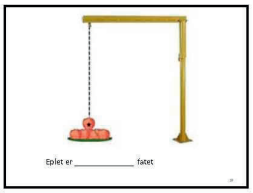
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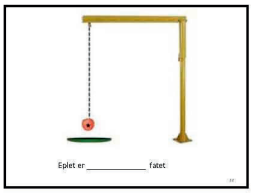
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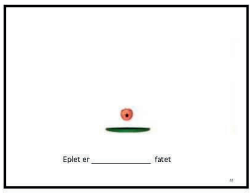
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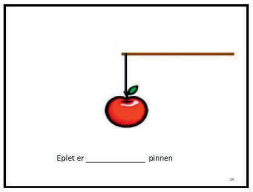
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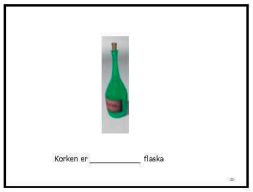
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Håndtaket er _____ døra

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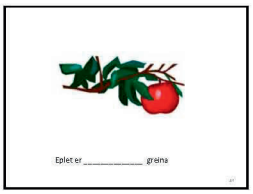
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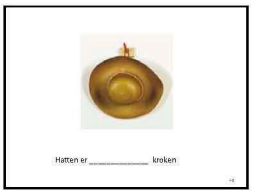
Blomstene er _____ vasen


Plasteret er _____ leggen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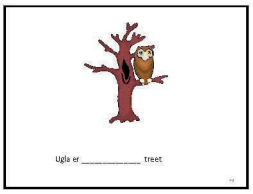
Katten er _____ matta


Frimerket er_____ konvolutten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Bildet er _____ veggen


Ringen er _____ fingeren

5

Appendix

9.4 Information to participants and background questionnaire

9.4.1 Information and consent form

Forespørsel om deltakelse i forskningsprosjektet

"Å skape nye rom. Tilegnelse av stedspreposisjoner i fremmedspråk"

Bakgrunn og hensikt
Dette er et spørsmål til deg om å delta i en forskningsstudie som undersøker hva som er viktig for norskspråklige som skal lære seg å bruke stedspreposisjoner (for eksempel *på, i, under* osv.) i et fremmedspråk. Veldig mange som lærer et fremmedspråk, synes nettopp preposisjoner er vanskelige å få taket på. Hensikten med studien er blant annet å finne ut om man kan gjøre noe som letter innlæringen av preposisjoner i fremmedspråk, samt å si noe om hva som påvirker bruken av preposisjonene på norsk og fransk.

I studien undersøker vi bruk av stedspreposisjoner på norsk som morsmål, på fransk som morsmål og på fransk som fremmedspråk. Til studien trenger vi deltakere i 3 kategorier: 1) En gruppe deltakere som har norsk som morsmål og ikke kan fransk. 2) En gruppe deltakere som har fransk som morsmål og ikke kan norsk. 3) En gruppe deltakere som har norsk som morsmål og fransk som fremmedspråk. Det vil være ca 30 deltakere i hver gruppe, til sammen ca 90 deltakere i studien.

Studien gjøres som en del av et doktorgradsprosjekt innenfor forskningsgruppen Språk og kognisjon ved Institutt for moderne fremmedspråk ved NTNU. Den er en tilpassing av en større studie om preposisjoner i fremmedspråk ved University of Northumbria, Storbritannia.

Hva innebærer studien?
For at resultatene skal bli så presise som mulig, trenger vi noe informasjon om deg. Du vil få tilsendt et spørreskjema hvor vi stiller en del spørsmål som er relevante for språkbruk på morsmål og fremmedspråk. Det gjelder blant annet hvilke språk du eventuelt kan eller snakker i tillegg til norsk og/eller fransk, hvor du er vokst opp/hvilken dialekt du snakker, og om du har eller har hatt noen språkvansker. Dersom du er i gruppa med fransk som fremmedspråk, trenger vi også noe informasjon om hvilket nivå du har på fransken din, målt ved hjelp av en kortere språktest på nett. Denne informasjonen vil ikke kunne knyttes til ditt navn når resultatene fra studien publiseres.

Selve forskningsstudien består av tre tester som gjøres på nett. Du vil få tilsendt lenke til hver av testene. Hver test består av en serie bilder med tilhørende setninger og preposisjoner som du skal vurdere. Det er ikke "riktige" eller "gale" svar, vi er ute etter din vurdering. Hver test tar om lag 30-45 minutter å gjennomføre.

Hva skjer med testene og informasjonen om deg
Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres. Alle opplysningene og testene vil bli behandlet uten navn eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger og tester gjennom en navneliste.

Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. Informasjonen om deg vil bli anonymisert ved prosjektslutt.

Testene du gjennomfører og informasjonen som registreres om deg, skal kun brukes slik som beskrevet i hensikten med studien.

Å skape nye rom Samtykke 15.08.2011

Frivillig deltakelse
Det er selvsagt frivillig å delta i studien. Du kan når som helst og *uten å oppgi noen grunn*, trekke ditt samtykke til å delta i studien. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Om du nå sier ja til å delta, kan du senere trekke tilbake ditt samtykke.

Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte Kjersti Faldet Listhaug, kjersti.listhaug@ntnu.no, telefon: 73 59 67 96.

Ytterligere informasjon
Kriterier for deltakelse
For å kunne delta i studien, må du:

- Gruppe 1) ha **norsk som morsmål**, og du må ***ikke kunne fransk***.
- Gruppe 2) ha **fransk som morsmål**, og du må ***ikke kunne norsk***.
- Gruppe 3) ha **norsk som morsmål** og du må ha ***fransk som fremmedspråk*** (nivå: middels/avansert)

Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

Navn: _____

E-post: _____

Adresse: _____

Jeg vil/kan delta i gruppe

☐ 1 – norsk som morsmål, kan ikke fransk

☐ 2 - fransk som morsmål, kan ikke norsk

☐ 3 – norsk som morsmål, fransk som fremmedspråk

(Dato og signatur)

Jeg bekrefter å ha gitt informasjon om studien

(Signert, prosjektleder, dato)

Appendix

Demande de participation au projet de recherche

« Se créer de nouveaux espaces. L'acquisition de prépositions spatiales en français L2.»

Données et finalités du projet

Dans le cadre du projet de recherche concernant l'étude des facteurs importants de l'apprentissage des prépositions spatiales (*sur, dans, sous* etc.), nous solliciterons votre participation. Comme les langues varient dans leur façon de découper et délimiter l'espace, ces prépositions constituent un véritable défi pour les apprenants d'une langue étrangère. Les buts de cette étude sont a) d'établir l'importance des facteurs qui déterminent l'emploi des prépositions spatiales en norvégien et en français langues maternelles, b) d'identifier les facteurs qui posent le plus de problèmes pour les apprenants de français.

Nous étudions l'emploi de prépositions spatiales en norvégien langue maternelle, en français langue maternelle et par des apprenants norvégiens de français langue étrangère. L'étude comprend 3 catégories de participants: 1) Un groupe de norvégiens natifs qui ne parlent pas français. 2) Un groupe de français natifs qui ne parlent pas norvégien. 3) Un groupe de norvégiens natifs qui parlent le français. Il y aura environ 30 participants dans chaque groupe, soit un total d'environ 90 participants.

Cette étude fait partie d'un projet de doctorat au sein du groupe « Langage et cognition » du Département des Lettres modernes à l'Université des sciences et techniques de Norvège (NTNU). Elle est une adaptation d'une grande étude issue de l'Université de Northumbria, Grande Bretagne, sur l'acquisition de prépositions spatiales en anglais et espagnol langues étrangères.

Participer à l'étude : Qu'est-ce que cela veut dire?

Pour assurer la précision des résultats, nous vous demanderons quelques renseignements sur vos compétences linguistiques. Vous devrez répondre à un questionnaire concernant vos connaissances en langues étrangères autres que le norvégien, vos séjours en des pays non-francophones, vos éventuelles difficultés linguistiques telles que la dyslexie, etc. Il ne sera pas possible de vous identifier à partir de ces données quand les résultats de l'étude seront publiés.

Le questionnaire sur les prépositions comprend trois parties qui se trouvent en ligne. Vous vous enregistrerez avec un code fourni par la responsable du projet (Kjersti Faldet Listhaug). Chaque partie contient une série d'images auxquelles sont associées des phrases et des prépositions. On vous demandera d'évaluer l'acceptabilité des prépositions relative à la combinaison image/phrase. Il n'y a pas de réponse « bonne » ou « mauvaise », ce qui nous intéresse, c'est votre avis. Il faut compter environ 30 minutes pour finir chaque partie. A la fin de chaque partie, vous êtes libre de quitter le questionnaire, puis de recommencer plus tard.

Traitement de vos données et des résultats du test

Il ne sera pas possible de vous reconnaître à partir des résultats de l'étude quand ceux-ci seront publiés. Les renseignements que vous aurez donnés, ainsi que vos réponses seront traités dans le plus strict anonymat. Un code vous lie à vos données et vos réponses. Seuls les

responsables du projet ont accès à la clé qui relie nom et code. Vos données seront anonymisées à la fin du projet.

Ni vos données personnelles, ni les résultats de votre participation, ne pourront être utilisés à d'autres fins que celles de la présente étude.

Participation volontaire
La participation à l'étude est volontaire. Si vous acceptez de participer veuillez signer la déclaration de consentement à la fin de ce document. Vous êtes libre de retirer votre consentement à tout moment, sans fournir d'explication.

Si vous avez des questions vous pouvez contacter le responsable du projet, Kjersti Faldet Listhaug: kjersti.listhaug@ntnu.no, téléphone : +47 934 59 083

Information supplémentaire
Critères pour la participation

- Groupe 1) **norvégien** langue maternelle, *aucune connaissance en français.*
- Groupe 2) **français** langue maternelle, *aucune connaissance en norvégien.*
- Groupe 3) **norvégien** langue maternelle, *français langue étrangère* (niveau moyen/avancé)

Consentement à la participation

Je consens à participer à l'étude

Nom: _____

E-mail: _____

Adresse: _____

Je participerai dans le groupe

☐ 1 – norvégien langue maternelle

☐ 2 - français langue maternelle

☐ 3 – norvégien langue maternelle, français langue étrangère

(Date et signature)

Je confirme avoir informé le participant de l'étude

(Date et signature de la responsable du projet)

9.4.2 Background information questionnaire

Bakgrunnsinformasjon for forskningsprosjekt om stedspreposisjoner i fremmedspråk.

Tusen takk for at du har sagt ja til å delta i mitt forskningsprosjekt om tilegnelse av stedspreposisjoner i fremmedspråk. I dette skjemaet ber jeg om bakgrunnsinformasjon som er nødvendig for at resultatene fra undersøkelsen skal kunne brukes.

Alle opplysningene du gir her, vil senere bli behandlet uten navn eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. Del B og C av dette skjemaet vil bare oppbevares med koden, ikke med ditt navn. Informasjonen om deg vil bli anonymisert ved prosjektslutt. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Legg merke til at skjemaet har 4 sider.

Skjemaet returneres i vedlagte svarkonvolutt eller leveres direkte til meg.

Med takknemlig hilsen,

Kjersti Faldet Listhaug
Stipendiat
Institutt for moderne fremmedspråk, NTNU

Del A: Personlig informasjon

Navn: _____

E-postadresse: _____

Fødselsår: _____

Kjønn ☐ Kvinne ☐ Mann

Bostedskommune: _____

Forskningsprosjekt Kjersti Faldet Listhaug

Deltakerkode:
(Fylles inn av prosjektleder)

Del B: Språklig bakgrunn

Morsmål

Er norsk morsmålet ditt?

☐ Ja ☐ Nei

Hvis ja, har du andre morsmål i tillegg?

☐ Ja ☐ Nei

Hvis ja, hvilke(t) språk? _____

På norsk, hvilken dialekt snakker du? _____

Hvor i Norge har du bodd, og hvor lenge?

Kommune	Antall år totalt

Engelsk og andre fremmedspråk

I **engelsk**, hvordan vurderer du ferdighetene dine på hvert av disse områdene?

	Grunnleggende	Middels	Avansert	Flytende
Lesing				
Skriving				
Snakke				
Lytte				
Totalt				

Har du bodd i, eller hatt lengre opphold i, et land hvor engelsk er hovedspråk?

☐ Ja ☐ Nei

Hvis ja, hvor lenge varte oppholdet/oppholdene? _____

_____

Har du bodd i, eller hatt lengre opphold i, et land hvor annet enn engelsk er hovedspråk?

☐ Ja ☐ Nei

Hvis ja, hvor var det, og hvor lenge varte oppholdet/oppholdene?_____

_____

2

Appendix

Hvilke språk kan du utover morsmålet ditt og engelsk?
*(Hvis du ikke snakker andre språk, gå til **del C**)*

Språk	Nivå			
	Grunnleggende	Middels	Avansert	Flytende
Tysk				
Fransk				
Spansk				
- angi språk				
- angi språk				
- angi språk				

For deltakere i gruppen med fransk som fremmedspråk
*(Hvis du ikke er i gruppen med fransk som fremmedspråk, gå til **del C**)*

I **fransk**, hvordan vurderer du ferdighetene dine på hvert av disse områdene?

	Grunnleggende	Middels	Avansert	Flytende
Lesing				
Skriving				
Snakke				
Lytte				
Totalt				

Har du bodd i, eller hatt lengre opphold i, et land hvor fransk er hovedspråk?

☐ Ja ☐ Nei

Hvis ja, hvor lenge varte oppholdet/oppholdene? _____

_____

Del C: Andre faktorer i språklæring

Har du, eller har du hatt, problemer med synet utover normal brillebruk?

☐ Ja ☐ Nei

Har du, eller har du hatt, problemer med hørselen?

☐ Ja ☐ Nei

Har du, eller har du hatt, språkvansker av noe slag (spesifikke språkvansker, dysleksi eller lignende)?

☐ Ja ☐ Nei

Forskningsprosjekt Kjersti Faldet Listhaug

Har du, eller har du hatt, andre diagnoser som kan tenkes å påvirke språklæring (ADHD, autisme eller lignende)?

☐ Ja ☐ Nei

Hadde du vanskeligheter med å lære forskjell på høyre og venstre?

☐ Ja ☐ Nei

*Hvis **ja** på ett eller flere av punktene over, vennligst spesifiser her:*

Er du flink til å gi veibeskrivelser (forklare hvordan folk skal gå/kjøre for å komme fra A til B)?

☐ Ja, veldig flink. ☐ Ja, nokså flink. ☐ Nei, ikke spesielt.

Er du flink til å følge veibeskrivelser?

☐ Ja, veldig flink. ☐ Ja, nokså flink. ☐ Nei, ikke spesielt.

*Hvis **nei** på ett av eller begge punktene over, vennligst spesifiser her:*

4

Appendix

Informations sur les compétences linguistiques du participant au projet de recherche *Se créer de nouveaux espaces*.

Vous avez consenti à participer à mon projet de recherche sur l'emploi des prépositions spatiales en français ainsi que sur l'acquisition des prépositions spatiales en français langue étrangère. Je vous en remercie. Ce questionnaire servira à établir certains aspects de vos compétences linguistiques nécessaires pour la bonne interprétation des résultats.

Toute information donnée ici sera dans la suite traitée dans l'anonymat le plus strict. Un code vous liera à votre information. Seules les personnes autorisées ont accès à la clé qui lie nom et code. Les parties B et C de ce questionnaire seront archivées avec le code uniquement. Votre nom n'y figurera pas. L'information vous concernant sera anonymisée à la fin du projet. Il sera impossible de vous identifier dans les résultats de l'étude lorsqu'ils seront publiés.

Vous retournerez le formulaire dûment rempli (4 pages) à la responsable du projet, Kjersti Faldet Listhaug, en main propre, ou par mail.

kjersti.listhaug@ntnu.no

Cordialement,

Kjersti Faldet Listhaug (responsable de projet)
Candidate PhD
Département des Lettres modernes
Université des sciences et techniques de Norvège (NTNU), Trondheim.

Partie A: Renseignements personnels

Nom: _____

E-mail: _____

Année de naissance: _____

Sexe ☐ Femme ☐ Homme

Département de résidence: _____

Projet de recherche Kjersti Faldet Listhaug

Code de participant:
(Rempli par le responsable du projet)

Partie B: Compétences linguistiques

Langue maternelle

Le français est-il votre langue maternelle?

☐ Oui ☐ Non

Si oui, avez-vous aussi d'autres langues maternelles?

☐ Oui ☐ Non

Si oui, quelle(s) langue(s)? _____

Départements et durée de résidence en France.

Département /Ville	Années de résidence

Anglais et autres langues étrangères

En **anglais**, quel est votre niveau de compétence dans chacun de ces domaines?

	Débutant	Moyen	Avancé	Courant
Lecture				
Ecriture				
Production orale				
Ecoute				
Dans l'ensemble				

Avez-vous vécu ou séjourné dans un pays où l'anglais est la langue principale?

☐ Oui ☐ Non

Si oui, où étiez-vous et quelle était la durée de votre séjour ? _____

_____

___

Avez-vous vécu ou séjourné, dans un pays étranger où une autre langue que l'anglais est la langue principale ?

☐ Oui ☐ Non

2

Appendix

Si oui, où étiez-vous et quelle était la durée de votre/vos séjour(s) ? _____

_____

Excepté l'anglais et votre langue maternelle, quelles langues parlez-vous?
(Si vous ne parlez pas d'autre langue, vous pouvez passer à ***la partie C****)*

Langue	Niveau			
	Débutant	Moyen	Avancé	Courant
Allemand				
Espagnol				
Italien				
- Indiquer une langue				
- Indiquer une langue				
- Indiquer une langue				

Partie C: Autres facteurs dans l'acquisition des langues

Avez-vous, ou avez-vous eu, des problèmes de vision autres que des corrections normales (lunettes)?

☐ Oui ☐ Non

Avez-vous, ou avez-vous eu, des problèmes d'ouïe?

☐ Oui ☐ Non

Avez-vous, ou avez-vous eu, des troubles langagiers (troubles du langage spécifiques, dyslexie ou autre)?

☐ Oui ☐ Non

Avez-vous été diagnostiqué pour d'autres formes de troubles susceptibles d'intervenir dans l'acquisition des langues (Autisme, TDA/H ou autre)?

☐ Oui ☐ Non

La différence entre « gauche » et « droit » (orientation de l'espace) a-t-elle semblé difficile à apprendre?

☐ Oui ☐ Non

Projet de recherche Kjersti Faldet Listhaug

*Si vous avez répondu **oui** à une ou plusieurs questions, veuillez préciser vos réponses ici :*

Etes-vous doué(e) pour donner des descriptions de route (expliquer la route de A à B)?

☐ Oui, très doué(e). ☐ Oui, assez doué(e). ☐ Non, pas particulièrement.

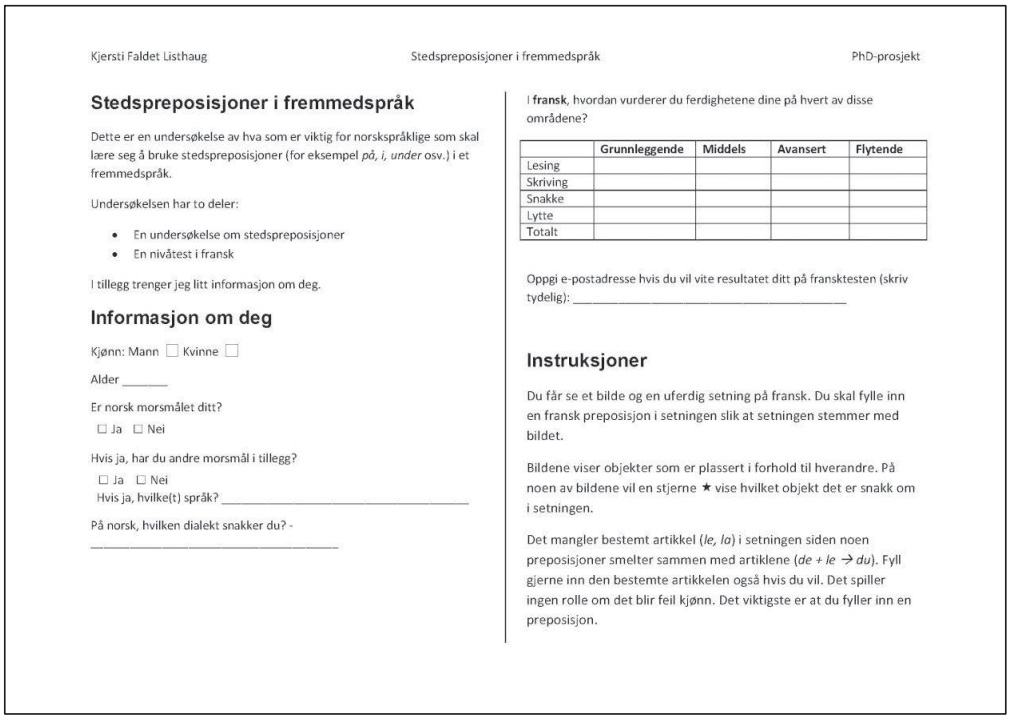
Etes-vous doué(e) pour suivre des descriptions de route ?

☐ Oui, très doué(e). ☐ Oui, assez doué(e). ☐ Non, pas particulièrement.

*Si vous avez répondu **non** à un ou deux des points ci-dessus, veuillez préciser vos réponses ici :*

4

9.4.3 Background information and information - production data study



Kjersti Faldet Listhaug Stedspreposisjoner i fremmedspråk PhD-prosjekt

Stedspreposisjoner i fremmedspråk

Dette er en undersøkelse av hva som er viktig for norskspråklige som skal lære seg å bruke stedspreposisjoner (for eksempel *på, i, under* osv.) i et fremmedspråk.

Undersøkelsen har to deler:

- En undersøkelse om stedspreposisjoner
- En nivåtest i fransk

I tillegg trenger jeg litt informasjon om deg.

Informasjon om deg

Kjønn: Mann ☐ Kvinne ☐

Alder _____

Er norsk morsmålet ditt?

☐ Ja ☐ Nei

Hvis ja, har du andre morsmål i tillegg?

☐ Ja ☐ Nei

Hvis ja, hvilke(t) språk? _____

På norsk, hvilken dialekt snakker du? -

_____

I **fransk**, hvordan vurderer du ferdighetene dine på hvert av disse områdene?

	Grunnleggende	Middels	Avansert	Flytende
Lesing				
Skriving				
Snakke				
Lytte				
Totalt				

Oppgi e-postadresse hvis du vil vite resultatet ditt på fransktesten (skriv tydelig): _____

Instruksjoner

Du får se et bilde og en uferdig setning på fransk. Du skal fylle inn en fransk preposisjon i setningen slik at setningen stemmer med bildet.

Bildene viser objekter som er plassert i forhold til hverandre. På noen av bildene vil en stjerne ★ vise hvilket objekt det er snakk om i setningen.

Det mangler bestemt artikkel (*le, la*) i setningen siden noen preposisjoner smelter sammen med artiklene (*de + le → du*). Fyll gjerne inn den bestemte artikkelen også hvis du vil. Det spiller ingen rolle om det blir feil kjønn. Det viktigste er at du fyller inn en preposisjon.

Paper I

Les prépositions spatiales en français et en norvégien : une étude expérimentale et comparative[1]

Kjersti Faldet Listhaug
Université des sciences et techniques de Norvège (NTNU)
kjersti.listhaug@ntnu.no

Résumé : La géométrie et la fonctionnalité font partie des facteurs de catégorisation des prépositions spatiales. Se fondant sur le *Functional Geometric Framework* (Coventry & Garrod 2004), cette étude expérimentale de la conceptualisation sous-tendant la compréhension et la production de prépositions spatiales en français et en norvégien – langues appartenant à des classes différentes dans la typologie de Talmy (2000) – montre pour la première fois l'influence des paramètres géométriques et fonctionnels sur la compréhension des prépositions spatiales dans ces deux langues. Les résultats suggèrent des similarités dans la représentation mentale des prépositions spatiales chez les locuteurs natifs français et norvégiens malgré les différences typologiques des langues.

Abstract: *Geometry and function are among the factors underlying comprehension and production of spatial prepositions. Based on the Functional Geometric Framework (Coventry & Garrod 2004), this experimental study investigated the influence of geometric and functional properties of spatial situations on acceptability ratings for spatial prepositions in French and Norwegian. These two languages belong to opposite categories in Talmy's (2000) typology. Results indicate similarities in conceptual representations for spatial prepositions in native speakers of Norwegian and French, despite the typological differences between the two languages.*

1. Introduction

L'expression de l'espace a une place importante dans les analyses de la relation entre la cognition humaine et l'expression linguistique. Ainsi son étude peut nous mener à une compréhension plus profonde des

1. Nous tenons à remercier Kenny Coventry pour nous avoir donné l'autorisation d'utiliser ses images dans cette étude. À l'origine, les images ont été utilisées pour «AHRC grant number 112211» accordée à Kenny Coventry et Pedro Guijarro-Fuentes. Le copyright des Figures 7 à 11 appartient à Kenny Coventry.

paramètres qui ont tendance à être encodés dans les langues naturelles. La variation dans la façon dont les langues répartissent et lexicalisent l'espace est très importante. Il n'est pas difficile, par exemple, de trouver des cas où le français et le norvégien expriment la même relation spatiale avec des prépositions normalement liées à des propriétés différentes :

1. Il y a de l'eau **dans** la bouteille.

2. Det er vann **på** flaska.
   il est eau sur bouteille-DEF
   Litt. : « Il y a de l'eau **sur** la bouteille. »

3. Il est **dans** la voiture. Il est **dans** le bus.

4. Han er **i** bilen. Han er **på** bussen.
   il est dans voiture-DEF il est sur bus-DEF
   Litt. : « Il est **dans** la voiture. Il est **sur** le bus. »

Malgré cette variation attestée, la lexicalisation de l'espace n'est pas tout à fait fortuite (Bowerman & Choi 2001 ; Feist 2008b ; Gentner & Bowerman 2009 ; Levinson & Meira 2003). La géométrie et la fonctionnalité, dont la physique qualitative, font partie des facteurs de catégorisation des prépositions spatiales.

Tandis que les propriétés géométriques et fonctionnelles déterminant l'emploi des prépositions et expressions spatiales en français ont été étudiées depuis une trentaine d'années (Aurnague, Vieu & Borillo 1997 ; Borillo 2007 ; Dendale & De Mulder 1997 ; Hickmann 2007 ; Vandeloise 1986, 1993), ce n'est pas le cas des prépositions norvégiennes, qui ont été traitées principalement d'un point de vue syntaxique (Tungseth 2003). Il existe quelques études de l'emploi des prépositions spatiales en norvégien langue étrangère (Szymańska 2010a, 2010b). L'analyse sémantique des prépositions *i* et *på* de Olsen (2000) mentionne l'avantage d'un modèle qui prend en compte les aspects fonctionnels de situations spatiales, mais l'analyse ne dépasse pas cette constatation. À notre connaissance, il n'existe pas d'études expérimentales sur le sémantisme des prépositions spatiales norvégiennes. À ce jour, nous constatons par ailleurs que le sémantisme des prépositions spatiales françaises a surtout fait l'objet d'études théoriques et descriptives.

Notre point de départ réside dans le *Functional Geometrical Framework* (FGF) (Coventry & Garrod 2004). À partir de là, nous présenterons la première étude expérimentale de l'influence des composantes sur les prépositions spatiales en français et en norvégien que ce cadre propose.

Le FGF identifie trois sources fondamentales pour la compréhension et pour la production des termes spatiaux : les routines[2] géométriques, les routines dynamico-cinématiques et la connaissance d'objets. L'importance de chacun de ces paramètres varie de préposition à préposition et d'une langue à l'autre. Notre étude posera en effet quatre types de situations spatiales pour lesquelles l'influence des composantes du FGF pour l'emploi des prépositions anglaises a déjà été établie. Nous viserons à montrer que les composantes de ce cadre sont également valables en français et en norvégien. Nous montrerons aussi comment les paramètres géométriques et fonctionnels sous-tendent une sélection de prépositions de façon analogue dans les deux langues, indiquant que ces paramètres relèvent de traits sinon universels, du moins régulièrement encodés dans le langage.

2. L'expression de la localisation statique en français et en norvégien

2.1. La Construction Locative de Base (CLB)

Le français et le norvégien appartiennent à deux classes de langues différentes dans la typologie de Talmy (2000). Le norvégien y fait partie des langues appelées langues satellites, tandis que le français, même si cette représentation a été contestée (Kopecka 2006 ; Pourcel & Kopecka 2005), fait partie des langues à cadrage verbal. La typologie de Talmy est largement étudiée, mais aussi fortement critiquée (Beavers, Levin & Tham 2010 ; Croft *et al*. 2010 ; Ibarretxe-Antuñano & Hijazo-Gascón 2012 ; Pourcel & Kopecka 2005). Plutôt que la stricte dichotomie proposée par Talmy, la tendance actuelle est de placer les langues dans un continuum selon leur degré de cadrage satellite ou de cadrage verbal. Pourtant, cette dichotomie s'est avérée très utile pour les études translinguistiques, puisqu'elle permet de former des hypothèses selon l'appartenance des langues en question. La distribution typologique du norvégien et du français laisse supposer qu'il y a des différences entre les deux langues quant aux outils linguistiques disponibles pour exprimer la localisation. Nous nous demandons ici si l'appartenance des deux langues à des catégories de cadrage différentes se reflète dans la compréhension des prépositions spatiales dans chacune des deux langues.

Toute étude comparative doit comparer des entités qui sont comparables. La tendance en linguistique cognitive est d'étudier la localisation statique telle qu'elle est exprimée dans le cadre de la Construction Locative

2. Dans la suite de ce travail, nous référons à l'opération de calcul des propriétés géométriques et fonctionnelles par l'anglicisme *routine*. Voir aussi la section 3 ci-dessous.

de Base (CLB) (Levinson & Wilkins 2006). La CLB est une construction qui répond à la question « Où est X ? ». Les langues varient quant aux outils linguistiques dont elles se servent pour exprimer la localisation, par exemple dans l'utilisation de verbes, adpositions et marqueurs morphologiques. Elles diffèrent dans le degré de spécificité sémantique encodé ainsi que dans leur façon de distribuer le contenu sémantique à travers les éléments de la construction. En français comme en norvégien la forme de la CLB est GN + Verbe + [Préposition + GN], où le premier groupe nominal désigne la cible et le dernier le site[3] : « La tasse est sur la table ». Les deux langues diffèrent, en revanche, dans le type de verbe préféré dans la CLB.

En français, les verbes neutres, c'est-à-dire les verbes qui n'expriment pas vraiment de contenu sémantique spatial, sont les plus fréquents dans la CLB (Kopecka 2004 : 65). La construction typique se forme autour de la copule *être* ou autour du verbe *se trouver*, comme dans l'exemple (5) :

5. Le livre est sur la table.

Ces verbes neutres servent uniquement à établir une relation locative entre le site et la cible. Dans le pivot verbal de la construction, le français laisse ainsi non spécifiée toute information concernant le type de relation spatiale entre le site et la cible, information qui doit alors être établie à partir du contexte. Par conséquent, la préposition à elle seule porte toute l'information spatiale dans la CLB française (cf. le contraste avec « Le livre est sous la table »).

Le norvégien, en revanche, exprime normalement la localisation statique à l'aide d'un verbe de posture. En norvégien un nombre limité de verbes peut apparaître dans la construction : *stå* (= être debout), *ligge* (= être allongé), *sitte* (= être assis) et *henge* (= être suspendu) sont les verbes les plus fréquents. Ces verbes expriment des aspects spatiaux tels l'orientation de la cible par rapport au site : orientation verticale vers le haut (*stå*) ou vers le bas (*henge*), orientation horizontale (*ligge*), ou, dans le cas d'une cible animée, une troisième posture « être assis » (*sitte*). En norvégien l'orientation de la cible est (obligatoirement) encodée dans le verbe, permettant, par exemple, de préciser le contraste entre un livre posé à plat et un livre posé verticalement (Kuteva 1999) :

6. Boka ligger på hylla.
   livre-DEF est allongé sur étagère-DEF
   Litt. : « Le livre est posé à plat sur l'étagère. »

3. Nous utilisons le terme *cible* pour la figure et le terme *site* pour le ground.

7. Boka står på hylla.
   livre-DEF est debout sur étagère-DEF
   Litt. : « Le livre est posé verticalement sur l'étagère. »

Même si les verbes de posture sont les plus fréquents dans la CLB norvégienne, une construction neutre avec la copule n'est pas impossible. En norvégien il est donc possible, dans certains contextes, de supprimer l'information portant sur l'orientation de la cible. Une telle option demeure toutefois atypique dans un bon nombre de contextes.

2.2. Les prépositions spatiales

Les prépositions spatiales sont des prépositions qui servent typiquement à localiser une entité (la cible) par rapport à une autre entité (le site). Le français et le norvégien disposent de prépositions simples ainsi que de locutions prépositives.

Outre les prépositions simples comme *à*, *contre*, *dans*, *devant*, *entre*, *sous* ou *sur*, le français dispose de locutions prépositives comme *à l'intérieur de*, *à côté de* ou *en face de* (Borillo 1998 ; Grevisse & Goosse 1986). Les locutions prépositives ont un caractère figé, c'est-à-dire qu'elles ne se prêtent pas aux mêmes manipulations syntaxiques que les groupes prépositionnels. Ce degré de figement varie toutefois d'une locution prépositive à l'autre (Adler 2001). Là où les prépositions simples encodent des relations spatiales d'une granularité grossière, les locutions prépositives spatiales servent souvent à identifier plus précisément les parties de l'espace en question, comme le montre la différence de nuance sémantique entre *dans* et *à l'intérieur de* (Borillo 1997).

Le norvégien, de son côté, utilise les prépositions simples, comme *ved* (= à), *på* (= sur), *i* (= dans), *bak* (= derrière), *over* (= au-dessus de), et les locutions prépositives, comme *ved siden av* (= à côté de), ainsi que des prépositions complexes formées à partir de deux prépositions simples : *inni*, formée de *inn* + *i* (= « in-in »/à l'intérieur de) ; *uti*, formée de *ut* + *i* (= « out-in »/dans une région d'espace d'une certaine étendue) ; *oppi*, formée de *opp* + *i* (= « up-in »/« en haut-dedans », dans un objet dont l'ouverture est vers le haut) ; *nedi*, formée de *ned* + *i* (= « down-in »/« au fond-dedans », dans un objet dont l'ouverture est vers le haut, et qui est conceptualisé d'un point de vue supérieur). De même : *innpå*, *utpå*, *oppå*, *nedpå*, formées des mêmes premiers éléments suivis de *på* (= sur), ou encore *innunder*, *oppunder*, *nedunder* où la dernière préposition est *under* (= sous). Comme le montrent ces exemples, les prépositions complexes servent à encoder de façon spécifique et précise certaines propriétés de la relation spatiale entre objets (Bakken & Vikør 2011). Bien que les prépositions

forment une classe fermée, ce paradigme est très productif en norvégien. Le phénomène est répandu pour tous types de prépositions : temporelles, spatiales, dynamiques, statiques, etc. (Faarlund, Lie & Vannebo 1997).

En somme, le norvégien et le français expriment la localisation statique par une CLB qui prend la même forme, mais les deux langues diffèrent dans la façon de distribuer l'information spatiale à travers les éléments de la CLB. Le norvégien véhicule des informations spatiales par l'intermédiaire du verbe ainsi que des prépositions, tandis qu'en français les prépositions fournissent à elles seules le sémantisme spatial. Les deux langues disposent d'un système prépositionnel qui leur permet d'exprimer de façon générale ou de façon plus spécifique la localisation d'un objet par rapport à un autre, mais elles diffèrent quant aux systèmes prépositionnels disponibles pour exprimer les relations spatiales de granularité fine.

3. Le *Functional Geometric Framework (FGF) for spatial language*

Depuis les années 1980 la grammaire cognitive connaît un essor de travaux sur le langage spatial, et notamment sur les prépositions spatiales. Ces travaux ont en commun une considération tant des propriétés géométriques que des propriétés fonctionnelles sous-tendant l'emploi des prépositions spatiales. De longues traditions montrant comment les propriétés fonctionnelles des objets entrant dans une situation spatiale affectent l'usage et l'acceptabilité de termes spatiaux (prépositions) ont mené Coventry & Garrod (2004) à établir leur *Functional Geometric Framework for spatial language*. Ce cadre pour l'analyse de la compréhension et de la production des termes spatiaux définit trois sources d'information : une source géométrique appelée *routines géométriques* et deux sources extra-géométriques appelées *routines dynamico-cinématiques* et *connaissance d'objets*. Les routines géométriques sont des processus perceptuels par lesquels la relation géométrique entre les objets dans une situation spatiale est calculée. Les routines dynamico-cinématiques, de leur côté, calculent les forces dynamiques existant entre les objets dans une situation ; des forces stables et opposées entre objets, mais aussi les forces en jeu à longue échéance. La connaissance d'objets inclut la connaissance des fonctions typiques d'objets (une carafe est un récipient approprié aux liquides, un tamis ne l'est pas), la connaissance de leurs affordances, ainsi que la connaissance de la cooccurrence régulière des prépositions et noms, soit des conventions linguistiques propres à la langue. L'information provenant des trois sources est intégrée dans un modèle de situation qui sert de base pour la compréhension et la production, spécifique à la situation, des prépositions spatiales. De ce fait, le FGF se place parmi les théories incarnées et situées (*embodied and situated theories*) du langage.

Les propriétés géométrico-fonctionnelles sous-tendant les prépositions *in* et *on* ainsi que *over*/*above* et *under*/*below* en anglais ont particulièrement été étudiées dans le cadre du FGF. Les prépositions topologiques *in* et *on* sont associées à des routines géométriques différentes, une routine *convex hull* ou fermeture convexe pour *in* et une routine *region connection calculus* ou connectivité pour la préposition *on*, mais à la même routine dynamico-cinématique : « *location control* ». « *Location control* » réfère à la capacité du site à contrôler la position de la cible et à en restreindre le mouvement (potentiel). Ce trait est établi déjà chez Vandeloise (1986, 1994, 2005), qui le définit comme un des traits de ressemblance de famille dans la relation contenant/contenu aussi bien que dans la relation porteur/porté. L'importance du « *location control* » pour les prépositions anglaises est attestée dans un nombre d'études expérimentales (Coventry & Garrod 2005 ; Feist 2010 ; Feist & Gentner 2003 ; Garrod, Ferrier & Campbell 1999 ; Richards, Coventry & Clibbens 2004). Selon Vandeloise (2008) l'usage prototypique des prépositions anglaises *at*, *on* et *in* utilisées avec des sites matériels correspond à l'usage prototypique des prépositions françaises *à*, *sur* et *dans* avec les mêmes types de site. En nous fondant sur cette observation, et sur l'importance du contrôle dans les analyses de Vandeloise, nous pouvons nous attendre à ce que les mêmes routines géométriques et dynamico-cinématiques qui ont été identifiées pour les prépositions *on* et *in* sous-tendent aussi les prépositions *sur* et *dans* en français.

Les prépositions *over*/*under* et *above*/*below* sont associées à une routine géométrique *attention vector sum* (Coventry & Garrod 2004 ; Regier & Carlson 2001) et à une routine dynamico-cinématique qui calcule le contact potentiel et le blocage de ce contact potentiel entre le site et la cible. La routine dynamico-cinématique liée aux prépositions anglaises *over*, *under*, *above* et *below* a été identifiée par un nombre d'études expérimentales (Carlson-Radvansky, Covey & Lattanzi 1999 ; Coventry & Mather 2002 ; Coventry, Prat-Sala & Richards 2001). Dans les descriptions de la préposition *sous* de Cadiot (2002) et de Vandeloise (1986), même si en général ce trait est lié à l'inaccessibilité à la perception chez ce dernier, cette capacité du site à couvrir ou à protéger la cible est aussi reconnue, comme par exemple dans (8) :

8. Le chat est sous la table.

Nous constatons que les études expérimentales anglaises ont leurs contreparties dans des études françaises théoriques. En effet, les idées de Vandeloise nous semblent avoir inspiré les études qui ont mené à la formulation du FGF. En ce qui concerne les prépositions spatiales

norvégiennes, ce type d'étude nous paraît inexistant. En revanche, il existe une étude expérimentale de l'interaction entre fonction et géométrie pour les prépositions suédoises *över*, *ovanför*, *under* et *nedanför* (Hörberg 2008). L'étude montre que l'acceptabilité de la préposition *över* (= au-dessus de) est plus affectée par les manipulations fonctionnelles que celle de la préposition *ovanför* (= au-dessus de), tandis que l'acceptabilité des prépositions *under* et *nedanför* (= sous) n'est pas différemment affectée par les manipulations fonctionnelles. L'étude établit donc une asymétrie dans l'importance de l'information fonctionnelle pour l'acceptabilité des prépositions désignant des relations supérieures et inférieures dans le système suédois. Les résultats de Hörberg mettent en évidence les types de variations qui peuvent exister entre les prépositions au sein de la même langue, variation aussi confirmée en espagnol (voir Coventry & Guijarro-Fuentes 2008 pour un compte rendu en anglais). Outre l'étude de Hörberg et l'étude mentionnée sur l'espagnol, le FGF est cautionné translinguistiquement par une étude de l'influence de relations géométriques et extra-géométriques sur les termes spatiaux dans vingt-quatre langues appartenant à onze familles linguistiques différentes (Feist 2008b).

4. Universalité dans l'expression spatiale ?

Certains traits du monde qui nous entoure sont saillants au point d'être systématiquement encodés par des langues diverses. Des études sur la lexicalisation du domaine de locution humaine ont montré que la distinction entre *marcher* et *courir* consiste en une discontinuité qui est encodée translinguistiquement (Malt, Gennari & Mutsumi 2010 ; Vulchanova & Zee 2013). Un autre exemple concerne la dénomination des parties du corps (Majid 2010). À l'égard du domaine spatial, Gentner & Bowerman (2009) avancent l'hypothèse que certaines discontinuités spatiales sont saillantes au point d'être réfléchies dans le système de lexicalisation d'un grand nombre de langues, alors que d'autres discontinuités sont moins saillantes et donc moins susceptibles d'être reconnues dans le système de lexicalisation de plusieurs langues. Feist (2008b), de son côté, maintient que la géométrie, les forces dynamiques et la fonctionnalité servent de sources pour certaines ressemblances de familles qui tendent à être encodées translinguistiquement.

Dans une étude de l'expression de la localisation statique dans neuf langues typologiquement distinctes, Levinson & Meira (2003) identifient une similarité translinguistique dans la lexicalisation de la catégorie SOUS, tandis que ces langues attestent d'une grande variation dans la lexicalisation des catégories DANS et SUR. La distinction «au-dessus/sous» est une distinction qui se développe à un âge précoce chez l'enfant. Quinn (1994,

2005) montre que des enfants âgés de 3 mois seulement sont capables de former des représentations catégorielles pour les relations spatiales «au-dessus» et «sous». En outre, des jugements linguistiques ainsi que non linguistiques sont plus précis pour des locations qui se trouvent directement sur l'axe vertical que pour des locations qui dévient de celui-ci (Hayward & Tarr 1995 ; Landau & Lakusta 2006). Les relations topologiques («dans/sur»), en revanche, attestent de schémas de lexicalisation divers. Cela s'explique entre autres par l'interdépendance de la géométrie et du «*location control*» pour ces types de situations, et par le nombre de catégories conceptuelles qui sont susceptibles d'être lexicalisées, comme par exemple la catégorie «*attachement*» (Levinson & Meira 2003) et la distinction entre «l'ajustement étroit» et «l'ajustement lâche» (Bowerman 2007 ; Bowerman & Choi 2001). Par conséquent, on s'attendra à ce que le français et le norvégien diffèrent davantage dans l'expression de la localisation topologique que dans celle de la localisation sur l'axe vertical.

5. La présente étude

5.1. Objectifs

L'objet de cette étude est d'établir dans quelle mesure les locuteurs de français et de norvégien sont attentifs aux mêmes paramètres lorsqu'ils jugent l'acceptabilité de prépositions spatiales dans des phrases qui décrivent des stimuli visuels. L'étude se sert d'un paradigme de jugement d'acceptabilité afin de cerner l'intuition propre à l'usage des prépositions chez les locuteurs des deux langues. Cela nous permet de dégager des différences dans la compréhension et la production des prépositions spatiales au-delà de celles qui se manifestent dans la production seule. Étant donné que des paramètres géométriques et dynamico-cinématiques sont censés sous-tendre la compréhension et la production de prépositions translinguistiquement, ces paramètres sont spécifiquement ciblés dans la présente étude. Nous cherchons par là à savoir si les locuteurs natifs du français et du norvégien sont attentifs aux mêmes manipulations dans le domaine géométrique et dans le domaine dynamico-cinématique, et si ces manipulations se manifestent dans des changements de jugements d'acceptabilité de façon analogue dans les deux groupes de locuteurs.

Compte tenu des différences typologiques entre le français et le norvégien, les locuteurs des deux langues ont l'habitude d'exprimer le domaine spatial différemment. On peut donc s'attendre à ce que les deux groupes de locuteurs prêtent attention à différents aspects des situations spatiales, et, par conséquent, que leurs jugements d'acceptabilité diffèrent pour les paramètres géométriques et dynamico-cinématiques. D'un autre

côté, ces dimensions se sont avérées importantes pour l'expression de l'espace à travers bon nombre de langues d'origines très différentes. De ce fait, il est possible que les jugements d'acceptabilité des deux groupes de participants soient affectés par les manipulations géométriques et dynamico-cinématiques de façon analogue.

Nos prédictions des résultats sont les suivantes :

a. les prépositions spatiales françaises ainsi que les prépositions spatiales norvégiennes seront affectées tant par des manipulations de relations géométriques entre les objets de la situation que par des manipulations de routines dynamico-cinématiques ;

b. les jugements d'acceptabilité pour les prépositions françaises et pour les prépositions norvégiennes seront affectés par les manipulations de façon analogue ;

c. dans la mesure où il y aura des différences dans les jugements d'acceptabilité pour les prépositions norvégiennes et françaises, ces différences évoqueront des différences de degré plutôt que des différences substantielles au niveau de la conceptualisation spatiale ;

d. les différences potentielles entre le français et le norvégien se montreront davantage dans la relation topologique, relation qui atteste d'une variation translinguistique substantielle, que dans la localisation sur l'axe vertical.

5.2. Participants

Deux groupes de sujets ont participé à cette étude expérimentale. Le premier est un groupe de natifs français (N = 22/24[4]) – L1 français, recrutés à l'université de Caen Basse-Normandie et parmi des étudiants Erasmus venant à l'université des sciences et techniques de Norvège (NTNU). Aucun des participants de ce groupe ne parlait norvégien au moment de l'enquête. Le deuxième groupe concerne des natifs norvégiens (N = 26) – L1 norvégien, qui ont été recrutés parmi les étudiants de NTNU ainsi que parmi des employés administratifs et scientifiques de NTNU. Aucun des participants dans ce groupe ne parlait français au moment de l'enquête. Les participants des deux groupes ont tous des connaissances d'anglais langue étrangère.

4. N = 22 pour les séries II et IV, avec une addition de deux participants pour les séries I et III.

5.3. Design

Les stimuli consistent en quatre séries d'images. À chaque série sont associées une phrase de la forme *La cible est* _____ *le site* et une sélection de 6 à 8 prépositions. Dans les images, des propriétés de géométrie et de fonctionnalité sont systématiquement manipulées. Les participants ont évalué l'acceptabilité de chaque préposition donnée en se basant sur leur capacité à compléter la phrase de façon à ce qu'elle corresponde à la situation de l'image. L'évaluation s'est faite sur une échelle de 8 points, où 0 = *préposition inacceptable* et 7 = *préposition parfaitement acceptable*[5]. Les stimuli ont été adaptés à partir d'une étude menée par Coventry et ses collègues (Coventry, Guijarro-Fuentes & Valdés 2011) concernant l'acquisition de prépositions spatiales en langue étrangère.

Les quatre séries d'images visent à étudier deux types de relations spatiales différentes. Deux séries d'images testent l'expression de la localisation sur l'axe vertical et deux séries testent l'expression de la localisation sur une surface ou dans un contenant.

5.3.1. Série I : Femme – parapluie

Les images montrent une femme tenant un parapluie[6]. La relation géométrique entre la femme et le parapluie est manipulée sur 3 niveaux : a) le parapluie est montré dans la position canonique sur l'axe vertical (directement au-dessus de la femme) ; b) avec une rotation de 45 degrés sur l'axe vertical et c) avec une rotation de 90 degrés sur l'axe vertical. L'aspect fonctionnel est manipulé par l'introduction de la pluie dans les images. Cette manipulation se fait aussi sur 3 niveaux : a) une condition contrôle sans pluie ; b) une condition fonctionnelle où la femme est protégée de la pluie par le parapluie et c) une condition non fonctionnelle où la femme n'est pas protégée de la pluie. Ensuite, deux phrases sont associées aux images permettant l'inversion du site et de la cible[7].

5.3.2. Série II : Saladier – boîte

Les images de cette série montrent une boîte qui est orientée vers un saladier de façon à ce qu'un contenu puisse être transvidé de la boîte dans le saladier. La relation géométrique entre le saladier et la boîte est manipulée sur deux niveaux : a) position proche ; b) position éloignée. L'aspect fonctionnel est manipulé sur trois niveaux : a) une condition

5. L'échelle a été transposée en 1-8 pour les analyses statistiques.
6. Voir, en Annexes, « Stimuli visuels » pour une illustration des séries.
7. Voir, en Annexes, « Stimuli linguistiques » pour les phrases en français et en norvégien.

contrôle ; b) une condition fonctionnelle où un contenu (des noix) est transvidé de la boîte dans le saladier et c) une condition non fonctionnelle où le contenu n'atteint pas le saladier. Deux phrases permettent l'inversion site / cible.

5.3.3. Série III : Pomme – saladier – plat

Dans la série III : Pomme – saladier – plat deux objets de référence différents sont examinés : a) un saladier, qui normalement devrait provoquer des instances de la préposition *dans* (un contenant) ; et b) un plat, qui normalement devrait provoquer des instances de la préposition *sur* (un porteur)[8]. Ensuite, la cible (une pomme) se trouve plus haut que le bord du saladier / plat, à 3 distances différentes de ce bord (3 niveaux de géométrie) : a) bas ; b) moyen et c) haut. La pomme est toujours placée sur d'autres pommes qui sont en contact avec le saladier / plat. L'aspect fonctionnel (« *location control* ») est manipulé de la façon suivante : la pomme est suspendue à un fil ou non, ce qui introduit – ou non – une source alternative de contrôle. Cela nous donne deux niveaux de « *location control* » : a) – source alternative ; b) + source alternative.

5.3.4. Série IV : Assiette / main – mouche / cadenas

Dans la série IV : Assiette / main – mouche / cadenas, deux sites sont présentés : a) une main et b) une assiette. La relation géométrique est manipulée par le degré de concavité du site sur 3 niveaux : a) plat ; b) moyen ; c) creux. Les sites sont appelés *main* (*hånd*) et *assiette* (*skål*) à chacun des 3 niveaux géométriques. Les termes *assiette* et *skål* ont été choisis parce qu'ils permettent tant l'emploi de la préposition *dans* (*i*) que celui de la préposition *sur* (*på*). On peut ainsi comparer l'acceptabilité des deux prépositions à travers la manipulation géométrique. Deux cibles de qualités différentes sont examinées : a) une mouche ; b) un cadenas.

L'aspect fonctionnel, « *location control* », est manipulé sur deux axes : le degré de contrôle exercé par le site et le degré auquel la cible permet ce contrôle. Premièrement, une main est censée exercer un plus fort contrôle sur la cible qu'une assiette, puisqu'elle peut se fermer. Deuxièmement, un cadenas est censé être moins susceptible de se déplacer qu'une mouche, qui peut s'envoler (Feist 2008a, 2010). Cela nous donne une matrice de « *location control* » à 4 niveaux où le contrôle est le plus fort dans la combinaison [main + cadenas] et le plus faible dans la combinaison [assiette + mouche] :

8. Le terme *plat* peut aussi provoquer des instances de *dans*. Voir sections 6.2.1 et 7.

Matrice de « *location control* » pour la série IV :
Assiette / main – mouche / cadenas

	Main	**Assiette**
Cadenas	Site - contrôle fort Cible - stable	Site - contrôle moins fort Cible - stable
Mouche	Site - contrôle fort Cible - instable	Site - contrôle moins fort Cible - instable

5.4. Procédure

Les questionnaires de notre enquête ont été complétés en ligne et les participants se sont trouvés libres de compléter les questionnaires à leur gré.

L'expérience comprenait trois séances qui pouvaient être complétées indépendamment. Les participants se sont enregistrés avec un code de participant, puis ils ont été dirigés vers une page d'instructions. Les instructions étaient fournies en norvégien pour les participants norvégiens et en français pour les participants français.

Suite aux instructions, l'expérience à proprement parler commençait. L'ordre de succession des images dans chaque séance était complètement aléatoire. Les mêmes prépositions étaient toujours présentées avec toutes les images d'une série, mais l'ordre dans lequel elles étaient présentées était aléatoire pour chacune des images. Il était, par ailleurs, impossible de continuer l'expérience sans évaluer toutes les prépositions données.

Les quatre séries d'images ont été réparties dans les trois séances. Les deux séries qui portaient sur la localisation sur l'axe vertical se trouvaient dans deux séances différentes. La série I : Femme – parapluie comportait dix-huit items expérimentaux et vingt-et-un items de remplissage (fillers), tandis que la série II : Saladier – boîte comportait douze items expérimentaux et vingt-cinq items de remplissage. Les prépositions évaluées étaient *au-dessus de*, *sous*, *en dessous de*, *au-dessous de*, *devant*, *derrière* et *sur* en français et *over* (= au-dessus de), *under* (= sous), *ovenfor* (= supérieur / plus haut / au-dessus), *nedenfor* (= inférieur / plus bas / au-dessous), *foran* (= devant) et *bak* (= derrière) en norvégien.

Les deux séries qui portaient sur les relations spatiales topologiques faisaient aussi partie de deux séances différentes. La série III : Pomme – saladier – plat comportait douze items expérimentaux et trente-deux items de remplissage tandis que la série IV : Main / assiette – mouche / cadenas comportait douze items expérimentaux et vingt-cinq items de remplissage. Les prépositions évaluées étaient *au-dessus de*, *sur*, *dans*, *à l'intérieur de* et *en haut de* en français et *over* (= au-dessus de), *på* (= sur), *i* (= dans),

oppi (= «up-in»/dedans), *nedi* (= «down-in»/dedans), *oppå* (= «up-on»/dessus) et *nedpå* (= «down-on»/dessus) en norvégien.

Seuls les résultats pour les prépositions *au-dessus de* et *sous* (*over* et *under*) sur l'axe vertical et les prépositions *sur* et *dans* (*på* et *i*) pour les relations de localisation topologique sont présentés dans l'étude actuelle.

6. Résultats

Nous présenterons ici une analyse comparative des jugements d'acceptabilité des deux groupes de participants : L1 français et L1 norvégien. L'intérêt principal est de mettre en évidence dans quelle mesure les différences éventuelles entre les deux groupes sont liées aux facteurs de géométrie et de fonctionnalité, ou si elles sont plutôt liées à des facteurs propres à la lexicalisation d'un domaine sémantique aux contours flous.

Les données ont été soumises à des analyses de variance (ANOVA) modèle mixte. Le groupe participant constitue le variable catégoriel, qui a alors deux niveaux : L1 français et L1 norvégien. Les analyses ont été effectuées à l'aide du logiciel StatSoft Statistica 12.0. Le correctif de Greenhouse-Geisser est rapporté dans tous les cas de sphéricité. Le seuil de signification est toujours fixé à $p < 0,05$.

6.1. Les relations sur l'axe vertical

6.1.1. Série I : Femme – parapluie

Les données de la série I : Femme – parapluie ont été analysées à l'aide d'une ANOVA 3 (géométrie : canonique, 45 degrés de rotation, 90 degrés de rotation) x 3 (fonction : contrôle, fonctionnel, non fonctionnel) x 2 (préposition : *au-dessus de*/*over*, *sous*/*under*) x 2 (groupe : L1 français, L1 norvégien).

L'analyse ne révèle ni effet du groupe, ni interaction de cette variable. Cela indique que les deux groupes ne diffèrent pas significativement dans la modification de leurs jugements d'acceptabilité suite aux manipulations géométriques et fonctionnelles. L'analyse révèle un effet principal de géométrie et un effet principal de fonction. Ces effets sont cependant qualifiés d'une interaction *géométrie* par *fonction* ($F(3,00, 144,12) = 5,0$, $p < 0,01$, η^2 partiel = 0,09). La Figure 1 montre cette interaction.

Grâce à des tests post-hoc de Tukey HSD, nous constatons que dans la condition impliquant une rotation de 45 degrés sur l'axe vertical, le score moyen d'acceptabilité du niveau non fonctionnel ($M = 3,68$) est significativement inférieur aux scores moyens des niveaux contrôle ($M = 4,59$, $p < 0,0001$) et fonctionnel ($M = 4,40$, $p < 0,001$). Dans

la position géométrique canonique et celle impliquant une rotation de 90 degrés, les différences sont non significatives. Ensuite, les tests montrent que le score moyen d'acceptabilité des prépositions diminue significativement de la position canonique (M = 7,79) à la position impliquant une rotation de 45 degrés (M = 4,22, p < 0,001), puis de cette dernière à la position impliquant une rotation de 90 degrés (M = 1,60, p < 0,001) (effet principal de *géométrie*). Cela veut dire que lorsque le parapluie est déplacé de sa position canonique sur l'axe vertical, les prépositions *au-dessus de*/*over* et *sous*/*under* sont de moins en moins adéquates à la description de la relation entre la femme et le parapluie.

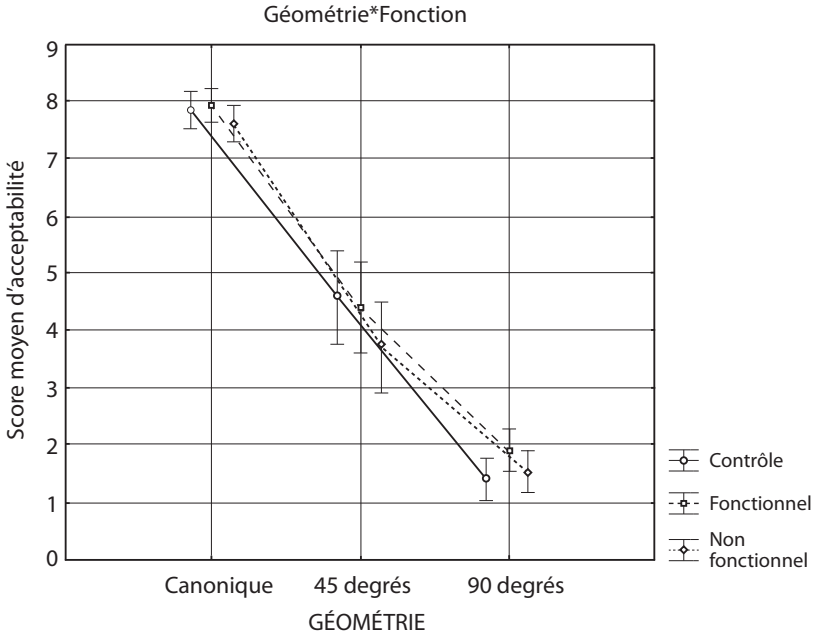


Figure 1 : Interaction de *géométrie* et *fonction* (L1 français et L1 norvégien)[9]

6.1.2. Série II : Saladier – boîte

Les données pour la série II : Saladier - boîte, ont été analysées à l'aide d'une ANOVA 2 (géométrie : position proche, position éloignée) x 3 (fonction : contrôle, fonctionnel, non fonctionnel) x 2 (préposition : *au-dessus de*/*over*, *sous*/*under*) x 2 (groupe : L1 français, L1 norvégien).

9. Dans les Figures 1 à 6, les barres verticales représentent des intervalles de confiance à 0,95.

L'analyse ne révèle ni effet du groupe, ni interaction de ce facteur, indiquant que les jugements d'acceptabilité des deux groupes ne diffèrent pas significativement à travers les conditions expérimentales. L'analyse dévoile un effet principal de géométrie ($F(1,46) = 34,86$, $p < 0,0001$, η^2 partiel = 0,43). En général, les prépositions sont moins acceptables lorsque la distance entre la cible et le site est grande (M = 5,20) que lorsqu'elle est moins grande (M = 6,18). Ensuite, l'analyse montre un effet principal de fonction ($F(2,92) = 4,15$, $p < 0,05$, η^2 partiel = 0,08). Cet effet apparaît dans la Figure 2. Grâce à des tests post-hoc de Tukey HSD, nous constatons que les prépositions sont jugées significativement moins acceptables dans la situation non fonctionnelle que dans la situation fonctionnelle ($p < 0,05$). La différence entre la condition contrôle et la condition fonctionnelle, ainsi que la différence entre la condition contrôle et la condition non fonctionnelle, sont non significatives. Finalement, l'analyse révèle un effet principal de préposition ($F(1,46) = 11,04$, $p < 0,01$, η^2 partiel = 0,19). La préposition *sous/under* est en général jugée moins acceptable (M = 5,22) pour ces situations que la préposition *au-dessus de/over* (M = 6,15).

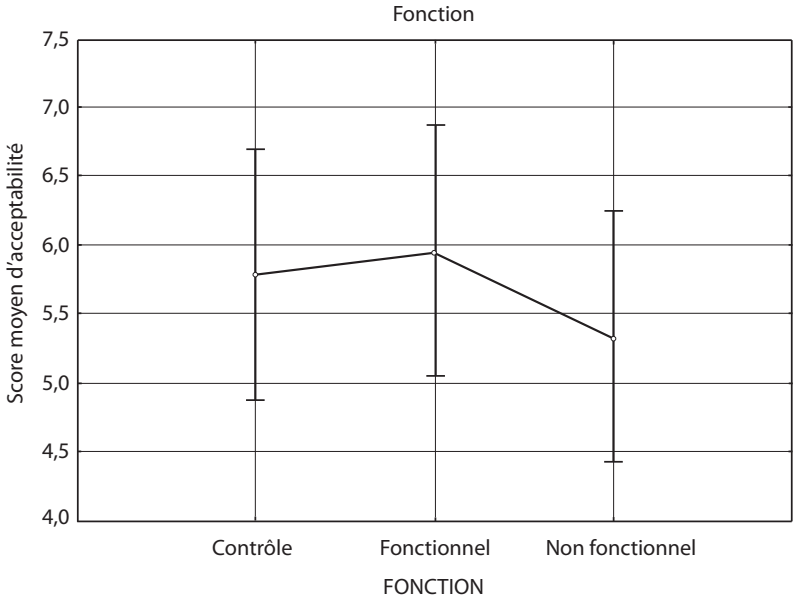


Figure 2 : Effet de *fonction* (L1 français et L1 norvégien)

En somme, en ce qui concerne les situations spatiales sur l'axe vertical, nous voyons que les deux groupes modifient leur jugement d'acceptabilité pour les prépositions *au-dessus de/over* et *sous/under* de manière parallèle. Les jugements d'acceptabilité sont influencés tant par la géométrie de la

situation spatiale que par la routine dynamico-cinématique de blocage d'objets tombants (pluie) et d'interaction potentielle (possibilité de transvider un contenu dans un récipient). Cela indique que ces paramètres sous-tendent les prépositions *au-dessus de* et *over* ainsi que *sous* et *under* de la même manière.

6.2. Les relations topologiques sur *et* dans

6.2.1. Série III : Pomme – saladier – plat

Nous avons mené une ANOVA 3 (géométrie : bas, moyen, haut) x 2 («*location control*» : contrôle par le site, contrôle alternatif) x 2 (site : saladier, plat) x 2 (préposition : *sur*/*på*, *dans*/*i*) x 2 (groupe : L1 français, L1 norvégien).

L'analyse révèle un effet principal de «*location control*» ($F(1,45) = 5,31$, $p = 0,026$, η^2 partiel = 0,11). Le score moyen d'acceptabilité est significativement inférieur dans la condition où il y a une source alternative de contrôle (M = 3,40) comparativement à la condition où le site contrôle la cible (M = 3,72).

Ensuite l'analyse révèle une interaction significative entre préposition et groupe ($F(1,45) = 27,17$, $p < 0,0001$, η^2 partiel = 0,38) ainsi qu'une interaction entre site et préposition ($F(1,45) = 84,66$, $p < 0,0001$, η^2 partiel = 0,65). Cela indique que les jugements d'acceptabilité pour les deux prépositions en question (*sur*/*på* et *dans*/*i*) diffèrent selon le type de site. Cette interaction est à son tour modulée par le facteur groupe ($F(1,45) = 39,60$, $p < 0,0001$, η^2 partiel = 0,47). Cela indique que les deux groupes, L1 français et L1 norvégien, diffèrent dans leur façon de moduler les scores d'acceptabilité pour les deux prépositions selon le facteur site. L'interaction est montrée dans la Figure 3.

Des comparaisons post-hoc Tukey HSD montrent que les scores moyens d'acceptabilité ne diffèrent pas significativement entre les deux groupes pour les prépositions *sur*/*på* et *dans*/*i* lorsque le site est un saladier. Les scores d'acceptabilité de *dans* et de *i* sont significativement supérieurs aux scores d'acceptabilité de *sur* ($p < 0,001$) et de *på* ($p < 0,001$) respectivement. Cela veut dire que et *sur* et *på* sont jugées peu acceptables lorsque le site est un saladier, et que les prépositions *dans* et *i* sont préférées dans ce cas. Cette situation est parallèle dans les deux langues (voir partie gauche de la Figure 3). Lorsque le site est un plat, en revanche, la situation est autre. Ici, les locuteurs français jugent *sur* et *dans* également acceptables ($p = 0,35$), tandis que les locuteurs norvégiens jugent *på* significativement plus acceptable que *i* ($p < 0,001$). Les locuteurs norvégiens jugent alors *på* très acceptable et *i* peu acceptable lorsque le site est un plat. Les locuteurs norvégiens préfèrent clairement *på* à *i* tandis que les locuteurs français hésitent entre *sur* et *dans*.

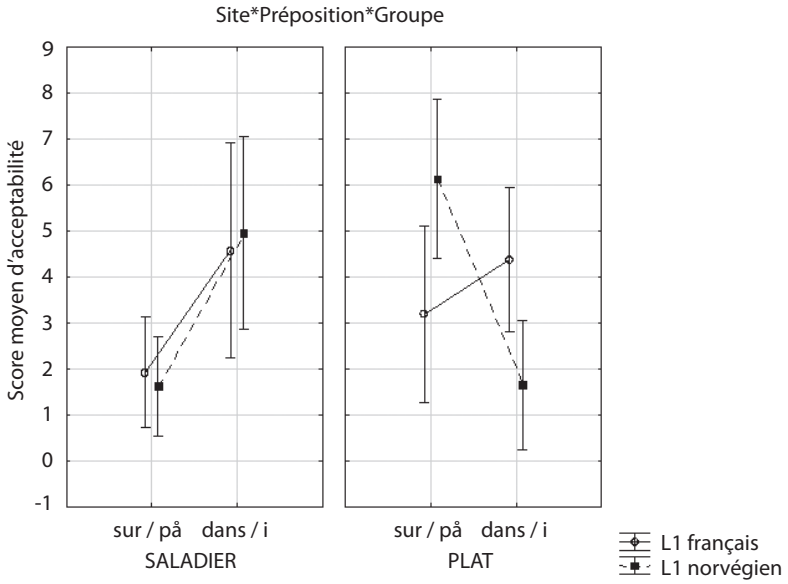


Figure 3 : Interaction triple entre *site*, *préposition* et *groupe*
(L1 français et L1 norvégien)

Finalement, il y a une interaction triple entre géométrie, site et préposition ($F(2,90) = 4{,}595$, $p = 0{,}013$, η^2 partiel = 0,09). Cette interaction est montrée dans la Figure 4.

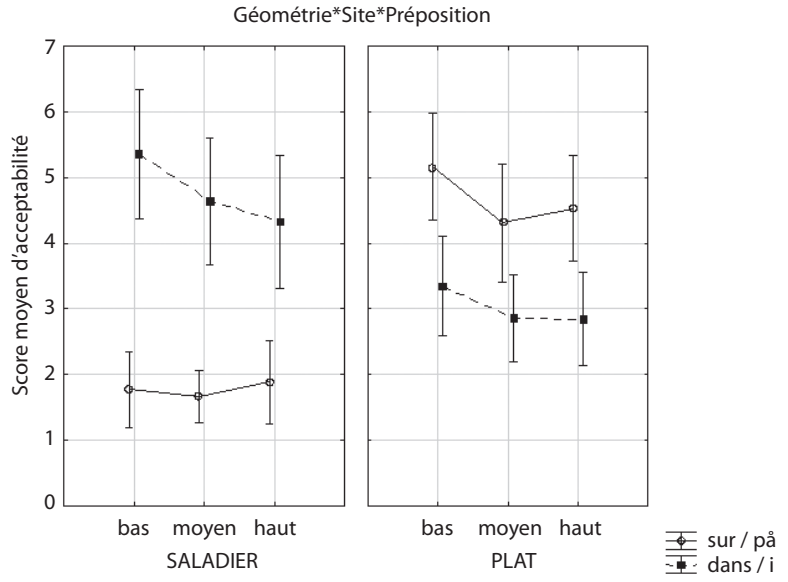


Figure 4 : Interaction triple entre *géométrie*, *site* et *préposition*
(L1 français et L1 norvégien)

Les tests post-hoc de Tukey HSD montrent que la préposition *sur/på* est significativement moins acceptable que la préposition *dans/i* lorsque le site est un saladier. Inversement, la préposition *sur/på* est significativement plus acceptable que la préposition *dans/i* quand le site est un plat. Cela est vrai à travers tous les niveaux de géométrie. Ensuite les tests montrent que l'acceptabilité de la préposition *sur/på* n'est pas affectée par les manipulations géométriques lorsque le site est un saladier. Elle est jugée peu acceptable à travers tous les niveaux de géométrie. En revanche, la préposition *dans/i* est significativement moins acceptable au deuxième niveau de géométrie qu'au premier niveau ($p < 0,01$). Entre le deuxième et le troisième niveau de géométrie la différence est non significative. Lorsque le site est un plat, la situation s'inverse. Le score moyen d'acceptabilité baisse significativement du premier au deuxième niveau de géométrie pour la préposition *sur/på* ($p < 0,01$), mais cette baisse ne continue pas du deuxième au troisième niveau (p = n.s.). L'acceptabilité de *dans/i* décroît non significativement du premier au deuxième niveau de géométrie. Entre le deuxième et le troisième niveau, la différence est non significative. Cela veut dire que les prépositions *sur/på* et *dans/i* sont jugées plus acceptables lorsque la pomme se trouve près du bord supérieur du site. Lorsque la distance entre le bord du site et la cible augmente, l'acceptabilité des prépositions pour décrire la situation diminue. Il suffit quand même que la distance soit d'une certaine importance. La géométrie ici implique aussi l'aspect fonctionnel de «*location control*», comme ce dernier est censé diminuer à mesure que la pomme s'éloigne du bord du site.

6.2.2. Série IV : Assiette / main – mouche / cadenas

Pour la série IV : Assiette / main – mouche / cadenas nous avons effectué une ANOVA 3 (géométrie : plat, moyen, creux) x 2 (site : main, assiette) x 2 (cible : mouche, cadenas) x 2 (préposition : *sur/på*, *dans/i*) x 2 (groupe : L1 français, L1 norvégien).

L'analyse révèle une interaction entre groupe et préposition ($F(1,46) = 4,72$, $p < 0,05$, η^2 partiel = 0,09). Cette interaction est montrée dans la Figure 5. Grâce à un test post-hoc de Tukey, nous constatons que les deux groupes jugent les prépositions *dans* et *i* également acceptables (M = 7,6 pour les Français et M = 7,0 pour les Norvégiens, p = n.s.), tandis que les Français jugent la préposition *sur* significativement plus acceptable que les Norvégiens ne jugent la préposition *på* (M = 4,7, M = 2,8, $p < 0,001$).

L'analyse montre une interaction triple entre géométrie, site et préposition ($F(1,73, 79,52) = 3,76$, $p < 0,05$, η^2 partiel = 0,08). L'interaction est montrée dans la Figure 6. Grâce à des tests post-hoc de Tukey HSD,

nous constatons que les jugements d'acceptabilité de la préposition *dans/i* sont les mêmes à travers les trois niveaux de géométrie et ce, pour les deux objets de référence. Pour *dans/i*, il n'y a aucune différence significative entre les jugements d'acceptabilité selon le type de site. En revanche, lorsque le site est une main, les jugements d'acceptabilité de la préposition *sur/på* sont significativement supérieurs aux jugements d'acceptabilité lorsque le site est une assiette. Cela est vrai pour les trois niveaux de géométrie (plat : $p < 0{,}01$, moyen : $p < 0{,}001$, creux : $p < 0{,}001$). Ensuite, lorsque le site est une assiette, l'acceptabilité de la préposition *sur/på* diminue significativement du premier au deuxième niveau de géométrie, plat et moyen ($M = 3{,}82$ et $M = 2{,}79$, $p < 0{,}001$). Nous voyons donc que la préposition *sur/på* est plus acceptable lorsque le site est une main plutôt qu'une assiette. Ensuite elle est jugée assez acceptable lorsqu'une assiette est plate, mais elle devient peu acceptable lorsqu'elle est associée à une assiette creuse. La préposition *dans/i* est jugée acceptable pour les deux types de site. Elle est considérée davantage acceptable quand elle est associée à un site creux, mais cette croissance est non significative.

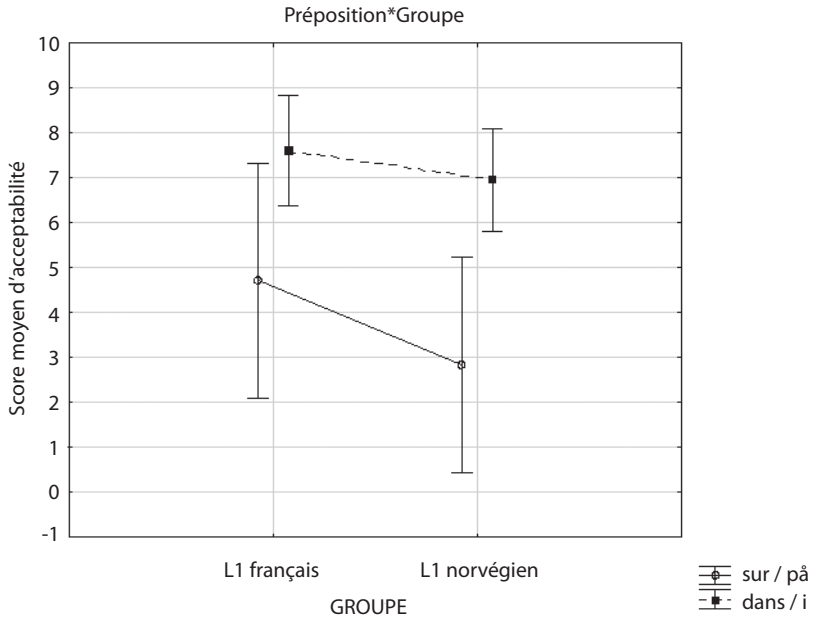


Figure 5 : Interaction entre *préposition* et *groupe* (L1 français et L1 norvégien)

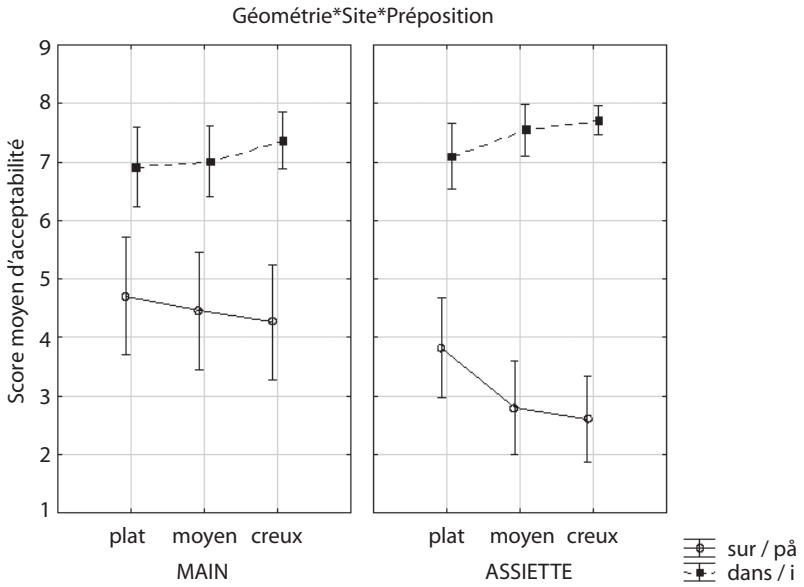


Figure 6 : Interaction triple entre *géométrie*, *site* et *préposition* (L1 français et L1 norvégien)

Finalement, l'analyse révèle une interaction entre cible et préposition ($F(1,46) = 20{,}62$, $p < 0{,}0001$, η^2 partiel = 0,31). Les tests post-hoc montrent que *dans* est jugée tout aussi acceptable avec la cible « mouche » (M = 7,20) qu'avec la cible « cadenas » (M = 7,36, p = n.s.), tandis que *sur* est jugée plus acceptable lorsque la cible est une mouche (M = 4,15) que lorsqu'elle est un cadenas (M = 3,40, $p < 0{,}001$).

En somme, nous constatons qu'il y a certaines différences entre les deux groupes de participants quant à leurs jugements d'acceptabilité des prépositions topologiques *sur*/*dans* d'un côté et *på*/*i* d'un autre côté. Cependant, ces différences ne semblent pas liées à des différences dans la façon dont les paramètres géométrie et routines dynamico-cinématiques influencent l'acceptabilité des prépositions. Elles semblent plutôt être liées à la façon dont les deux langues peuvent utiliser une préposition avec un site particulier, ou à l'acceptabilité générale des prépositions pour décrire la situation des images présentées.

7. Discussion et conclusion

Cette étude a eu pour objectif de dévoiler des parallélismes éventuels dans les paramètres qui sous-tendent certaines prépositions spatiales en français et en norvégien. Nous avons vu que les deux langues expriment la localisation statique par des moyens linguistiques différents, ce qui

relève de leur appartenance à des classes différentes dans la typologie de Talmy. Une comparaison qui va au-delà du simple constat que les deux langues diffèrent doit nécessairement comparer des entités comparables. C'est pourquoi nous avons choisi de comparer les taux d'acceptabilité d'une sélection de prépositions lorsqu'elles sont utilisées dans une CLB (à verbe copule) qui décrit des stimuli visuels bien contrôlés. Cette étude expérimentale trouvait son point de départ dans les paramètres identifiés dans le FGF. Nous nous sommes alors servie d'un type de stimulus visuel consistant en des situations spatiales à partir desquelles l'influence de routines géométriques et de routines dynamico-cinématiques sur la compréhension et la production de prépositions spatiales a bien été établie en anglais. De plus, les composantes du FGF se sont avérées importantes pour ces types de situations dans plusieurs langues.

En ce qui concerne la localisation sur l'axe vertical, nos résultats attestent d'un parallélisme parfait entre les deux langues. Les participants modifient leurs jugements d'acceptabilité des prépositions *au-dessus de* et *sous*, ainsi qu'*over* et *under*, selon des changements concernant la relation géométrique entre les objets dans la situation, mais aussi selon des changements concernant la fonctionnalité des objets. Pour la série I : Femme – parapluie ainsi que pour la série II : Saladier – boîte, les prépositions sont jugées plus acceptables dans une position géométrique canonique qu'elles ne le sont dans les relations géométriques moins typiques. Ensuite, les prépositions sont jugées moins acceptables dans les situations non fonctionnelles que dans les situations fonctionnelles. Nos résultats mettent en évidence l'importance des routines géométriques et de la routine dynamico-cinématique de « blocage/contact potentiel » pour la compréhension de ces prépositions spatiales dans les deux langues. Nos prédictions[10] a) et b) sont alors confirmées pour la localisation sur l'axe vertical : les jugements d'acceptabilité des prépositions sont affectés par les deux types de manipulations expérimentales et ils le sont de façon analogue en français et en norvégien.

En ce qui concerne les situations topologiques, nos résultats montrent qu'il y a certaines différences entre les deux groupes de participants. Pour la série III : Pomme – saladier – plat, les différences entre les deux groupes s'avèrent liées à l'acceptabilité des prépositions associées à un site particulier : le plat. En revanche, les deux groupes ne diffèrent pas significativement sur les facteurs géométrie et fonction. Cela indique que les routines géométriques et les routines dynamico-cinématiques sous-tendent la compréhension des prépositions *sur*, *dans*, *i* et *på* de façon analogue.

10. Voir la section 5.1.

Les différences d'acceptabilité relèvent donc d'une autre composante du FGF : la connaissance d'objets (*object knowledge*), composante incluant aussi la connaissance de la cooccurrence typique des mots d'une langue. Tandis que le norvégien privilégie l'usage de la préposition *på* avec un site appelé *fat*, le français permet tant l'usage de *dans* que l'usage de *sur* avec ce site appelé *plat*. Notons que ni l'usage de *dans* ni l'usage de *sur* n'est jugé « très » ou « parfaitement » acceptable dans cette situation. Selon Zwarts (2008), cela est typique des situations où deux prépositions sont en concurrence. Zwarts traite, dans ces cas, la sélection d'une préposition comme un processus d'optimalisation à partir duquel la préposition qui satisfait le mieux à un système de contraintes hiérarchisées est sélectionnée. Ici, il y a une contradiction entre le choix privilégié de *dans* avec le mot *plat* et le caractère peu creux du plat impliqué par les stimuli (images). En ce qui concerne la série IV : Assiette / main – mouche / cadenas, la différence de jugement d'acceptabilité des prépositions entre les deux groupes de participants relève de l'acceptabilité générale des prépositions pour décrire les situations dans les images. Les deux groupes trouvent *dans* et *i* également acceptables, tandis que les participants norvégiens trouvent *på* moins acceptable que les Français ne trouvent *sur*. Malgré cette différence, les deux groupes modifient leurs jugements d'acceptabilité suite aux manipulations expérimentales de la géométrie et du « *location control* » de manière parallèle. En d'autres termes, la routine géométrique et la routine dynamico-cinématique de « *location control* » ne sont pas à l'origine des différences de jugement d'acceptabilité entre les deux groupes de participants. Par conséquent, nos prédictions a) et b) concernant l'influence de ces routines sont confirmées à l'égard des relations topologiques aussi.

Notre prédiction d) est également confirmée : les différences entre le français et le norvégien se sont manifestées uniquement dans les résultats concernant les relations topologiques et non pas dans les résultats des relations sur l'axe vertical. Nous avons vu dans la section 4, « Universalité dans l'expression spatiale ? », que la lexicalisation des relations topologiques atteste d'une variabilité translinguistique importante. Une des raisons de cette variabilité est que ces situations représentent un continuum de situations où la géométrie et le « *location control* » sont interdépendants à des degrés variés. La façon de sectionner en lexicalisant ce continuum varie d'une langue à l'autre. Les différences de jugements d'acceptabilité entre les deux groupes se manifestent dans deux cas spécifiques : a) une différence dans l'acceptabilité des prépositions *dans* et *sur* d'un côté et *i* et *på* de l'autre lorsque celles-ci sont associées à un *plat* / *fat*, mais non pas lorsqu'elles sont associées à un *saladier* / *bolle* et b) une différence d'acceptabilité entre les prépositions

dans et *i*, mais non entre *sur* et *på*, lorsque le site est une *main*/*hånd* ou une *assiette*/*skål*. Ces résultats attestent d'une différence de degré et non pas d'une conceptualisation qualitativement différente des situations spatiales dans les deux langues. Ainsi, notre hypothèse c) se trouve, elle aussi, confirmée.

Il est important, enfin, de rappeler les limites de la présente étude. En effet, elle ne fait qu'effleurer la question de la représentation spatiale chez les locuteurs français et norvégiens. Pour chaque série, nous n'avons choisi qu'un seul type d'objets. Or, il est envisageable que d'autres objets placés dans les mêmes situations spatiales engendrent d'autres résultats, ou, inversement, que les résultats soient corroborés par l'ajout d'autres types d'objets dans les mêmes situations. Ainsi, avant de postuler de façon spécifique l'importance des routines géométriques et dynamico-cinématiques pour chacune des prépositions étudiées ici, des études plus approfondies doivent être faites. Nos résultats confirmant l'influence de la géométrie ainsi que de la fonctionnalité pour la compréhension des prépositions en français et en norvégien présentent cependant un nouvel appui translinguistique en faveur du FGF. Lorsque, dans la CLB, la préposition simple porte en elle seule tout le sémantisme spatial, les mêmes paramètres sous-tendant leur usage sont en jeu en norvégien et en français. Ce qui est intéressant, c'est la grande absence de différences significatives entre les jugements d'acceptabilité des participants français et norvégiens. Malgré le fait que les deux groupes de locuteurs aient l'habitude d'exprimer le mouvement et la localisation dans l'espace à l'aide d'outils linguistiques différents, nos résultats suggèrent des similarités dans la représentation mentale pour les prépositions spatiales dans ces deux groupes. Les quelques différences que nous avons pu identifier ne relèvent pas de différences fondamentales dans la conceptualisation de l'espace dans les deux langues.

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Annexes

Stimuli visuels

Série I : Femme – parapluie

Figure 7 : Trois niveaux de géométrie : canonique, 45 degrés et 90 degrés. Fonctionnalité : contrôle. © Kenny Coventry

Série II : Saladier – boîte

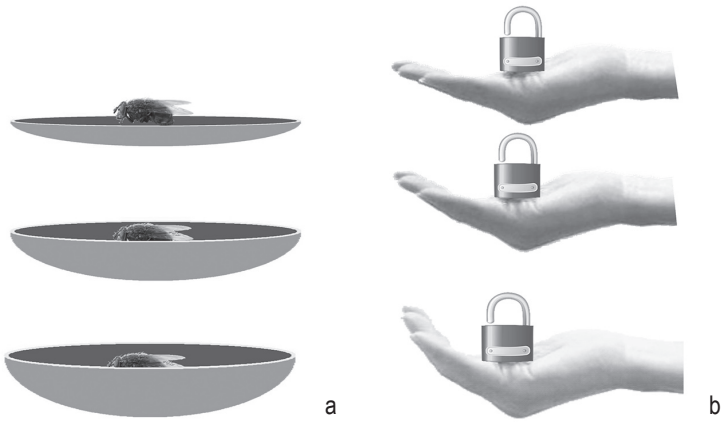
Figure 8 : Deux niveaux de géométrie : position proche et position éloignée. Fonctionnalité : contrôle. © Kenny Coventry

Série III : Pomme – saladier – plat

Figure 9 : Trois niveaux de géométrie : haut, moyen, bas.
Site : plat. © Kenny Coventry

Figure 10 : Trois niveaux de géométrie : haut, moyen, bas.
Site : saladier. « *Location control* » : source alternative
© Kenny Coventry

Série IV : Assiette / main – mouche / cadenas



Figures 11 : a) Site : assiette. Cible : mouche. b) Site : main. Cible : cadenas.
Trois niveaux de géométrie : plat, moyen, creux. © Kenny Coventry

Stimuli linguistiques

Phrases associées aux images des séries I à IV
en français et en norvégien

Série	Français	Norvégien
I : Femme – parapluie	La femme est ____ le parapluie. Le parapluie est ____ la femme.	Dama er ____ paraplyen.* Paraplyen er ____ dama.
II : Saladier – boîte	Le saladier est ____ la boîte. La boîte est ____ le saladier.	Bollen er ____ boksen. Boksen er ____ bollen.
III : Pomme – saladier – plat	La pomme est ____ le plat. La pomme est ____ le saladier.	Eplet er ____ fatet. Eplet er ____ bollen.
IV : Assiette/main – mouche/cadenas	La mouche est ____ l'assiette. La mouche est ____ la main. Le cadenas est ____ l'assiette. Le cadenas est ____ la main.	Flua er ____ skåla. Flua er ____ hånda. Hengelåsen er ____ skåla. Hengelåsen er ____ hånda.

* L'article défini se réalise en norvégien comme un suffixe : -en au masculin, -a au féminin, -et au neutre.

Paper II

Spatial prepositions in the L2: Geometry vs. function

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Abstract

This study investigated whether geometric and functional information affected comprehension of spatial prepositions denoting location on the vertical axis in Norwegian late learners of L2 French in the same way as in native speakers. The L2 users rated French prepositions in sentences describing visual scenes where geometric and functional aspects were systematically manipulated. Ratings were compared to those of native controls from both languages. Results showed that the L2 participants differed from native French speakers only in how acceptability ratings changed as a result of geometric manipulations. Furthermore, L2 French ratings differed from L1 Norwegian ratings on the same parameter, indicating that negative transfer from L1 cannot explain the L2 French results. This suggests that while L2 users can make native-like linguistic distinctions based on functional information they are not equally sensitive to distinctions based on geometric relations. This is consistent with findings in Coventry, Guijarro-Fuentes, and Valdés (2011).

Key words: spatial prepositions, geometry, function, second language acquisition

1 Introduction

Prepositions are notoriously hard to learn in a second language. This is true for abstract as well as for more concrete meanings, such as spatial meanings. One of the reasons for the difficulties encountered with spatial prepositions is that languages differ considerably in how they partition space. They differ in what features of spatial situations they encode lexically, as well as in what situation types are encoded using a single lexical item or referred to by more than one lexical item (see for instance Gentner & Bowerman, 2009). Directly underlying this variation is the fact that there are almost infinite ways in which objects can be located in relation to each other, whereas a given language only has a limited set of prepositions or other spatial terms available to express all of these spatial arrays and possibilities. The linguistic items available to a speaker are few compared to the spatial scenes they must serve to express.

Paper II

While there is extensive cross-linguistic variation in the expression of space, lexicalization patterns within this domain are still constrained by shared tendencies to encode salient perceptual discontinuities. Bowerman and Choi (2001) identify an underlying "similarity gradient" of spatial relationships based on the lexical items used to describe spatial scenes by participants from 38 languages. Gentner and Bowerman (2009) maintain that some ways of lexically partitioning space along this similarity gradient are more common cross-linguistically than others, and that these common lexicalisation patterns depend on properties of spatial situations which are cognitively and perceptually salient to humans. In such cases, children do not need much linguistic input in order to acquire the categories and their labels. Other ways of partitioning space, Gentner and Bowerman (2009) argue, are less common across languages and category distinctions are also less salient. Therefore, children need more extensive input in order to correctly form the categories onto which spatial labels are be mapped. Choi and Hattrup (2012) argue that linguistic information may be necessary for category formation in spatial language if perceptual information is not salient enough or if several salient perceptual features compete. Investigating static spatial descriptions from 24 languages, Feist (2008b) found that geometry, force dynamics, and function are underlying components that must be considered for the expression of location in space. Furthermore, she argues that these features are sources for certain family attributes that tend to be encoded cross-linguistically. The cross-linguistic variation in how these features are bundled together or how they are weighted makes the acquisition of spatial prepositions a semantic challenge for L2 learners. It is therefore interesting to investigate what particular components of spatial scenes are (more) problematic in L2.

The current article reports on an experiment which investigated acceptability judgments for prepositions in L2 French by Norwegian late L2 learners (age of onset≈ 15). The experiment targeted French prepositions denoting location on the vertical axis, i.e., *au-dessus de* ('over'), *sous* ('under'), *au-dessous de* ('under'), and *en dessous de* ('under'). The study particularly investigated how geometric and functional information present in spatial scenes influence L2 speakers' acceptability ratings for these prepositions and whether one or the other of the meaning components is more difficult for L2 users to master to a native-like level. Furthermore, it investigated whether changes in geometrical or functional properties of a spatial scene affect acceptability ratings in the L2 in the same way as they affect the acceptability ratings of native speakers. In a study of factors influencing spatial preposition meaning in L1 French and L1 Norwegian, Listhaug (2014) found that changes to geometric and functional information affect native-speaker acceptability judgments for prepositions in analogous ways in the two languages. An implication of this finding is that Norwegian learners of L2 French can expected

to be quite successful in using French spatial prepositions if they rely on their L1 intuitions about the relative weighting of geometric and functional information. Moreover, these findings mean that any differences between the L1 French and L2 French users cannot be attributed to a general difference between French and Norwegian.

2 Function and geometry in spatial language and in second language acquisition

Spatial prepositions are prepositions such as *on, in, over* and *behind,* which serve to describe where an object, the *located object* (LO) is located relative to another object, the *reference object* (RO)[1]. It is no surprise, therefore, that geometric relations between the LO and the RO have been central to the description of meaning in spatial language. It does not take many examples, however, to show that geometric information alone does not easily capture the meaning of spatial prepositions: Goldfish *in* a bowl are located within the containable inside of the bowl. An apple, however, may be located above the rim of a bowl if sitting on other apples, but still be described as being *in* the bowl. A crack *in* a bowl is not in the part of the bowl usually associated with containment, etc. The necessary contribution from other sources to the meaning of spatial terms has therefore been studied since the mid-1980s. Over the last three decades, the interplay between geometry and function for the comprehension of prepositions has been thoroughly established, both in theoretical work and in usage-based and experimental research (Carlson & Van der Zee, 2005; Coventry & Garrod, 2004; Coventry, Prat-Sala, & Richards, 2001; Garrod, Ferrier, & Campbell, 1999; Herskovits, 1986; Vandeloise, 1986). There is also evidence that both geometrical and extra-geometrical information is important for the selection of spatial terms across languages (Bowerman & Choi, 2001; Feist, 2008b, 2010; van der Zee, Adams, & Niemi, 2009).

2.1 The *Functional Geometric Framework*

The various and repeated evidence in support of both geometry and function as underlying factors for the comprehension of spatial prepositions led Coventry and Garrod (2004) to propose a model of interacting components in spatial language called *The functional geometric framework* (FGF). The framework identifies *geometric routines*, *dynamic-kinematic routines* and *object knowledge* as central to the online production and processing of spatial prepositions. The last two of these components are sometimes referred to as *extra-geometric*. Within this

[1] I use the term *located object*, abbreviated LO, for the figure/trajector and the term *reference object*, RO, for the ground/landmark.

framework it is assumed that information from all three components integrates and allows speakers to form situation models, i.e., a mental model of a spatial scene, onto which spatial terms are mapped.

Geometric routines are perceptual routines which identify the type of geometrical relationship which exists between objects, i.e., where objects are located relative to each other. Rather than having the characteristics of logic formulae, geometric routines can be applied flexibly to spatial scenes. An example of a geometric routine is one which computes whether an object is in a region above another object, relevant for the use of a preposition like *over*. This routine, the attention vector sum (AVS) model, takes into account the shape and size of both the reference and located object in the computation of the "above" region (Miller & Carlson, 2013; Regier & Carlson, 2001).

Dynamic-kinematic routines have to do with force dynamics and the way objects behave in the physical world over time. Important to location on the vertical axis is a perceptual routine which calculates *threatening contact* or *blocking contact.* This routine calculates whether an object is in a position to block something from falling on another object, and has been found to be important for the use of prepositions such as *over* and *under* (Coventry & Mather, 2002; Coventry et al., 2001). For example, the routine calculates whether an umbrella is in such a position that it protects a woman from falling rain. The degree to which the umbrella fulfills its blocking function and protects the woman from the rain influences the appropriateness of the preposition *over* in a sentence like "The umbrella is over the lady".

Finally, object knowledge involves language users' stored representations of objects and their knowledge of how objects typically interact. It also includes knowledge about how linguistic labels map onto the objects, i.e., how objects are habitually conceptualized in the language. There is evidence that different labels used for the same object may drive different geometric routines. An object labelled *plate* may drive a routine identifying supporting surfaces, hence *the apple is **on** the plate*, but a routine identifying containable insides if it is labelled a *bowl*, i.e., *the apple is **in** the bowl* (Coventry & Prat-Sala, 2001; Feist & Gentner, 2003). These habitual conceptualizations are conventions which vary across languages; English and Norwegian language users have to know that that a car is conceptualized as a container and associated with the preposition *in* (*in the car/i bilen*) whereas larger vehicles, like buses, are conceptualized as supporting surfaces and associated with *on* (*on the bus/på bussen*). In French, a bus is conceptualized as a container and thus associated with the preposition *dans* ("in"). Moreover, knowledge about how objects are functioning in context, i.e., in a particular situation, is important for how we use spatial prepositions. A newspaper can be used as protection from the rain. There is evidence that in such cases acceptability judgments for spatial prepositions

are affected by the dynamic-kinematic routine relevant for the situation-specific, non-prototypical, use of the object (Coventry et al., 2001).

While the FGF has primarily been developed on the basis of data from studies of English prepositions, it has also been shown to be a valid framework for the investigation of preposition meaning across languages (Coventry & Guijarro-Fuentes, 2004; Hörberg, 2008). Findings in Listhaug (2014) indicate that the meaning of the Norwegian prepositions *over* and *under* and the French prepositions *au-dessus de* and *sous* is in fact underpinned by the same geometric and extra-geometric routines as the English prepositions *over, under, above,* and *below* (Coventry et al., 2001). These results indicate that the Functional Geometric Framework does capture meaning components for French and Norwegian spatial prepositions, and as such they provide further cross-linguistic support for the FGF. However, further research is needed to establish the exact weightings of the routines for individual prepositions in Norwegian and French.

2.2 Acquisition of spatial prepositions in L1 and L2

When children learn their native language, they do so as they are also learning about the world around them. These processes are not independent (Barsalou, Simmons, Barbey, & Wilson, 2003). For instance, children develop visual object recognition based on whole-object geometric shape between age 18 and 24 months. At the same time they acquire a large number of object labels. In this period they also show patterns of category-appropriate extensions in their object naming (Smith, 2003, 2009). There is evidence that the emergence of such abstract representations of object shape assists object label learning (Son, Smith, & Goldstone, 2008). Moreover, the ability to interact with objects also affect category formation (Smith, 2005).

When children learn how to talk about the location of objects, they build upon preverbal knowledge of physical forces (see Coventry & Garrod, 2004 for an overview) and knowledge of how objects behave and interact with each other. They learn what spatial terms map onto what type of spatial arrays and configurations, and in doing so they factor in both the geometric relationships between objects and the functional relationships between them (Coventry, 2013). Studies have shown that in the course of development functional properties such as location control[1] and knowledge of how (familiar) objects interact are available to children early on, whereas fine grained geometric distinctions are harder and take longer for children to map onto linguistic forms in their native language (Coventry, Guijarro-Fuentes, & Valdés, 2011; Feist, 2008a; Richards, Coventry, & Clibbens, 2004). Looking at the developmental trajectory of word meaning in children, Feist (2008a) studied factors influencing spatial preposition use in English-

[1] Location control is a dynamic-kinematic routine that refers to the ability of the reference object to constrain the location of the located object over time.

speaking preschoolers and 13-year-olds, compared to results from English-speaking adults. She found that 13-year-olds, but not preschoolers, modified their responses in an adult-like way as a function of the label used for the reference object (object knowledge), as well as for manipulations involving dynamic-kinematic properties of the scenes. None of the groups modified their responses as a function of manipulations to the geometrical properties of the scenes studied, whereas there was a reliable effect of these manipulations in the adult control group. The results indicate that semantic representations are enriched also after the initial acquisition of a word, and that, in the case of spatial prepositions, extra-geometrical features are mastered to an adult-like level earlier than geometrical features. There is solid evidence that the acquisition of word meaning is a lengthy process (e.g., Clark, 2010; Styles & Plunkett, 2009).

Learning to talk about location in a second language is a challenge. Knowledge about what components of the FGF pose more problems for the learner may help us understand where the difficulties in L2 acquisition lie. Coventry and Guijarro-Fuentes (2008) hypothesize from existing research in second language acquisition that learners are likely to focus on individual cues when learning spatial language in the L2; initially learners will focus either on geometric or on extra-geometric cues, and only later in the acquisition process will they become sensitive to the interplay between these components. If development of spatial language in L2 follows the same trajectory as in L1 development, we would expect L2 learners to be able to consider functional properties in a target-like manner early on in the acquisition process, whereas target-like mastery of geometrical information should develop later. In other words, geometrical properties should cause more problems for the L2 learner than functional ones. However, evidence from research on L2 acquisition of spatial terms so far points in both directions.

First, there is some evidence that the extra-geometric component of the FGF causes more problems for the L2 learner than the geometric component. Munnich and Landau (2010) found that functional properties are particularly hard to pin down for late L2 learners. They investigated the acquisition of spatial prepositions in English by native speakers of Korean and Spanish. The participants were tested on a production and on a judgment task with stimuli consisting of photographs and sentences targeting the English prepositions *in, on, over* and *under*. These spatial relationships are represented differently in Spanish and Korean. Spanish collapses containment and support, whereas Korean collapses contact and noncontact.

In an analysis of the types of non-native-like responses by the L2 users, Munnich and Landau (2010) found that the category boundaries between *in* and *on* and between *on* and *over* were the most difficult to master for both the Spanish and the Korean L2 users. The most common non-target responses were the substitution of *on* for *in* in *owl in tree*, *dent in can* and *passengers in seats*. According to Munnich and Landau (2010), *in* and *on* represent "regions defined by

geometry", but also "regions" defined by function, i.e., constraint of movement/support[1]. In order to select the appropriate region, they argue, one must know what kinds of functions matter in the target language. They hypothesize that mapping the correct functional representation to a reference object and hence selecting the appropriate spatial preposition poses difficulties for the L2 learners, and that it is easier for an L2 learner to invoke geometric information. For instance, the L2 users in the study did not confuse *under* with *on* or *over*, something which the authors claim indicates that geometric features, i.e., polarity on the vertical axis, are more easily available to the L2 learner.

However, there might be an alternative explanation. Munnich and Landau (2010) collapse the two extra-geometric components of the FGF, i.e., dynamic-kinematic routines and object knowledge, into the notion of "regions" defined by function. The error patterns in their study reveal that it may not be dynamic-kinematic routines that are particularly difficult for the L2 user, but rather the object knowledge-component. Both *in* and *on* are strongly influenced by the same dynamic-kinematic routine, namely *location control*. The L2 users may well have identified the dynamic-kinetic routine. This would explain the extension of *in* for *on* and vice versa, as well as the extension of *on* to the covering sense of *over* (*tablecloth over table*). However, the participants in the study seemed to have problems with the language-specific mapping of prepositions to certain types of reference objects or spatial situation types. Situation types represent continua whereas linguistic labels are discrete. Therefore, mapping from a situation type to a linguistic label forces a cut-off-point which, cross-linguistically, is somewhat arbitrary. This has been demonstrated for cutting and breaking events as well as putting events (Majid, Boster, & Bowerman, 2008; Slobin, Bowerman, Brown, Eisenbeiß, & Narasimhan, 2011). Moreover, objects may be conceptualized in different ways in different situation types. Thus, the same object is associated with different prepositions according to the situation type it enters into: In English, trees are conceptualized as containers for birds (*bird **in** tree*), but as supporting surfaces for apples and leaves (*apples/leaves **on** tree*). A typical problem for the L2 users in Munnich and Landau's study is precisely the language-specific conceptualization of a tree as a container for a bird (*owl **in** tree)*, or of a surface as a container for a crack (*crack **in** pavement).* Such conventions are based on stored information about how objects, object labels, and prepositions co-occur in the language in question. Thus, the problem in the L2 acquisition process may be a matter of storing and learning certain expressions, that is, mapping the specific situation type to the correct linguistic label in the L2, especially if this differs from the habitual conceptualization in the L1.

[1] Constraint of movement is equivalent to location control in my terms.

Paper II

Evidence that functional aspects are acquired early on by L2 users whereas geometrical properties are mastered later in the acquisition process comes from a large scale study by Coventry and colleagues (Coventry et al., 2011). Participants in the study were L2 speakers of Spanish and English with three different proficiency levels – beginners, intermediate, and advanced – as well as native speaker control group from each language. The participants were asked to rate how appropriate each of a set of prepositions was to complete sentences describing pictures of spatial scenes. Coventry et al. (2011) reported on a part of the study targeting prepositions denoting location on the vertical axis, i.e., the prepositions *over, under, above* and *below* in English and corresponding Spanish prepositions. In the pictures, geometric and functional properties of the spatial scenes were manipulated. The results showed that L2 users' acceptability ratings differed from those of L1 users on geometry. Native speakers made more graded distinctions based on geometry than did L2 users. However, with increasing language proficiency, the ways in which L2 users' acceptability ratings were affected by changes in geometry increasingly resembled native-speaker ratings. According to Coventry et al. (2011) this suggests that speakers do not distinguish geometric relations to the same extent at different proficiency levels. Furthermore, the L2 users did not differ from native speakers with respect to how changes to functional properties of the spatial scene affected acceptability ratings. This suggests that all speakers made distinctions on the basis of functional relations in the same way, irrespective of proficiency level. The findings indicate that while functional information affects judgments about prepositions in a native-like way from very early on in the acquisition process, distinctions based on geometry take longer for the L2 learner to acquire. It is only with increasing proficiency in the target language that the L2 user develops judgments similar to those of L1 speakers .This is interesting as it indicates a similar developmental trajectory for spatial language in the L2 as the one found for L1 in Feist (2008a).

Prepositions are highly sensitive to the properties of both the reference object and the located object, but not all prepositions are equal in this respect. There is a tight link between geometrical information and functional information associated with the topological terms such as *in* and *on*. For projective prepositions like *over*, *above*, on the other hand, geometry alone is more informative. The above/below distinction is one that is made early by young infants. Quinn (1994, 2005) found that infants as young as 3 months were able to form categorical representations of the spatial relations "above" and "below", and that they responded to novel stimuli on the basis of these representations. At 6-7 months they had also formed abstract categories, responding to novel stimuli also when a novel object was presented alongside the

novel spatial relation[1]. Landau and Lakusta (2006) (see also Hayward and Tarr (1995)) demonstrate that both linguistic and non-linguistic judgments are more accurate for locations that fall directly along the cardinal axes (above, below, left, right) of a reference object than when locations veer off these axes. However, functional properties of the above/below distinction have also been investigated (Carlson-Radvansky, Covey, & Lattanzi, 1999; Coventry & Mather, 2002; Coventry et al., 2001; Hörberg, 2008). These studies have revealed that knowledge of how objects fall to the ground influences acceptability judgments for spatial prepositions denoting location on the vertical axis.

The present study looked specifically at the representation of this vertical spatial relationship in Norwegian L2 learners of French. It tested the same spatial relationship as in the study reported by Coventry et al. (2011, pp. 277-281) to see whether findings in that study hold also for L2 French users.

3 The study

3.1 Aims

The present study targeted French prepositions denoting location on the vertical axis: *au-dessus de* ('over'), *sous* ('under'), *au-dessous de* ('under'), and *en dessous de* ('under'), and Norwegian L2 users' comprehension of these. The study was set up as a judgment task in order to tap into L2 users' intuitions about preposition meaning in French. The participants were asked to give acceptability judgments for prepositions in sentences which described visual stimuli. In the visual stimuli, geometric and dynamic-kinematic properties of the relationship between the objects involved were systematically manipulated. This methodology allows for a more fine-grained analysis of the influence of underlying meaning components than what can be achieved using a production task.

The aim of the study was to investigate the relative importance of geometric and dynamic-kinematic information for the comprehension of L2 spatial prepositions, and particularly to identify which of the components were potentially more difficult to master to a native-like level for the L2 users. Furthermore, the study aimed at establishing whether and to what degree the L2 users relied on the constraints imposed by geometry and function on preposition usage in their L1. Of interest in the study was also the degree to which the L2 users adjusted their

[1] Quinn (2005) also found that children were able to form categorical representations for "left" and "right", suggesting that it is not verticality that is particularly easy, but placements on either extreme of an axis. They did not find the same for a diagonally placed bar.

acceptability ratings as a function of changes in geometric and dynamic-kinematic information compared to native speakers.

Based on previous findings for both L1 and L2 acquisition of prepositions, the predictions of the present study were:

a) that the Norwegian L2 users of French, having a relatively high level of L2 proficiency, would provide acceptability ratings similar to those of the L1 French group, i.e., their overall comprehension of the prepositions would be good.

b) that the L2 participants would still differ from native speakers of French in the degree of adjustment to changes to geometrical aspects of the scenes, but not to dynamic-kinematic aspects.

3.2 Participants

There were three groups of participants: A French L2 (FL2) group comprising native speakers of Norwegian having learned/learning French as an L2 (n=28), a French L1 (FL1) group comprising native speakers of French with no knowledge of Norwegian (n=24), and, finally, a Norwegian L1 (NL1) group comprising native speakers of Norwegian with no knowledge of French (n=26). The French L2 group was recruited among present and previous students of French at The Norwegian University of Science and Technology, NTNU, ranging from first year students[1] to students with completed master's degrees. The French L1 group was recruited among students at the Département des Sciences du Langage, Université de Caen Basse Normandie and among French exchange students to NTNU. The Norwegian L1 group was recruited among students at the Faculty of Humanities at NTNU, and among staff members from various faculties at NTNU.

The majority of Norwegian speakers of French are late L2 learners. French is only taught as an optional subject in Norwegian schools[2], normally offered around age 13/14 (*ungdomsskole*) or 16/17 (*videregående skole*). Young people in Norway are rarely exposed to French outside of the classroom or other formal instruction settings. Any supplementary input has to be actively sought out by the learner (TV, radio, newspapers or French speaking societies). French prepositions are treated in class, and usually given in a simplified glossary with a Norwegian translation.

[1] The first year students participated in the experiment in their second semester. Many had attended a 5-week programme at the Norwegian Study Centre in Caen, France prior to participation.

[2] There are some international schools that offer French earlier. These are not widely available to Norwegian students, however, as they are located only in the major cities.

The participants in the L2 group took an online placement test for French courses which gives an indication of their proficiency level (Oxford University Language Centre: http://www.lang.ox.ac.uk/courses/tst_placement_french.html). Most of the participants fell into the Upper Intermediate and Advanced (n=23) proficiency levels. Four participants achieved scores in the Intermediate category, whereas one single participant got a Lower Intermediate score. The average score was 37 out of 50 points. This relatively high proficiency level of the L2 users entails that one can assume that they had had enough exposure to the target language to be familiar with the prepositions presented in the experiments. Furthermore, one can be quite certain that the rating data taps into their intuitions about the prepositions in the target language, rather than problems with the overall understanding of the meaning of the prepositions. The L2 participants were all tested in Norway and all had knowledge of English as a second language.

3.3 Design

The test materials consisted of a series of pictures, each of which was associated with a sentence and a set of prepositions for rating. In the pictures, properties of geometry and function are systematically manipulated. Test materials are adopted from Coventry et al. (2011) (see also section 5 below), a large scale study of L2 English and Spanish.

The series consists of pictures of a lady holding an umbrella, accompanied by the French and Norwegian translation equivalents of the sentences "The lady is _____ the umbrella" and "The umbrella is _____ the lady"[1]. The geometrical relation between the lady and the umbrella is manipulated over three levels. The lady is shown holding the umbrella in the upright, canonical position in the first level, whereas in the second level the umbrella is tilted 45 degrees away from the gravitational plane and, finally, in the third level it is tilted 90 degrees from the gravitational plane. The dynamic-kinematic aspects of the scene are manipulated by the introduction of rain into the pictures. There is one control condition where no rain is shown, there is a functional condition where the rain hits the umbrella so that the woman remains protected from it, and a non-functional condition where the rain hits the woman so that the umbrella does not fulfill its purpose of protecting her from getting wet. The rain is never mentioned in the linguistic stimuli; it is only introduced in the pictures. The two versions of the sentence correspond to a manipulation of which object serves as the reference object (RO) and which object serves as the located object (LO).

[1] The sentences in French and Norwegian as well as examples of the pictures are given in the appendix.

Paper II

Prepositions for rating were selected on the basis of a pilot study where native speakers of French and Norwegian participated in a production task containing the same stimuli. In addition, the prepositions chosen complied with the original test design for English and Spanish. Prepositions included for this picture series were *over* (=over), *under* (=under), *ovenfor* (=above, higher than), *nedenfor* (=below, lower than, underneath), *foran* (=in front of) and *bak* (=behind) in Norwegian and *au-dessus de* (=over), *sous* (=under), *en dessous de* (=under/lower than), *au-dessous de* (=under/below/lower than), *devant* (=in front of) and *derrière* (=behind) in French.

Participants were asked to rate prepositions on a scale from 0 (=not appropriate) to 7 (=very appropriate) as to how appropriate they thought each preposition was to complete the sentence so that it corresponded to the situation in the picture. For the purpose of statistical analysis the scale was transposed to 1-8. In the Norwegian version of the test, prepositions were listed alone for rating. In the French version, however, the prepositions were presented along with the definite article of the RO noun to prevent any interference from grammaticality judgements on the acceptability rating of the prepositions. In French the preposition *de* followed by the definite masculine article *le* is realised as the contracted form *du,* whereas the preposition *de* followed by the definite feminine article *la* is realised as *de la*. So for the sentence *Le parapluie est* _____ *femme*, participants rated expressions such as *au-dessus de la* and *devant la*, whereas for the sentence *La femme est* _____ *parapluie* the participants rated expressions such as *au-dessous du* and *derrière le.*

In the present study, data for the French prepositions *au-dessus de* and *sous* (L1 and L2)are presented and compared to data for the Norwegian prepositions *over* and *under* in the main analysis. While prepositions meaning 'in front of' and 'behind' were included in the experiment, these prepositions are not analyzed here as they are not associated with the dynamic-kinematic routine tested for, namely potential contact with/protection from falling objects. The Norwegian prepositions *ovenfor* and *nedenfor* are compound prepositions with no direct translation equivalents in French, and are therefore also not included in the present analyses. French has one preposition denoting "over" (*au-dessus de)*, and three prepositions denoting "under" (*au-dessous de, en dessous de* and *sous).* Out of the three French prepositions denoting "under", *sous* was selected for the overall analysis as it was frequently used to describe this spatial scene by native speakers of French in the pilot study; *au-dessous de* was never used and *en dessous de* was only marginally used to describe this spatial scene. However, in a follow-up analysis to the overall analysis, L2 users' acceptability ratings for the three prepositions denoting "under" are compared to those of L1 speakers of French.

3.4 Procedure

Participants completed the experiment online. This means that they were free to complete the experiment at their preferred time from any computer with an internet connection. The Norwegian L1 group completed the experiment in Norwegian whereas the French L1 and French L2 groups completed the experiment in French. After having logged in with their specific participant id, participants were given detailed instructions on what to do during the session and on how to use the rating scale. The groups were given initial instructions in their respective native language.

There were 18 trial items and 21 filler items. Trial and filler items were completely randomized. All prepositions appeared with every trial item but the order in which they were listed with each item was also fully randomized.

3.5 Results

The results from the L2 French group for the prepositions *au-dessus de* and *sous* were first compared to those of the L1 French group to see if there were differences in rating between the native speakers of French and the L2 users. Secondly, the results of the L2 French group were compared to the results of the L1 Norwegian group for the Norwegian prepositions *over* and *under* to see whether the L2 users' ratings differed from those of native speakers of Norwegian.

Analysis for the lady and umbrella picture series was carried out as a 3 (geometry – canonical, 45 degrees rotation, 90 degrees rotation) x 3 (function – control, functional, non-functional) x 2 preposition (*over/au-dessus de* and *under/sous*) repeated measures ANOVA with language group as a between-subjects factor. Analyses were carried out separately for the two combinations of language groups. Corrections (Greenhouse-Geisser) are reported where appropriate. All results are significant at the $\alpha = 0.05$ level.

3.5.1 Comparing L1 French and L2 French

The analysis including the L1 French and L2 French groups yielded no main effect of language group. As expected there were main effects of geometry ($F(2, 100)=244.74$, $p=0.00001$, partial $\eta^2 =0.83$) and function ($F(2,100)=12.32$, $p=0.00002$, partial $\eta^2 =0.20$). There was also a main effect of preposition ($F(1,50)=7.56$, $p=0.008$, partial $\eta^2 =0.13$), indicating that ratings for *au-dessus de* and *sous* differed. Furthermore there was an interaction effect of geometry and preposition ($F(2, 100)=5.43$, $p=0.006$, partial $\eta^2 = 0.10$), indicating that the two prepositions are differently affected by the geometrical manipulations. In addition there was an interaction effect of geometry and language group ($F(2, 100)=4.38$, $p=0.02$, partial $\eta^2 =0.08$) and an interaction of

preposition and language group ($F(1, 50)=4.56$, $p=0.04$, partial $\eta^2=0.08$) . There was no interaction effect of function and language group.

Similarly to the results reported by Coventry et al. (2011), the main effect of geometry was modulated by language group. Planned comparisons showed that the decline in acceptability was the same for both groups across the two non-prototypical geometric positions, i.e., from the 45 degree (L1: M=4.03, SE=0.89, L2: M=4.58, SE=0.83) to the 90 degree (FL1: M=1.54, SE=0.52, FL2: M=2.07, SE=0.49) level of geometry ($t(100)=-0.026$, $p=0.979$). However, the two groups differed significantly in the decline of acceptability ratings from the canonical upright position (FL1: M=7.75, SE=0.50, FL2: M=6.99, SE=0.46) to the 45 degree rotation ($t(100)= 2.337$, $p=0.023$). The decline in acceptability was more pronounced for the L1 group than for the L2 group, indicating that the L1 users made more graded distinctions on the basis of geometric position than did the L2 users. Post-hoc tests showed that acceptability ratings differed significantly across all three levels of geometry for both language groups (see Figure 1) but that acceptability ratings in the two groups did not differ on the individual levels of geometry (simple effects). This is in line with the hypothesis that overall acceptability ratings in the L2 group would resemble those of the native group because of the relatively high proficiency level. The findings indicate that although the L2 users did not make the same graded distinctions on the basis of geometric information as native speakers, they nevertheless did make distinctions that would be sufficient for selecting the appropriate preposition for the scene.

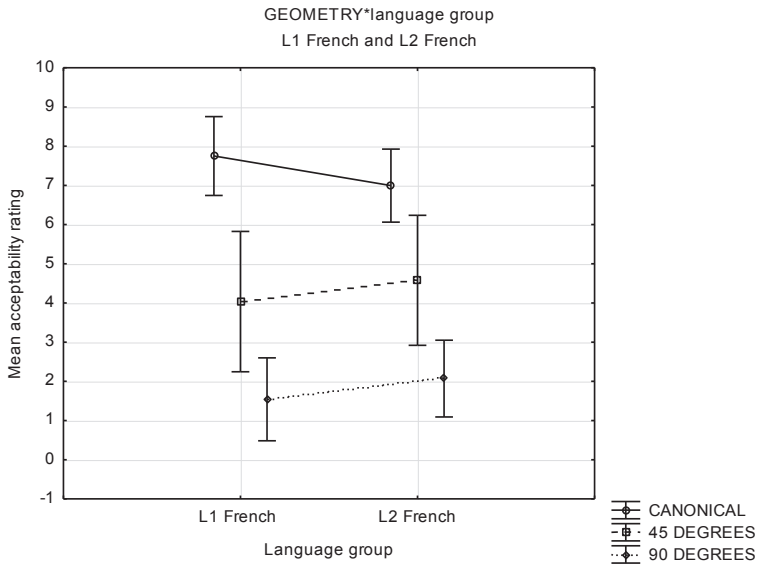

Figure 1 Interaction of geometry and language group (L1 French and L2 French). Bars denote 95% confidence intervals.

The main effect of preposition was also modulated by language group. The Tukey HSD post hoc test revealed that acceptability ratings for *sous* were significantly lower than those for *au-dessus de* (p=0.004) in the L2 group[1]. There were no significant differences in the acceptability ratings for the two prepositions in the L1 group, nor did ratings for *sous* or *au-dessus de* differ across language group. A possible reason for the lower acceptability ratings in the L2 group for *sous* than for *au-dessus de* is that there is only one preposition denoting "over" in French (*au-dessus de*) whereas there are three denoting "under" (*au-dessous de, en dessous de* and *sous*), leading to a higher confidence in the acceptability of *au-dessus de* in the L2 group. This is in line with claims that it is more difficult to acquire lexicalization patterns if the L2 makes more discriminations than the L1 does than the reverse (e.g. Cadierno, 2008; Stockwell, Bowen, & Martin, 1965).

There is no indication in these data that high proficiency L2 users would not be able to produce the correct spatial preposition (out of the two analyzed) for these spatial scenes. However, the results indicate that even though the L2 participants mastered the target like selection of preposition, they did not make the same graded meaning distinctions as L1 users do, i.e., the L2 participants have not fully mastered the importance given to geometric information in native language judgments.

The lack of interaction effect between function and language group indicates that there were no significant differences in how the dynamic-kinematic manipulations affected acceptability ratings in the L2 and L1 group. Dynamic-kinematic information may therefore be less problematic for the L2 learner than distinctions based on geometry, at least for the "over/under" relationship.

3.5.2 Comparing L1 Norwegian and L2 French

The analysis comparing the L1 Norwegian group to the L2 French group showed no main effect of language group. Again, as expected, there were main effects of geometry ($F(2, 104)=329.52$, $p=0.000001$, partial $\eta^2=0.86$) and function ($F(2,104)=11.0$, $p=0.00005$, partial $\eta^2=0.17$) as well as a main effect of preposition ($F(1,52)= 5.0$, $p=0.03$, partial $\eta^2=0.09$). The main effects of geometry and preposition were both modulated by language group ($F(2,104)=4.67$, $p=0.015$, partial $\eta^2=0.08$, and $F(1,52)=7.11$, $p=0.01$, partial $\eta^2=0.12$, respectively). Furthermore there was an interaction effect of geometry and function ($F(4,208)=2.96$, $p=0.02$, partial $\eta^2=0.05$) and of geometry and preposition ($F(2,104)=5.85$, $p=0.004$, partial $\eta^2=0.10$). There was a three-way interaction of geometry*preposition*language group ($F(2, 104)=3.61$, $p=0.03$, partial $\eta^2=0.06$).

[1] Descriptives are shown in the Appendix, Table 3.

The fact that there was an interaction effect of geometry and language group indicates that ratings in the L2 group are not based on L1 intuitions. If they were, L2 French and L1 Norwegian acceptability ratings would not differ significantly. Interestingly, planned comparisons for the three-way interaction of geometry*preposition*language group revealed a pattern similar to the one we saw in the comparison of L1 French and L2 French. Regarding the prepositions *over/au-dessus de*, the comparisons showed that the two groups differed significantly (t(104)=-2.44, p=0.02) in the decline in acceptability ratings from the canonical position (NL1: M=7.73, SE=0.40, FL2: M=7.39, SE=0.38) to the 45 degrees rotation(NL1: M=4.46, SE=0.55, FL2: M=5.37, SE=0.53), whereas they did not (t(104)=1.13, p=0.26) in the decline from the 45 degrees rotation to the 90 degrees rotation position (NL1: M=1.62, SE=0.42, FL2: M=2.05, SE=0.40). With respect to the prepositions *under/sous*, the planned comparisons revealed that the groups differed significantly in the decline in acceptability rating from the canonical position (NL1: M=7.94, SE=0.50, FL2: M=6.60, SE=0.48) to the 90 degrees rotation position (NL1: M=1.72, SE=0.39, FL2: M=2.10, SE=0.38) (t(104)=3.12, p=0.003). Moreover, Tukey HSD post hoc tests showed that the groups differed in acceptability ratings in the canonical position (p=0.016), where L2 users' acceptability ratings for *sous* were significantly lower than the native Norwegian speakers' acceptability ratings for *under* (see Figure 2).

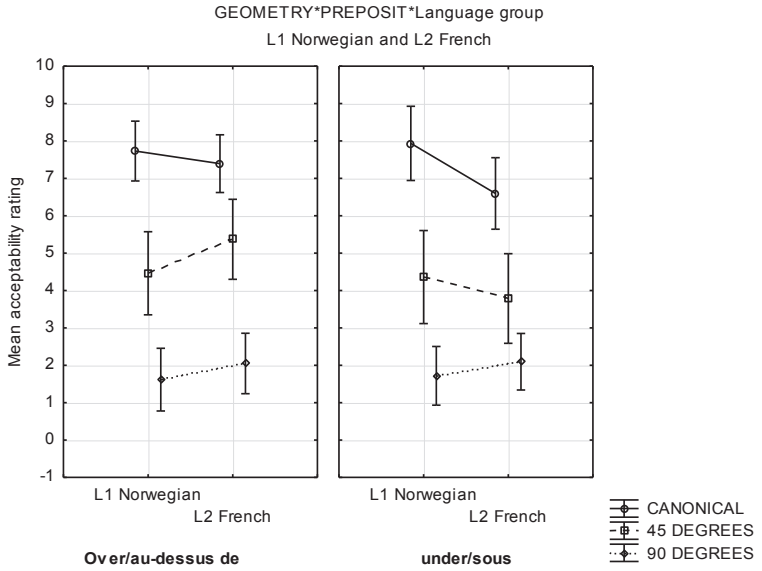

Figure 2 The three-way interaction of geometry, preposition and language group (L1 Norwegian and L2 French). Bars denote 95% confidence intervals.

Tukey HSD post hoc tests for the interaction effect of preposition and language group revealed exactly the same pattern as for the corresponding interaction effect found when comparing L1

French and L2 French. There were no significant differences in the ratings for *over* (M=4.60, SE=0.54) and *under* (M=4.67, SE=0.56) in the L1 Norwegian group, whereas the L2 French group gave significantly lower ratings for *sous* than for *au-dessus de* (p=0.004)[1]. This indicates that the difference in acceptability ratings for *sous* and *au-dessus de* in the L2 group is not based on any difference between *over* and *under* in Norwegian.

3.5.3 *Sous, au-dessous de*, and *en dessous de*. Comparing L1 French and L2 French

We have seen that L2 users made native-like distinctions based on functional, but not geometric information for the prepositions *au-dessus de* and *sous,* and that geometric distinctions made in the L1 of were not directly transferred to the L2. The question remains, however, whether the patterns found in L2 acceptability ratings for *au-dessus de/sous* extend to all the prepositions denoting inferiority on the vertical axis. Ratings for the three prepositions *sous*, *au-dessous de* and *en dessous de* were therefore submitted to a separate analysis comparing results from the native speakers of French and the L2 speakers of French to see if the same differences were found for all three prepositions. In this case, a comparison to rating data for Norwegian prepositions was not possible, as there is only one preposition denoting inferior location on the vertical axis in Norwegian (*under*).

Analysis for these results was carried out as a 3 (geometry – canonical, 45 degrees rotation, 90 degrees rotation) x 3 (function – control, functional, non-functional) x 3 preposition (*sous, au-dessous de, en dessous de*) repeated measures ANOVA with language group as a between-subjects factor. Greenhouse-Geisser corrections are reported where appropriate. All results are significant at the $\alpha = 0.05$ level.

The analysis yielded no main effect of language group. Again, there was a main effect of geometry ($F(1.74, 87.08)=194.48$, $p<0.0001$, partial $\eta^2=0.97$) and of function ($F(2, 100)=14,12$, $p<0.0001$, partial $\eta^2=0.22$). These effects mirror the ones found in the analyses in the previous sections. Moreover, there was an interaction effect of geometry and function ($F(4, 200)=4.78$, $p=0.001$, partial $\eta^2=0.09$). There was also a main effect of preposition ($F(2, 100)=3.92$, $p=0.023$, partial $\eta^2=0.07$), which in turn was modulated by language group ($F(2, 100)=7.45$, $p=0.001$, partial $\eta^2=0.13$). There was also an interaction effect of geometry and preposition ($F(3.46, 173.22)=4.96$, $p=0.002$, partial $\eta2=0.09$). Crucially, there was a three-way interaction between geometry, preposition and language group ($F(3,47, 173.22)=5.01$, $p=0.001$, partial $\eta^2=0.09$). The interaction is shown in Figure 3. Tukey HSD post hocs revealed that L2 acceptability ratings for the three prepositions did not differ significantly in each of the three geometrical positions. In

[1] See Appendix, Table 3 for descriptives.

the native-speaker group, however, acceptability ratings were significantly lower for *au-dessous de* (M=5.38, SE=0.66) than for *sous* (M=7.75, SE=0.54, p<0.0001) and for *en dessous de* (M=7.24, SE=0.53, p<0.0001) when the umbrella was in the upright position. In the other two positions, L1 acceptability ratings for the three prepositions did not differ significantly. This indicates that L1 users made a distinction between, on the one hand, *sous* and *en dessous de*, which were rated as equally good prepositions to describe the relationship between the woman and the umbrella in the upright position, and, on the other hand, *au-dessous de*, which was not particularly suitable to describe this relationship. The L2 users, on the other hand, were not sensitive to this distinction between the three prepositions.

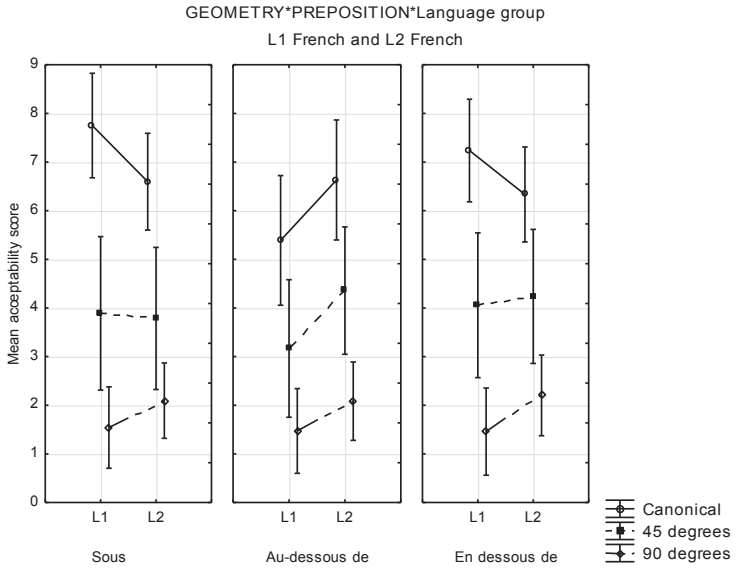

Figure 3 The three-way interaction of geometry, preposition and language group (L1 French and L2 French). Bars denote 95% confidence intervals.

Furthermore, planned comparisons revealed that L1 and L2 users did not differ in how they adjusted their acceptability ratings for the preposition *au-dessous de* as a function of changes to the position of the umbrella. For the other two prepositions, however, planned comparisons revealed that the two groups differed in the magnitude of adjustment to acceptability ratings from the upright, canonical position to the 90 degree position (*sous*: t(100)=2,90, p=0.006, *en dessous de*: t(100)=3.36, p=0.001). This indicates that L2 users made smaller adjustments to their acceptability ratings as a function of changes in geometry than the native speakers did for the two prepositions *sous* and *en dessous de*, while they made adjustments of the same magnitude as the native speakers did for the preposition *au-dessous de*. A likely explanation for

this is the difference between the two groups' acceptability ratings for *au-dessous de* in the upright position.

3.6 Discussion

We have seen that the prediction that the overall acceptability judgments of the L2 group would not differ significantly from those of the native speakers of French was borne out. This indicates that overall knowledge about the meaning of the prepositions and the situations in which they can be used is relatively target-like in the L2 group tested. However, the L2 judgments do not mirror native speaker judgments for the preposition *au-dessous de*, indicating that not all of the prepositions tested are mastered to the same level by the L2 speakers. Furthermore, we have seen that L2 users modulated their acceptability ratings as a function of changes to dynamic-kinematic information in the same way as native speakers did, for all four prepositions included in the study. This suggests that the L2 users make meaning distinctions based on dynamic-kinematic information in a native-like way. This finding is consistent with findings in Coventry et al. (2011), and confirms the hypothesis that differences between L1 and L2 user ratings would not be found for dynamic-kinematic information. However, one must bear in mind that L1 Norwegian and L1 French speakers have been found not to differ significantly in how they modulate their acceptability ratings as a result of dynamic-kinematic manipulations (Listhaug, 2014). The acceptability judgments of the L2 users in the present study also did not differ significantly from those of the L1 Norwegian speakers over the dynamic-kinematic factor. This means that it is impossible to determine whether the L2 group based their modulations on intuitions from their L1 or whether they had mastered those of the target language. In other words, the present data cannot rule out a hidden positive transfer from the L1 to the L2.

Manipulations of geometrical information in the scenes, on the other hand, did yield differences in acceptability ratings between the L2 users and the native speakers of French. Thus, the hypothesis that the L2 users' ratings would differ from the L1 speakers of French following changes to geometric information was confirmed. This difference is not due to any differences between the prepositions in Norwegian and French, as native-speaker ratings do not differ significantly for this factor (Listhaug, 2014). Moreover, the acceptability judgments of the L2 French users differed from those of the L1 Norwegian group as well. This indicates that the L2 users did not simply transfer L1 intuitions about the weighting of geometrical information to the L2 prepositions. In the particular scene depicted in the experiment, geometry is highly salient and also highly decisive for the choice of preposition. Clearly, the L2 group was sensitive to this, as their acceptability ratings differed significantly from one level of geometry to the other. However, the magnitude of change in their acceptability rating as a function of changes to

geometrical position differed from that found in the acceptability ratings from L1 users (both L1 French and L1 Norwegian). Furthermore, this same pattern was attested in three of the four prepositions investigated: *au-dessus de*, *sous*, and *en dessous de*. The pattern was not found for *au-dessous de*; in this case, the L2 users overestimated the acceptability of the preposition, particularly in the canonical position. Thus, while high proficiency L2 users would be able to select the appropriate preposition for this kind of spatial scene, their intuitions about preposition use do not necessarily equal those of native speakers. While the effects found here are relatively small, these findings are interesting from a theoretical point of view. Coventry et al. (2011) looked at three groups of L2 speakers with different levels of proficiency and found that differences in acceptability ratings over the three positions of the umbrella increased as the proficiency level of the participants became higher. The participants with the highest proficiency level were the ones who made the most native-like distinctions. The present study only looked at a single group of L2 participants with a relatively high level of French proficiency and showed the same relationship between upper intermediate/advanced L2 users and native speakers as in Coventry et al.'s study, but in a different language pair. Future research on the comprehension of prepositions by Norwegian L2 learners of French should include L2 participants with different levels of proficiency.

An important aspect of the methodology used in the present study is that it allows for a study of the different components underlying spatial preposition meaning and the degrees to which L2 learners are sensitive to these. This means that it is also possible to study how knowledge about the relative importance for each of the components changes also after a preposition has entered into the L2 users' productive vocabulary. A number of studies have shown that native-like production does not always entail that the subtleties underlying the behavior have been mastered to a native-like level. Dimitrova-Vulchanova, Martínez, Eshuis, and Listhaug (2012) found that while the L2 users were able to use appropriate linguistic items (verb + preposition) for expressing motion, they did make mistakes in the way verbs and prepositions co-occur or they extended the pattern in ways native speakers never do. Along the same lines, research on gestures in the L2 has shown that advanced L2 speakers who display target-like linguistic behavior, still often align gestures with speech in a way that reveals L1 foci or produce gestures that reflect conceptual material from the L1 (see Gullberg, 2008 for an overview). Research on attainment in second language acquisition has addressed the issue of the details that reveal "L2-ness" even in the advanced L2 user (Hyltenstam & Abrahamsson, 2000, 2003). The differences between native speakers and advanced L2 users are often not qualitative, but a matter of degree. The L2 users in this study do not differ significantly from the L1 users in how acceptable they think the prepositions are in each condition tested, and in a production task it is highly

likely that they would produce the same preposition as native speakers do (with the possible exception of *au-dessous de*). Nevertheless, their discrimination based on geometrical information is not native-like.

4 Conclusion

The topic of this study was the interplay of geometric and extra-geometric information in L2 spatial language. The Functional Geometric Framework partitions extra-geometric information into two categories, dynamic-kinematic routines and object knowledge, including knowledge of how nouns and prepositions co-occur in a language. Findings in this study show that Norwegian L2 users of French discriminate less on the basis of changes in geometrical information in their acceptability judgments - at least for this type of spatial scene - than do native speakers of both French and Norwegian, indicating that subtleties in geometrical information are hard to master in the L2 and that transfer from the L1 is not the cause of the difficulty. L2 users modulated their responses as a function of manipulations of dynamic-kinematic information in the same way native speakers did, indicating that dynamic-kinematic information is mastered by L2 learner earlier in the acquisition process than geometrical information. However, in this case it is not possible to say whether the L2 users have acquired target-language weightings for dynamic-kinematic information or base their modifications on their native language.

5 Acknowledgements

I would like to thank Kenny Coventry for the use of the pictures in the experiments. The pictures were originally used in AHRC grant number 112211 awarded to Kenny Coventry and Pedro Guijarro-Fuentes. The copyright for Figure 4 is held by Kenny Coventry.

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7 Appendix

7.1 Visual stimuli

Figure 4. Example of pictures used in the experiment. Levels of geometry: Canonical, 45 degrees rotation and 90 degrees rotation.

7.2 Linguistic stimuli in French and Norwegian

French: La femme est _____ parapluie.[1]

Norwegian: Dama er _____ paraplyen.[2]

French: Le parapluie est _____ femme.

Norwegian: Paraplyen er _____ dama.

[1] The definite article of the RO noun was presented along with the prepositions for rating.

[2] The definite article in Norwegian is realized as the suffix *–en* in the masculine, *-a* in the feminine.

7.3 Descriptive statistics

The tables 1 and 2 contain descriptive statistics for all variables and levels for French (both L1 and L2) and Norwegian prepositions, respectively. Table 3 shows the mean acceptability rating for *au-dessus de*, *sous, au-dessous de* and *en dessous de* collapsed over all geometrical and functional levels, for L1 and L2 French speakers.

Table 1 Mean acceptability score and standard deviation for all variables and levels. L1 French (N=24) and L2 French (N=28).

	Canonical		45°		90°	
	M	SD	M	SD	M	SD
Control						
Au-dessus de						
L1 French	7.71	0.75	4.58	2.62	1.58	1.10
L2 French	7.00	2.40	5.32	2.33	2.04	2.05
Sous						
L1 French	7.83	0.48	4.25	2.71	1.42	1.06
L2 French	6.89	2.04	4.25	2.44	1.86	1.74
Au-dessous de						
L1 French	5.13	2.15	3.46	2.34	1.50	1.18
L2 French	6.57	2.04	4.36	2.36	1.75	1.34
En dessous de						
L1 French	7.13	1.36	4.75	2.49	1.46	0.98
L2 French	5.89	2.41	4.43	2.44	1.89	1.75
Functional						
Au-dessus de						
L1 French	7.92	0.28	4.04	2.39	1.75	1.23
L2 French	7.71	1.33	5.86	2.30	2.25	2.14
Sous						
L1 French	7.92	0.28	4.17	2.70	1.88	1.42
L2 French	7.04	1.91	4.00	2.54	2.79	2.44
Au-dessous de						
L1 French	5.71	2.27	3.42	2.34	1.58	1.10
L2 French	6.68	2.19	4.71	2.55	2.61	2.25
En dessous de						
L1 French	7.42	1.32	4.33	2.62	1.58	1.18
L2 French	6.64	2.21	4.54	2.50	3.11	2.69
Non-functional						
Au-dessus de						
L1 French	7.63	0.82	3.92	2.66	1.29	0.75
L2 French	7.46	1.84	4.93	2.51	1.86	1.55
Sous						
L1 French	7.50	1.10	3.25	2.46	1.33	0.92
L2 French	5.86	2.85	3.11	2.18	1.64	1.62
Au-dessous de						
L1 French	5.33	2.35	2.63	2.22	1.33	0.82
L2 French	6.64	2.13	4.00	2.33	1.89	1.66
En dessous de						
L1 French	7.17	1.31	3.08	2.48	1.33	0.92
L2 French	6.45	2.06	3.75	2.43	1.61	1.17

Table 2 Mean acceptability rating and standard deviation for all variables and levels. L1 Norwegian (N=26)

	Canonical		45°		90°	
	M	SD	M	SD	M	SD
Control						
Over	7.92	0.27	5.00	2.04	1.35	1.13
Under	7.92	0.39	4.54	2.45	1.27	0.83
Functional						
Over	7.88	0.59	4.54	2.34	1.77	1.31
Under	8.00	0.01	4.85	2.22	2.27	2.16
Non-functional						
Over	7.39	1.58	3.85	2.17	1.73	1.43
Under	7.88	0.43	3.69	1.98	1.62	1.17

Table 3 Mean acceptability rating and standard error for all prepositions. L1 French (N=24) and L2 French (N=28).

	L1 French		L2 French	
	M	SE	M	SE
Au-dessus de	4.49	0.57	4.94	0.53
Sous	4.39	0.65	4.16	0.60
Au-dessous de	3.34	0.75	4.36	0.69
En dessous de	4.25	0.70	4.26	0.65

Paper III

Spatial prepositions in the L2: Does proficiency have a role?

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Abstract

This paper reports on two studies investigating the depth of knowledge of spatial prepositions in native Norwegian L2 learners of French. First, an explorative study aimed at establishing tendencies in preposition production in first- and second-semester students of French at university level. Second, an experiment eliciting judgments about preposition acceptability from one group of intermediate and one group of advanced learners aimed at investigating whether there is evidence that knowledge of preposition meaning continues to change also after prepositions are established in productive vocabulary. Findings in the study are that preposition production is more structured and consistent in the second-semester group than in the first-semester group, and that the advanced group makes more consistent acceptability judgments than does the intermediate group. These findings are taken to indicate that the semantic network for spatial prepositions undergoes structuring and tightening with increased proficiency in the L2.

Key words: spatial prepositions, L2, lexical knowledge.

1. Introduction

Learning to talk about where objects are located involves multiple components that have to be mastered individually. Learners must identify and store in long term memory labels for the objects involved in a spatial scene. Furthermore, they must identify other items involved in the expression of location in the language, such as particles, case, adpositions or specific verbs, and the language-specific ways of distributing spatial semantic content over these elements in a sentence. Having identified the lexical items and grammatical structures involved, learners must map spatial expressions onto the appropriate spatial scenes or configurations.

L2 acquisition differs from L1 acquisition in that L2 learners already have established form-meaning mappings in their L1. When acquiring spatial prepositions, L2 learners are likely to initially rely on the knowledge they have of correct preposition usage in their L1, if their L1 has prepositions, that is, before they gradually tune in to the appropriate target-language usage. In

doing so, they may first focus on single cues, adding subsequent cues as their proficiency develops and only later in development become sensitive to the complex interaction of multiple cues (Coventry & Guijarro-Fuentes, 2008; Ellis, 2006). Such a process is not specific to L2 acquisition. Feist (2008) found that in the acquisition of spatial prepositions in the L1, adult-like representations of the interaction of geometry and function were only attained in adolescence. With respect to attention to these cues, i.e., geometry and function, the development in L2 has been found to resemble the development in L1 with functional features being available earlier in the developmental process than geometric ones, at least for some spatial configurations (Coventry, Guijarro-Fuentes, & Valdés, 2011).

This study looks at the development of L2 spatial preposition representation in late Norwegian learners of L2 French.

2. L1 and L2 lexical development

2.1 General lexical development

L1 acquisition and L2 acquisition are both different and similar processes (Bley-Vroman, 2009). Whereas L1 acquisition overlaps with the development of conceptual knowledge about the world and the entities in it, L2 learners, and in particular late L2 learners, have already established conceptual knowledge about the world. They come to the acquisition task with extensive implicit knowledge about linguistic properties and principles, and they have already established form-meaning mappings in their L1. Nevertheless, L1 and L2 acquisition processes are also similar in many respects. Both types of acquisition hinge on the mapping of a form, lexical or structural, onto a semantic meaning. Input is a necessary ingredient in both processes (Chenu & Jisa, 2009). How L2 syntactic and semantic representations develop is a matter of considerable debate. Stringer (2007, 2008, 2011) argues for a full lexical transfer whereby L2 users have full access to L1 representations including lexical features underlying syntactic structures in the L2.

Vocabulary size is often used as a measure of linguistic competence. There is a well-known correlation between vocabulary size and language proficiency in L1. Researchers distinguish between vocabulary breadth (lexical diversity, number of different words) and vocabulary depth (lexical density, interconnection of words with other words in a lexical network) (Vermeer, 2001). There are various ways to assess vocabulary size. In L2 research, word-association (WA) paradigms are often used and are thought to measure vocabulary depth. Vocabulary depth takes time to develop (Schmitt & Meara, 1997). Studies looking at L2 users' word association results have shown that with increasing proficiency L2 users get WA results

that quantitatively resemble those of native speakers' in that deeper links emerge (Zareva, 2007). For instance, there is more commonality – i.e. the L2 participants perform more similarly and with less within-group variation as they home in on the meaning of a stimulus word. Furthermore, the responses show less heterogeneity of meaning connections over time. Not only do L2 users provide more of the same word-associations as they become more advanced, they also show more stringency in what meaning connections they display. This is indicative of a lexical development in L2 from a sparse semantic network to one that gradually becomes denser and more structured. Studies of neural development show findings consistent with such a view (Chee, 2005; Chee, Hon, Lee, & Soon, 2001; Chee, Soon, Lee, & Pallier, 2004; Green, Crinion, & Price, 2007). Some studies show that grey matter density in parts of the brain is important for vocabulary learning increases with increased second language proficiency (Lee et al., 2007; Mechelli et al., 2004).

Consolidation of linguistic knowledge happens over different timeframes. When it comes to the integration of a new word into the lexicon, consolidation takes place in a matter of hours. Nevertheless, a certain time for off-line integration is necessary. Sleep has been found to impact on the establishment of stable representations in the neocortical systems of the brain (Lindsay & Gaskell, 2010). However, consolidation over such a short timeframe is not enough for a fully-fledged representation of a word in the mental lexicon. On the other hand, this type of consolidation ensures that novel words quickly become part of a learner's lexicon. This is necessary for later retrieval and production of an item. Knowledge that has been consolidated can be further exploited in the acquisition process (Mather, 2013). As vocabulary size gets bigger, the growing knowledge affects the ability to develop new knowledge, thus vocabulary learning gets faster. (Kuhl & Rivera-Gaxiola, 2008; McMurray, 2007; McMurray, Horst, & Samuelson, 2012). In adult L2 acquisition some aspects of target-language linguistic knowledge have been found to develop rapidly, scaffolding further development (McLaughlin, Osterhout, & Kim, 2004).

The process a concept undergoes on its way to becoming so deeply rooted in long term memory that it can be effortlessly activated and retrieved, is called *entrenchment* (Langacker, 1987; Schmid, 2007). Entrenchment depends on frequency of exposure and, most importantly, frequency of use. It involves a development of representations in terms stabilization of core semantic content, but also in the understanding of metaphoric and extended meanings. More entrenched forms will be easier to retrieve and to produce than less entrenched forms. Basic level categories are more likely to be entrenched, because they are often used, fairly simple, and represent a balance between specificity and readily available conceptual content (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). Entrenchment is a form of consolidation that operates

over a long timeframe, maybe even years. Ellis (2006) maintains that learners first attend to only one cue at a time, and only later in the acquisition process are able to focus on multiple cues and so develop a more fundamental or native-like understanding of a concept and avoid usage errors. Such processes are of course also involved in L1 acquisition. Styles and Plunkett (2009) argue that when children acquire words in their L1, they first map the word onto a general representation – a word like *socks* may initially be mapped onto a situation involving getting dressed. At this stage the child is able to pick out a picture of socks if it is contrasted by a picture of a lorry, but maybe not if it is contrasted by pictures of other items of clothing. Later the word gets mapped to dressing the legs, and so may be picked out if contrasted with a picture of a sweater, but not if contrasted with a picture of a pair of trousers. In this way, the authors claim, the child's conceptual representation for "socks" gets consolidated and narrowed down through multiple exposures to both the word and the situation in which it is used. Clark (2010) maintains that learning vocabulary is a lengthy process, and that acquiring the full meaning of a word takes time. Particularly, she argues, learning the conventions of vocabulary use in the language takes time.

One aspect that does differ in the L1 and the L2 acquisition processes is the possible end state or final outcome. L2 users, even near-native ones, do not obtain the same global proficiency levels as native speakers (Abrahamsson & Hyltenstam, 2009; Hyltenstam & Abrahamsson, 2000). There will probably always be subtle details that distinguish native speakers of a language from L2 speakers.

2.2 Spatial language development

There is extensive cross-linguistic variation as to what properties of the spatial domain are reflected in lexicalization. For L2 learners the spatial domain therefore constitutes a semantic challenge. When children learn to talk about location in their native language, they build upon pre-linguistic knowledge about how objects behave in the physical environment, about how objects can interact and be interacted with, as well as knowledge about spatial conceptual categories (Hespos & Spelke, 2007; Needham & Baillargeon, 1993; Quinn, 1994, 2005). Furthermore, salient geometric properties of objects (shape) supports object label learning (Smith, 2009; Son, Smith, & Goldstone, 2008) Children learn to map the spatial terms available in the language onto the language-appropriate spatial scenes and situations. According to Gentner and Bowerman (2009) spatial distinctions that are encoded in many languages are easier for children to learn than distinctions that are coded in few languages. There is evidence that the language the child learns influences recognition of non-linguistic spatial categories in such a way that the child develops sensitivity to the distinctions that are relevant for the language learnt (Bowerman & Choi, 2001; Göksun, Hirsh-Pasek, & Golinkoff, 2010). In the

process, sensitivity to other distinctions may become weakened (McDonough, Choi, & Mandler, 2003). Research has shown that although the language learnt does not shape overall spatial conceptualization, the pattern of encoding in L1 may have temporary effects on non-linguistic spatial representations (Landau, Dessalegn, & Goldberg, 2010; Landau & Lakusta, 2006; Munnich, Landau, & Dosher, 2001). According to Slobin's thinking for speaking hypothesis (Slobin, 1996), speakers learn to attend to those aspects of a scene their language systematically encodes when they are planning utterances, such as for instance path or manner of motion.

Geometric and functional properties have been shown to underlie comprehension and production of spatial prepositions cross-linguistically (Coventry & Garrod, 2004; Vandeloise, 1986). Feist (2008) showed that the acquisition of spatial prepositions in the L1 follow a developmental trajectory where functional information is mastered early on whereas adult-like representations for geometrical information take time to develop. This is consistent with a view that learners attend to single cues at a time and that a full understanding of the complex interplay of multiple cues emerge later in the acquisition process. This may also be the case in the acquisition of prepositions in the L2. The question is whether it is the geometric or the functional information that is acquired first. Munnich and Landau (2010) maintain that functional properties of spatial language are problematic for L2 learners. However, there is also evidence that it takes longer for the L2 learner to pin down the fine-grained geometrical properties spatial prepositions encode than the functional aspects of the spatial situations they build upon (Coventry et al., 2011; Listhaug, under revision). The latter findings are interesting as they indicate that the developmental profile of spatial language learning may be parallel in L1 and in L2. In both cases functional information is acquired earlier than geometrical information.

A third factor that comes into play in the expression of location in a second language is the fact that object labels (nouns) affect how spatial situations are conceptualized (Coventry & Garrod, 2004). An object labelled *bowl* is usually conceptualized as a container and associated with the preposition *in*. If the same object is labelled *dish* it may be conceptualized as a support and associated with the preposition *on*. Languages vary in such conventionalized noun-preposition pairings. As Bowerman puts it, topological semantic development "[…] is also a deeply social process of learning how to conceptualize spatial entities according to the conventions that the target language has established over time to allow speakers to communicate about space." (Bowerman, 2007, p. 199). Such conventions may be especially problematic for L2 learners.

In an investigation of the acquisition of spatial prepositions in L2 English by Dutch children, Lowie and Verspoor (2004) found that both the frequency of L2 prepositions and their similarity to L1 prepositions (cognate status) affected development of lexical representation in

the L2 learners. As predicted, the researchers found that similarity to L1 prepositions facilitated the acquisition of L2 prepositions at lower proficiency levels. At higher proficiency levels there were no such effect. These participants had developed lexical representations for prepositions with both high and low similarity to prepositions in the L1. Any effects of L2 preposition frequency are to be expected only in groups that have had sufficient exposure to target language input, thus frequency was hypothesized to have an effect only in high-proficiency groups. However, frequency effects were found also in the low-proficiency groups. Lowie and Verspoor explain this unexpected result by the overall frequency of prepositions and the fact that Dutch children are extensively exposed to English. However, there was an interaction effect between similarity and frequency. Similarity effects were only found with low frequency prepositions, meaning that infrequent L2 prepositions were acquired more easily if they were similar to L1 prepositions. According to the authors this is indicative of lower proficiency groups displaying conceptual overlap between L1 and L2 lexical items.

3. The present study

Having both functional and lexical properties, prepositions are an interesting category. In some cases they are pure relational words. Like verbs, they take complements. However, they also often have a specific semantic content, as do for instance spatial prepositions. They form a closed class, and are highly frequent. The implication of this is that prepositions are likely to undergo conceptual strengthening and restructuring even in participants with relatively low proficiency levels. This explorative study investigates the development of conceptual representations for prepositions in L2 French by late Norwegian learners. First, an experiment eliciting production data seeks to investigate tendencies in preposition production over two different levels of proficiency; lower intermediate/intermediate learners and intermediate/upper intermediate learners. Cluster analysis is used to explore differences on the behavioral level as evident in the lexicalization patterns in the domain of static location. Second, an experiment eliciting rating data from an intermediate/upper intermediate group and an advanced learner group seeks to study whether conceptual development continues after initial word learning. The hypothesis is that consolidation and further strengthening of lexical knowledge will continue also after a native-like behavioural output is reached. This can only be assessed using methods that are sufficiently fine-grained to go beyond error patterns and tap into factors that underlie comprehension (Coventry et al., 2011).

'In' and *'on'* are among the first spatial prepositions to be produced by children (Bowerman, 1996; Meints, Plunkett, Harris, & Dimmock, 2002; Tomasello, 1987). Although acquisition of spatial language follows a different development for French-speaking children than for English-

speaking children (Hickmann, 2007), it is likely that *dans* 'in' and *sur* 'on' will be acquired early by L2 learners of French. Both prepositions are simple and highly frequent. However, French and Norwegian vary in how they combine their respective equivalents of 'in' and 'on' with labels for reference objects. L2 learners have to learn target-language specific combinations of prepositions and object labels. This area is therefore prone to lexical transfer from L1. While 'over' and 'under' are produced later by English-speaking children than 'in' and 'on', there is evidence that children have categorical understanding of the concepts from an early age (Quinn, 1994, 2005). 'Under' is also a category that is encoded cross-linguistically (Levinson & Meira, 2003). Thus, comprehension of the 'over' and 'under' categories should not be a problem for Norwegian learners of French. However, in French the small orthographic and phonological difference between *au-dessus de* 'over' on the one hand and *en dessous de*, *au-dessous de,* and - to a lesser degree - *sous* 'under' on the other may cause problems for Norwegian learners, especially in production. Unlike the Dutch learners of English in Lowie and Verspoor's study, Norwegian learners of French cannot benefit from preposition similarity as there are no cognates among the spatial prepositions in the two languages.

4. Experiment 1

4.1 Design

The experiment was set up as a production task. Participants were presented with visual stimuli consisting of image series depicting four types of spatial scenes; two image series targeting spatial relationships on the vertical axis, and two image series targeting topological spatial relationships. Geometrical and functional properties of the scenes were systematically manipulated in each of the image series. Each picture was described with a sentence of the type "The located object is _____ the reference object." Participants were asked to complete the sentence by filling in a preposition so that the sentence corresponded to the situation depicted in the image.

On the vertical axis one picture series, *Series I Lady and umbrella*, showed pictures of a woman holding an umbrella directly above her head (canonical position), with a rotation of 45 degrees from the vertical axis, or with a rotation of 90 degrees from the vertical axis (see section 9.3 for examples of the stimuli used). Functional properties were manipulated by the introduction of rain in the pictures. In the control condition, no rain was present in the picture, in the functional condition the rain hit the umbrella, and in the non-functional condition the rain hit the woman, and not the umbrella. Associated to the pictures were the sentences *La femme est* _____

parapluie ('The lady is _____ the umbrella') and *Le parapluie est* _____ *femme*[1] ('The umbrella is _____ the lady'). There were 18 pictures in the series. The other picture series, *Series II Box and bowl*, showed a box placed above the rim of a bowl. The box was oriented so that content could be poured from the box into the bowl. The box was placed either near the rim of the bowl or further away from it. In the control condition, no content was shown in the pictures, in the functional condition content (nuts) was seen pouring from the box into the bowl, and in the non-functional condition the content missed the bowl. Sentences are *La boîte est* _____ *saladier* ('The box is _____ the bowl') and *Le saladier est* _____ *boîte* ('The bowl is ____ the box'). There were 12 pictures in the series.

For the topological relations one picture series, *Series III Apple – bowl/plate*, showed an apple placed at three different distances - low, mid and high - from the rim of a bowl or a plate. The apple was either on top of a stack of other apples (contact) or not (no contact). Furthermore, it was either suspended from a string (+ alternative source of location control) or not (- alternative source of location control). Sentences associated with the pictures were *La pomme est* _____ *saladier* ('The apple is ___ the bowl') or *La pomme est* _____ *plat* ('The apple is _____ the plate'). There were 24 pictures in the series. The final picture series was *Series IV Hand/dish – fly/lock*. The pictures showed a hand or a dish (reference object) with three degrees of curvature – flat, mid or curved. The located object was either a fly or a padlock. Sentences for this series were *La mouche/le cadenas est* _____ *la main/l'assiette* ('The fly/the padlock is _____ the hand/the dish'). There were 12 pictures in the series, 6 with each of the reference objects. In total, therefore, 66 pictures were included in the experiment.

A numbered list of all the pictures and their respective geometrical and functional properties is given in Table 1 in the Appendix, section 9.1. The number in the list corresponds to the number in the graphs in Figure 1 and Figure 2.

4.2 Participants

Participants were all native speakers of Norwegian in their first year of studying French at the Norwegian University of Science and Technology, NTNU. All had knowledge of French from school before attending classes at university level. The first group (N=23) was tested in their first semester of French university-level studies. They were tested approximately 2 months into the semester in order to ensure that they had had some regular French input. The second group (N=22) was tested in their second semester of French university-level studies. This group was tested towards the end of the semester. By this time many, but not all, participants had been on

[1] Because the preposition and the definite article of the following noun sometimes merge in French (*de + le → du*), the noun designating the reference object was left bare in the stimuli.

a 5-week stay at l'Office Franco-Norvégien d'Echanges et de Coopération (OFNEC) at the University of Caen Lower Normandy in France. Both groups were however tested in Norway in a typical foreign-language classroom setting. None of the groups had received explicit instruction on preposition usage during their university studies. The participants were all tested in Norway. All participants had knowledge of English as a second language.

The proficiency level of the participants was measured using an online placement test for French courses (http://www.lang.ox.ac.uk/courses/tst_placement_french.html) and a self-report. Maximum score on the placement test was 50 points. The average scores were 22.35 for the first-semester group and 29.41 for the second-semester group. Both of these scores fall within the range of scores (21-30) indicating an "intermediate" level of proficiency in French. To assess whether the groups differed on proficiency level, group means were compared using an independent samples t-test. Bootstrapping based on 1000 samples was performed in order to correct for slight deviations from normality. Levene's Test for Equality of Variances was significant, hence the values not assuming equality of variances are reported. The test showed that the first-semester group scored significantly lower than the second-semester group ($t=(33.5)=-2.99$, $p=.005$ and $r=.46$). The results of the self-report confirm the pattern of the placement test. On the self-report 56.6 % of the first semester participants rated their knowledge of French as "basic"[2], 8.7 % as somewhere between "basic" and "intermediate"[3], 21.7 % rated their knowledge as "intermediate", whereas 13% failed to indicate their level. Among the participants in the second semester group, 9.1 % rated their knowledge of French as "basic", 9.1% somewhere between "basic" and "intermediate", 59.1% rated their knowledge "intermediate", 4.5% somewhere between "intermediate" and "advanced" and 18.2% rated their knowledge of French as "advanced". Taken together, these measures are indeed indicative of a significant difference in level of proficiency in the two groups.

4.3 Procedure

The experiment was carried out during an ordinary French lecture. It was administered as a booklet in which pictures were pseudo-randomized and ordered so that pictures from the same series did not appear on the same page in the booklet. This means that the pictures served as fillers for each other. Participants were encouraged not to go back to look at previous answers. Instructions were given by the experimenter in the participants' native language. Norwegian translation equivalents for the object labels (e.g., *boîte* = *boks*, *saladier* = *bolle*) were provided on the black board for both groups. The participants wrote the answers directly in the booklet.

[2] Categories were: basic, intermediate, advanced and fluent. Participants indicated their level by ticking a cell in a table.
[3] These participants ticked the line between category cells, clearly indicating that they placed themselves between the two categories.

Participants were told that providing the definite article for the reference object was optional. Any mistakes concerning the definite article (gender, form) were disregarded during the coding.

4.4 Method

Data were analyzed using cluster analysis, which is an exploratory method. As such it cannot be used for significance testing or for verifying hypotheses. It is used to explore patterns of data. It clusters variables together based on how dissimilar/similar they are. Similar categories are clustered together first, and then more and more dissimilar categories are linked. The technique has been used in linguistics to explore patterns of lexicalization in various domains. It has the advantage of being able to show how certain properties may drive lexicalization patterns, including what kinds of underlying features are linked and tend to be lexicalized similarly and which features are distinctive driving cut-off points in the lexicalization (Majid, Bowerman, van Staden, & Boster, 2007; Vulchanova, Martinez, & Vulchanov, 2013). Various types of cluster analyses have also been used to explore hypotheses about universal tendencies in lexicalization patterns cross-linguistically (Levinson & Meira, 2003). In the present study, cluster analysis was used to investigate the lexicalization patterns in the domain of static location. The aim was to explore patterns in L2 users' mapping of prepositions to visual scenes.

Each picture was treated as a separate variable and the number of times any preposition was used for each of the pictures was counted. A matrix was created with the 66 pictures as rows and the 24 elicited prepositions/answer categories as columns (see section 4.5). The cells in the matrix were filled in to indicate the number of times the term heading the column was used to describe the picture heading the row. Thus, if 10 participants used *dans* to describe the relationships between the objects in picture number 1, the *dans*/picture 1 cell in the matrix was given the value 10. Only one answer per participant per picture was counted. In the rare cases where participants had provided more than one answer, the first one was selected for coding. If no participant produced the preposition at the head of the column to describe the picture at the head of the row, the cell was given a value of 0. The matrix was then used as input for the cluster analysis.

The method chosen was hierarchical agglomerative clustering (tree clustering) where the linkage distance used was Euclidian distances, whereas Unweighted Pair-Group Average (UPGMA) was used as the linking rule. The UPGMA linking rule is efficient when objects fall into natural groups, as the pictures in the present analyses do. Clustering was performed on raw data.

Comparison of the clusters was done on a superficial level, not using statistical methods. Results will be interpreted accordingly. There are, however, good reasons to believe that the method is

valid for preliminary investigation of underlying factors which tend to be reflected in L2 user production. One important limitation, of course, is that L2 users may not have all the relevant prepositions available for the production task, compared to native speakers.

4.5 Coding

Answer types were predominantly spatial prepositions such as *dans, sur, sous* and *devant*. All of these were coded separately. Slight misspellings were ignored as long as it was clear which preposition was intended (e.g., **derriere* for *derrière* and the omission of the hyphen in *au-dessus de* / **au dessus de*). However, a distinction was maintained based on spelling of *au-dessus de* 'over' vs *au-dessous de* 'under' where *-u-/-ou-* is a meaningful distinction. The same was observed for *dessus* vs *dessous* and *en dessous de* vs the non-existant form *en dessus de*. Some participants produced prepositions which are strictly speaking temporal prepositions, such as *avant* 'before' and *après* 'after'. These are however sometimes used for spatial descriptions and Vandeloise (1986) includes them in his analysis of the expression of space in French. A pilot study among native speakers of French also yielded such responses to some of the images used in the present study. These prepositions were therefore coded separately and included in the analysis. Participants also produced complex prepositions, *locutions prépositives*, of the type [PP [NP[PP]]] as in *à côté de* 'next to'. By far the most frequently produced complex prepositions of this type were *à côté de* 'next to', *à gauche de* '(to the) left of' and *à droite de* '(to the) right of'. Because these were so systematically produced, and because they were also used in the pilot study with native speakers, they were coded as separate categories and included in the analysis. Other examples of complex prepositions are *sur le haut de* 'on the top of', *au front de* 'in the front of', *en face de* 'facing', *à l'extérieur de* 'outside of' and *en haut de* 'in/at the top of'. These were produced in low numbers, often by one single participant. They were therefore coded collectively in a PP-NP-PP-category. Some participants provided answers containing *dessus*, *dessous* and *dedans*. These are prepositions that do not take complements, hence their traditional classification as adverbs, but are versions of prepositions that do[4]. They were systematically produced with pictures showing spatial relationships on the vertical axis, i.e. used to express semantic content consistent with the stimuli. These were therefore coded separately despite the fact that they yielded ungrammatical sentences in French. Finally, some answers were coded as "other". These were expressions that do not exist in French (for instance the rather inventive "souvant" modelled after *devant* 'in front of' and *avant* 'before'), other types of prepositions than spatial prepositions (for example *malgré* 'in spite of'), and some adverbs such as *bas* 'low' et *haut* 'high', used for instance in **La pomme est haut le plat.* ('The apple is

[4] Consider the examples: *Son adresse est marquée sur la feuille*. 'His address is written on the piece of paper.' - *Voici la feuille, son adresse est marquée dessus.* 'Here is the piece of paper. His address is written on (it).'

high the plate.'). In addition, some prepositions that were produced only once were coded in this category, such as for instance *en* 'in'. The category contains 15 different words or expressions produced in total 88 times. The total number of answers is 2970, and thus only 3 % of the answers fall into the "other" category. When participants failed to provide an answer, this was coded as a null-answer and included in the analysis.

According to this coding scheme, 24 different answer categories were used: *Dans, sur, à, sous, derrière, devant, avant, arrière, après, dessous, dessus, dedans, au-dessus de, au-dessous de, en dessous de, à gauche de, à droite de, à côté de, de, près de, loin de*, PP-DP-PP, other, and 0-answers. For each picture the number of times each answer was provided was counted. When none of the participants provided a preposition for a specific image, the category was given a value of 0. Some of the answer types were only produced by participants in one of the proficiency groups. All categories were nevertheless included in the analyses for both groups.

4.6 Results

4.6.1 Cluster analysis - first semester group

For the first semester group, the resulting icicle plot (see Figure 1) shows two main clusters with a linkage distance of 16.30. One cluster contains 24 pictures which can be described by the prepositions *sur* and *dans*. The other cluster contains 42 pictures that can be described by *au-dessus de, sous, devant* and *derrière*. The first cluster contains an ON-cluster (7 pictures) with pictures from series III where an apple is on a plate (contact), and one picture from series IV showing a padlock on a flat dish. Furthermore, it contains an IN-cluster (17 pictures) with pictures from series III showing an apple in a bowl (contact) and from series IV showing a fly or a lock in a curved dish or in a flat or a curved hand. The linkage distance between the two sub-clusters is 11.73.

The larger cluster with 42 pictures contains a *sous*-cluster with 4 pictures from series I (lady under umbrella), linked to the remainder of pictures by a linkage distance of 12.06. There is one cluster regrouping 11 pictures from series I; here the umbrella is rotated either 45 or 90 degrees away from the vertical axis. Prepositions used for these pictures are *devant* and *derrière*, as well as *à côté de, à droite de* and *à gauche de*. This cluster is linked to an 'au-dessus-de'-cluster (linkage distance 11.11) containing 27 pictures. These are the 12 pictures from series II, where 6 showing the bowl under the box form a sub-cluster of their own, 3 pictures from Series I showing the umbrella in its canonical position over the lady, and the 12 non-contact pictures from series III showing an apple over a plate or a bowl.

The icicle plot for the first semester production data is characterized by theoretically plausible clusters, i.e., the pictures group together in ways that would be expected. Furthermore, pictures of topological relations are grouped together in one cluster whereas pictures of spatial relations on the vertical axis are grouped in another (including pictures from the topological picture series where there is no contact between the located object and the reference object and for which 'in' or 'on' therefore are non-felicitous). The sub-clusters are stringy with relatively large linkage distances between the individual pictures. This is indicative of a certain amount of variation in the type of prepositions used by the participants for each picture. Still, there is an overall systematicity in responses, as can be seen from the bundling of pictures in meaningful clusters.

4.6.2 Cluster analysis - second semester group

The tree diagram for the second semester group (see Figure 2) shows two main clusters, where pictures which can be described by *sur* and *dans* (24 pictures) are found in one cluster, and pictures which can be described by *au-dessus de, sous, devant* and *derrière* (42 pictures) in another. The linkage distance between the two main clusters is 22.48.

The first cluster, *sur/dans*, contains 2 sub-clusters with a linkage distance of 16.73. The first sub-cluster contains 8 pictures that have predominantly been described by the preposition *sur*: An apple on a plate (series III) and a fly or a lock on a flat dish (series IV). The furthest linkage distance in this cluster is 4.77. The second sub-cluster contains 16 pictures that have predominantly been described by the preposition *dans*: An apple in a bowl (series III) and a fly or a lock in a curved dish or a flat or curved hand (series IV). The linkage distance between these pictures is 6.65.

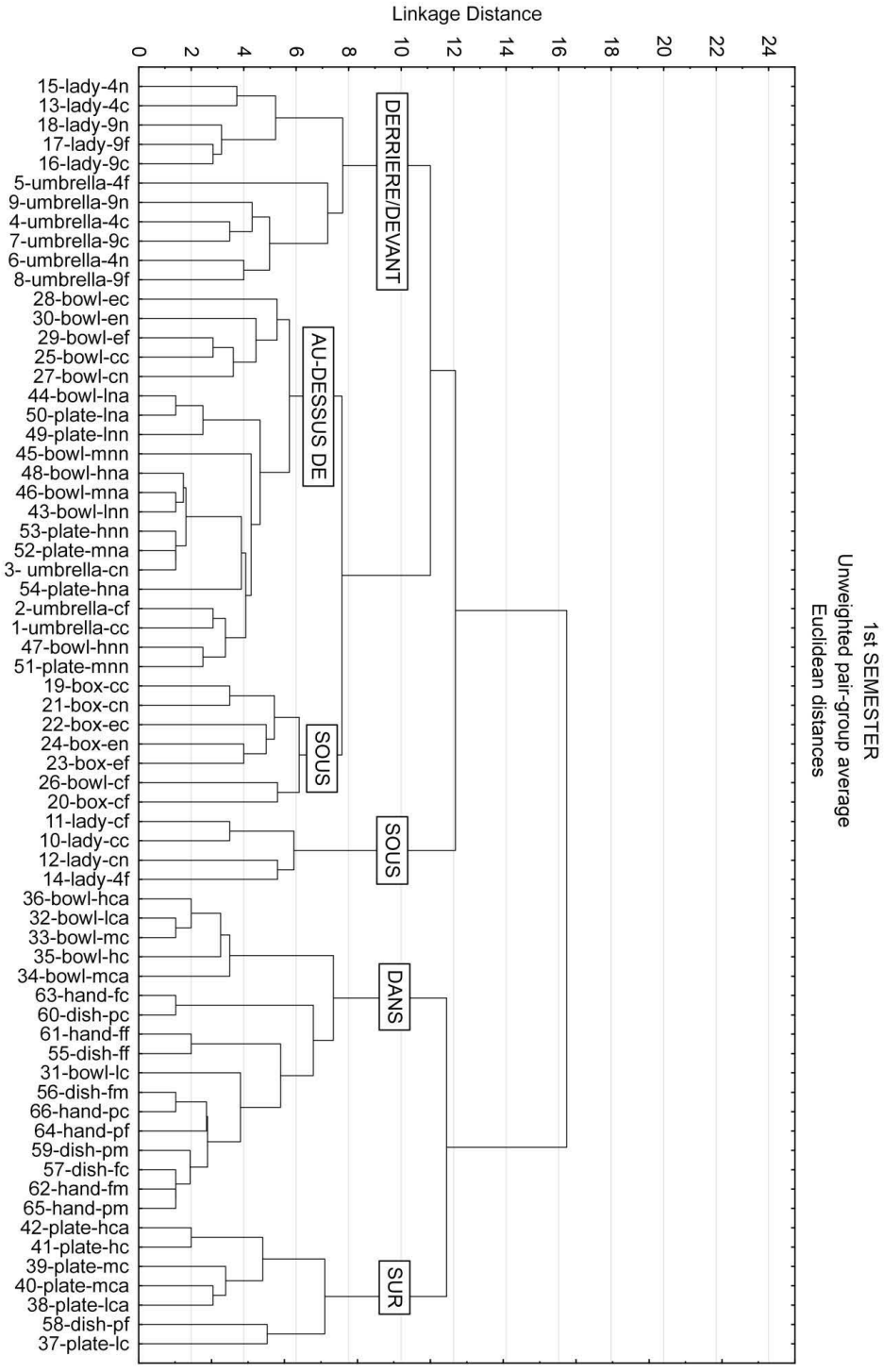

Figure 1 Cluster analysis of responses in the first-semester group

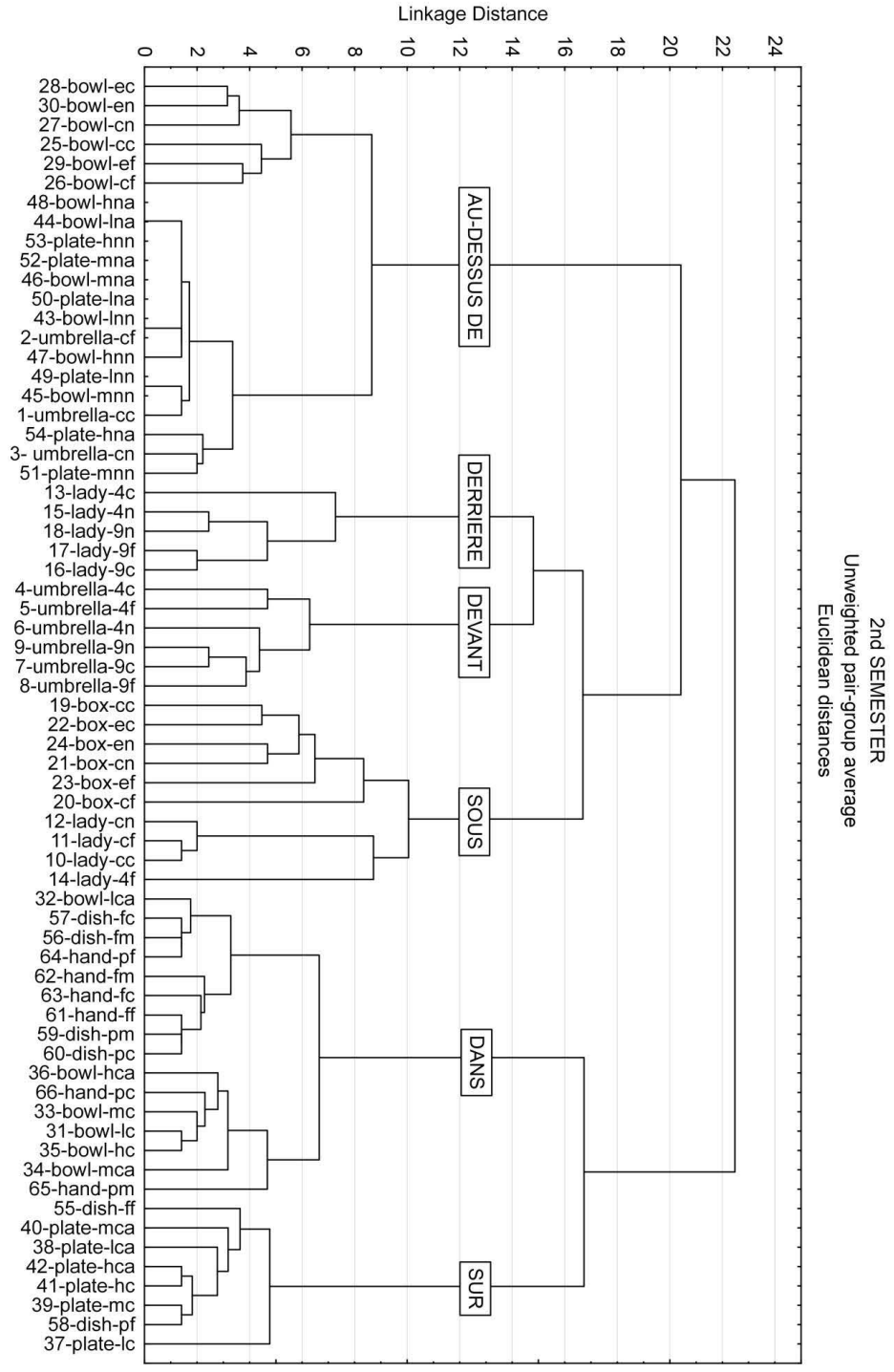

Figure 2 Cluster analysis of responses in the second-semester group

The second main cluster contains two sub-clusters linked at a linkage distance of 20.42. The first sub-cluster contains pictures that have predominantly been described by the preposition *au-dessus de.* It contains one cluster made up of 12 pictures from Series III where there is no contact between the located object (apple) and the reference object (bowl or plate) and 3 pictures from Series I where the umbrella is in its canonical position over the lady. Furthermore, it contains a cluster made up of 6 pictures from Series II showing the box over the bowl. The linkage distance between these two clusters is 8.65. Furthermore, this second main cluster contains a sub-cluster of pictures which have predominantly been described by *sous, devant* and *derrière*. This cluster has two sub-clusters of its own, one for *sous* and one for *devant/derrière*. These are linked at a distance of 16.68. The *sous*-cluster contains 4 pictures from Series I showing the lady under the umbrella, and 6 pictures showing a bowl under a box (Series II). The *devant/derrière* cluster contains 11 pictures from series I, all of them depicting the umbrella either in the 45 degree rotation or the 90 degree rotation condition. *Devant* and *derrière* pictures are clearly separated into two clusters (linkage distance 14.81); the repartition depends on whether the lady (*derrière*) or the umbrella (*devant*) is the located object.

Typical of this second semester tree diagram are clear overall clusters with long linkage distances. Individual pictures are linked quite tightly together within these clusters. This is indicative of a production pattern where groups of pictures have been described with few prepositions, i.e. there is little variation in the preposition production for the individual pictures. This leads to clear distinctions between different types of spatial situations ('in' vs. 'on' vs. 'over' vs. 'under'), but little variation within the situation types. As expected, longer clusters, indicative of more variation in preposition production, are seen where several prepositions are equally good for describing a spatial scene. This is for instance the case for *Series I Lady and umbrella* where the umbrella is rotated away from its canonical position. Here prepositions like *devant, derrière, à côté de, à gauche de* and *à droite de* are all felicitous in completing the sentence.

4.7 Discussion - experiment 1

Looking at the icicle plots for both groups, it is clear that preposition production in the two groups is not fundamentally different. Both groups bundle items together in meaningful clusters. Moreover, the resulting clusters to a large degree contain the same items. The difference between the two groups is primarily found in a) the linkage distance of the two main clusters (OVER/UNDER and IN/ON) which is 22.48 in the second-semester group and 16.30 in the first-semester group, b) the linkage distance between the sub-clusters, where the second-semester group has more pronounced sub-clusters with longer linkage distances than the first-semester group.

The clusters are formed on the basis of the same properties in the two groups. The IN/ON-clusters are formed around the type and the shape of the reference object (RO); flat ROs (*plat* and the flat *assiette*) in the 'on'-cluster, curved ROs (*saladier, assiette* and *main*) in the IN-cluster. Furthermore, contact ensures that the RO controls the located object (LO). Properties underlying the OVER-clusters are non-contact between RO and LO, and geometric position where the LO is above the RO. The UNDER-clusters show the LO below the RO. The intrinsic orientation of the lady in combination with the geometric position of the umbrella is the underlying property of the IN FRONT OF/BEHIND-clusters, which contain pictures only from *Series I Lady and umbrella* in both groups. Interestingly, in both proficiency groups the functional image in the 45 degree rotation condition (picture 14) clusters in another cluster – the UNDER-cluster – with the canonical UNDER-items of the same series. The cluster analyses therefore indicate that functional properties influence the lexicalization of spatial relationships early in L2 development (Coventry, Prat-Sala, & Richards, 2001). However, native speakers of both Norwegian and French base acceptability ratings for prepositions on functional as well as geometrical information in spatial scenes (Listhaug, 2014, under revision). It is therefore impossible to say whether the production pattern found is based on L1 preferences, or whether target language representations have been acquired.

A closer look at the production data underlying the clusters reveals patterns in the difference between the two groups. For each cluster resulting from the second semester data, the overall percentage of production for the most common prepositions in both participant groups was calculated. The results are shown in tables in the appendix, section 9.2. These results confirm what the clusters indicate; in the first semester group responses are distributed over more types of prepositions, whereas the second semester group is overall consistent in production patterns with one preposition accounting for the majority of answers in the cluster type.

What also becomes clear is that the first-semester group struggles to produce the preposition *au-dessus de*, and to a certain extent also the preposition *sous*. One of the problems students in the first-semester group reported after having taken part in the experiment was that they did not remember the preposition denoting 'over' in French. In the OVER- and the UNDER-cluster 0-answers make up 43 and 23 percent of the answers, respectively. In contrast, only 1 percent of the answers are 0-answers in each of the two clusters in the second-semester group. As a consequence, the 0-answers contribute extensively to the formation of both the OVER- and the (two) UNDER-cluster(s) in the first-semester data. The consistency in answer types here is in fact largely due to 0-answers. *Au-dessus de*, and to a lesser degree *sous*, seem to take longer to become established in productive vocabulary than *sur* and *dans*. This is not unexpected, as *au-dessus de* is more complex than *sur* and *dans*, less frequent than these, and also orthographically

and phonologically similar to its antonyms *au-dessous de* and *en dessous de*. Interestingly, no participants in either group confused *au-dessus de* with either *au-dessous de*, *en dessous de* or *sous* for non-contact scenes from *Series III Apple – bowl/plate (La pomme est _____ saladier/plat*). In contrast, some participants did confuse the prepositions in picture series where the RO and the LO were interchangeable (*Le saladier est _____ boîte* vs *La boîte est _____ saladier*). This is probably due to inattentiveness to the relationship between the linguistic stimuli and the visual stimuli rather than to problems distinguishing between the prepositions.

Another interesting finding is that *sur* accounts for 13% of the answers in the OVER cluster among the first-semester participants (see Table 4 in the appendix). Hickmann (2007) found that French children learning French as their L1 overextended the use of *sur* to location without contact on the vertical axis. She cites one child who says *Il est sur la maison* 'it is on the house' about a plane flying over a house. In her study, the youngest children typically used *sur* where adult native speakers used *au-dessus* 'above'/'over' or *en dessous* 'below'/'under'. The usage decreased around the age of 5. Pierart (1978) found that L1 French children regularly produced *sur* where adult L1 users produced *au-dessus de* up until the age of 4. These studies indicate that production of the prepositions *au-dessus de* and *en dessous de/sous* takes some time to stabilize in native speakers. It is perhaps not surprising that production in the L2 follows the same pattern. In both cases the users have a limited vocabulary and so have to make do with the items they do have available to encode the category in question. As vocabulary grows and more items are available, it becomes possible for language users to refine their expression of the category to adult-like production in the case of L1 and to native-like production in the case of L2.

In sum, the two cluster plots show that among participants in the first-semester group there is considerable variability in preposition production whereas among participants in the second-semester group prepositions production has converged towards specialized prepositions for the specific spatial configurations. Once this stable pattern of production is established, the question remains whether semantic structuring continues with increasing proficiency.

5. Experiment 2

In order to assess whether any differences related to proficiency persist after a consistent pattern of L2 preposition production is established, an experiment eliciting rating data was conducted. In this experiment, effects of geometrical and functional properties underlying comprehension of spatial prepositions were targeted. Thus, experiment 2 allows for a fine-

grained study of development in spatial preposition semantics beyond what can be identified at the behavioural level.

5.1 Participants

Participants were 28 Norwegian late learners of L2 French recruited among present and previous students of French at NTNU, ranging from first year students[5] to students with completed master's degrees. None of them had participated in Experiment 1. The proficiency level of the participants was measured using the same placement test and as in Experiment 1 and a self-evaluation. In the placement test, most of the participants fell into two categories of proficiency level; Upper Intermediate and Advanced (n=23). A few participants fell into the Intermediate category (n=4), whereas one single participant only achieved a Lower Intermediate score. The average score of the group as a whole was 37 out of 50 points. The participants were then divided into two groups on the basis of their scores on the placement test. The first group comprised 14 participants who scored 39 points or lower. The average score in this group was 29.57. The second group comprised 14 participants who scored 40 points or higher. The average score in this group was 42.43. To assess whether the groups really differed in proficiency level, group means were compared using an independent samples t-test. Bootstrapping based on 1000 samples was performed in order to correct for deviations from normality. Levene's Test for Equality of Variances was significant, hence the values not assuming equality of variances are reported. The test showed that proficiency level in the two groups differed significantly ($t(17.26)=-7.21$, $p<0.001$, $r=.87$). On the self-evaluation 64 % of the participants in the lower-proficiency group rated their French proficiency to be "intermediate", while 36 % rated it to be "advanced". In the higher-proficiency group, 43% rated their proficiency as "intermediate", whereas 57% rated their proficiency to be "advanced". The L2 participants in this study have an overall high proficiency level of French but were not in an immersion setting. They were all tested in Norway. All of the participants had knowledge of English as a second language.

5.2 Design

Participants were shown the same visual and linguistic stimuli as the participants in experiment 1. However, in this version, participants completed the experiment online. Thus participants were free to complete the experiment at their preferred time from any computer with an internet connection. Whereas experiment 1 was a cloze test, experiment 2 used a rating paradigm. A set of prepositions for each picture series was given for rating. The prepositions for

[5] The first year students participated in the experiment in their second semester. Many had attended a 5-week programme at the Norwegian Study Centre in Caen, France prior to participation.

rating were selected on the basis of a pilot study where native speakers of French and Norwegian participated in a production task based on the same stimuli.

Participants were asked to rate prepositions on a scale from 0 (=not appropriate) to 7 (=very appropriate)[6] as to how appropriate they thought each preposition to be to complete the sentence so that it corresponded to the situation in the picture. As prepositions and definite articles sometimes are contracted in French, the prepositions were presented along with the definite article of the reference object noun to prevent any interference from grammaticality judgments on the acceptability rating for the prepositions. For the sentence *Le parapluie est* _____ *femme*, participants rated expressions such as *au-dessus de la* and *devant la*, whereas for the sentence *La femme est* _____ *parapluie* the participants rated expressions such as *au-dessous du* and *derrière le.*

Prepositions for the two vertical axis series were *au-dessus de* 'over', *sous* 'under', *en dessous de* 'under'/'lower than', *au-dessous de* 'under'/'below'/'lower than', *devant* 'in front of' and *derrière* 'behind'. Prepositions for the two topological series were *au-dessus de* 'over', *sur* 'on', *dans* 'in', *à l'intérieur d*e 'inside' et *en haut de* 'on top of'. Only data for *au-dessus de, sous, dans* and *sur* are presented here.

5.3 Procedure

After having logged in with their specific participant id, participants were given detailed instructions on what to do during the session and on how to use the rating scale. The participants were given initial instructions in Norwegian.

The experiment comprised 3 sessions which could be completed separately. The 4 picture series were distributed over all 3 sessions. The two vertical axis series were placed in different sessions. *Series I Lady and umbrella* contained 18 trial items and 21 filler items, whereas *Series II Box and bowl* contained 12 trial items and 25 fillers. The two topological relations series were also in different sessions. *Series III Apple – bowl/plate* contained 24 trial items and 20 fillers. *Series IV Hand/plate – fly/lock* contained 12 trial and 25 filler items. In each session, the order of appearance of the pictures was completely randomized. All prepositions in the preposition set appeared with every trial item but the order in which they were listed with each item was fully randomized.

5.4 Results and discussion – experiment 2

Results were analyzed for each picture series separately using a mixed model ANOVA with proficiency group as the between-subjects factor.

[6] For the purpose of statistical analysis the scale was transposed to 1-8.

There were no main effects of, nor any interaction effects with, proficiency group in any of the four picture series. This indicates that acceptability ratings for these prepositions are equally affected by changes in geometric or functional information in the two groups. There are at least four possible reasons for this: a) Group sizes may be too small to yield reliable results. b) The participants' proficiency level was measured using a placement test and a self-evaluation, both of which indicate differences between the groups. It is, however, possible that groups do not really differ on proficiency level. c) The L2 raters based their ratings on L1 intuitions, hence the groups do not really display differences in rating patterns. A study of L1 French and L1 Norwegian rating data has shown that there are very few differences between the two languages when it comes to the influence of geometric and dynamic-kinematic information on acceptability ratings for the spatial prepositions included in this analysis (Listhaug, 2014). It is possible that the participants based their ratings on L1 intuitions. If they did, no significant differences between the two proficiency groups would be found. Finally, d) once a certain proficiency level has been attained the prepositions have become entrenched and so show no further development. It is possible that the participants have developed target-like representations for the L2 prepositions. As L1 French and L1 Norwegian rating data show the same effects of geometry and function across the scenes tested, this could be the case.

However, as a group, the L2 French participants do not display the same rating patterns as L1 French participants for all the scenes tested. Listhaug (under revision) found that L2 users' acceptability ratings differed both from French and Norwegian native speakers' acceptability ratings in how graded distinctions they made on the basis of geometry whereas they did not differ from native speakers on the basis of functionality. This suggests that functional properties are acquired earlier in the acquisition process than geometrical ones (See also Coventry et al., 2011). Furthermore, whereas L1 users of French accept both *dans* and *sur* when the RO is labelled *plat*, L2 users of French overwhelmingly prefer *sur* over *dans*. This is evident in the production data in experiment 1, where L2 users actually converge towards a non-target pattern of consistent use of *sur*. This is likely to be a case of lexical transfer from Norwegian, as Norwegian L1 users clearly preferred *på* over *i* for the same RO (labelled *fat*). Plates and dishes can be of various types. Their conceptualization is context dependent, integrating cultural knowledge (Levinson & Meira, 2003), geometrical properties such as shape, functional information such as the degree to which the plate is able to control the location of its content, and language-specific lexical factors such as which preposition most frequently co-occurs with the object label. The subtle hierarchies for which cues take precedence in the target language may not be fully captured by L2 users. It is therefore unlikely that the L2 participants in this study have developed a native-like representation for spatial preposition usage as such.

Nevertheless, as a consequence of the similarities between Norwegian and French, the L2 participants may use all the information they have available in their L1 to form stable representations for some types of spatial preposition usage in French at an earlier stage in proficiency development than would otherwise be expected.

While no difference between groups was found in mean acceptability ratings, the data revealed another interesting pattern. There is a difference in rating consistency in the two groups. Levene's test for homogeneity of variance was significant for some of the variables included in the analyses. In these cases, variance was always bigger in the group with the lowest proficiency. An example is shown in Figure 3.

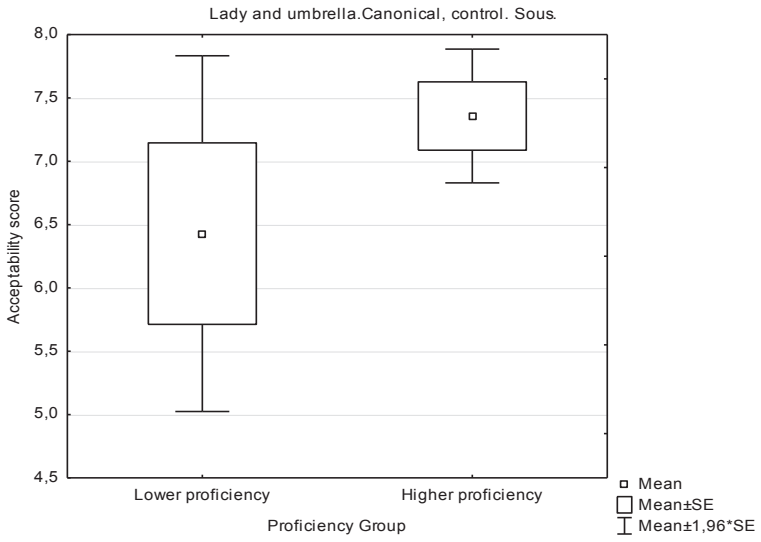

Figure 3 Box plot showing heterogeneity of variation in *Series I Lady and umbrella*. Geometry: canonical position, function: control condition. Prepositions: *sous*.

The box plot shows the mean and standard error for the acceptability score of *sous* for one of the pictures, picture nr 10, in the *Series I Lady and umbrella* with the sentence *La dame est* _____ *parapluie*. In this case the geometrical position of the umbrella is directly above the lady (canonical position) and there is no rain shown in the picture (control condition).

As this pattern was consistent for all variables where the assumption of Levene's test was violated, it is clear that within-group variation diminishes with increased proficiency. Interestingly, in an experiment that compared the acceptability ratings of native speakers of French to those of L2 users of French, the exact same pattern appeared (Listhaug, under revision). In this case, whenever there was heterogeneity of variance, variance was bigger in L2

user ratings than in the native speaker ratings. Figure 4 below shows the differences in variance in the same variable as in Figure 4; however, this time between native speakers and all L2 users.

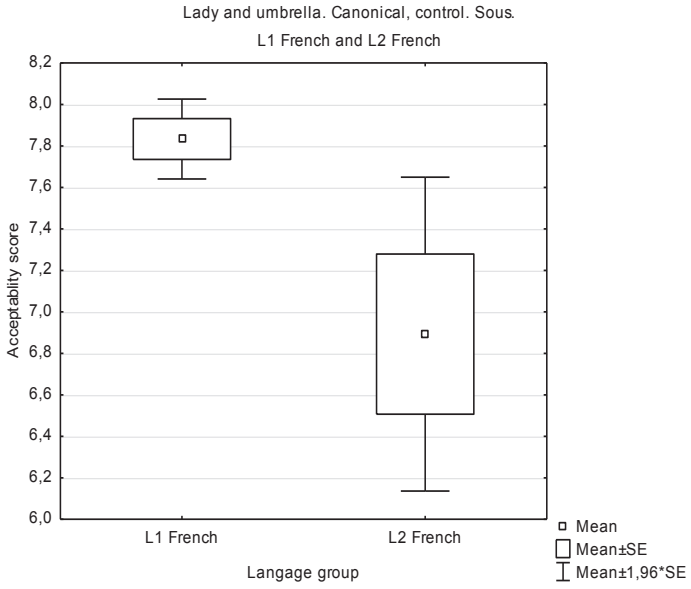

Figure 4 Box plot showing heterogeneity of variance in Series I Lady and umbrella. Geometry: canonical position, function: control condition. Prepositions: sous. L1 French and L2 French (all participants combined).

Experiment 1 established that variation in preposition production diminished with increasing proficiency in the L2. Experiment 2 showed that once prepositions are part of the productive vocabulary of L2 users, variation is still attested in intuitions about preposition usage and meaning. This variation diminishes with increasing levels of proficiency, but is still evident when high-proficiency L2 users' intuitions are compared to those of native speakers.

6. General discussion

This study has shown that the sematic network for spatial prepositions in more proficient L2 user shows evidence of having undergone structuring and tightening as compared to les proficient L2 users, both in production and in acceptability judgments.

Results from experiment one shows that L2 preposition production is more structured and consistent in the second-semester group than in the first-semester group. The cluster analysis yielded clusters centering on the same types of visual stimuli in the two groups. However, the smaller linkage distances between major clusters in the lower proficiency group are indicative of a larger variation in the preposition production in this group compared to the more advanced group. This is most apparent in the OVER/UNDER-cluster, where null answers in fact account

for much of the group's cluster internal consistency. The long distances between major clusters in the second-semester group are consistent with little heterogeneity in the production of prepositions. The participants produced prepositions consistently with scene types; they chose different prepositions to describe different sets of scenes. Furthermore, they were more consistent in their use of these prepositions than were the participants in the first-semester group. The tighter clusters in the second-semester group probably reflect better comprehension of prepositions and more knowledge about preposition usage with increased proficiency.

Sur and *dans* were produced by both groups in experiment 1. In contrast, a*u-dessus de* - and to a lesser degree, *sous* - was reliably produced by the second-semester group but not by the first-semester group. The data therefore support an order of acquisition of prepositions in L2 which is parallel to that of L1 acquisition. About 6 months of academic study of French separate the two subject groups. Neither group had had any explicit instruction in preposition usage at university level. Still, the massive shift from null-answers in the first-semester group to reliable production of *au-dessus de* in the second-semester group is evident across the board, despite within-group variation in proficiency level. A*u-dessus de* enters the productive vocabulary very fast. Moreover, once the preposition is produced, it is rarely confused with its antonyms, *au-dessous de, en dessous de* and *sous*, despite the phonological and orthographic similarity. Sufficient consolidation for production relies on exposure to input. In this case, it seems that little exposure is needed for this consolidation to happen. While this was never tested, it is likely that these prepositions were part of the first-semester participants' receptive vocabulary. An interesting finding was that some first-semester participants, in lack of 'au-dessus de', used *sur* to express an 'above' relationship, as *sur* is a preposition also French-speaking children overgeneralize to non-contact situations on the vertical axis (Hickmann, 2007; Pierart, 1978).

Interestingly, in both proficiency groups, there are indications that functional properties of spatial scenes affect preposition production. This is consistent with findings that functional properties underlying the semantics of spatial prepositions are mastered early in both L1 and L2 spatial language development (Coventry et al., 2011; Feist, 2008; Listhaug, under revision).

The process of semantic structuring continues also after the entry of a lexical item into productive vocabulary, as can be seen from the increasing consistency in the use of *dans* and *sur* in the second-semester group compared to the first-semester group as well as in the increased consistency in acceptability ratings with increasing proficiency in French. The least amount of variability in acceptability ratings is seen in native speakers. This is likely to indicate a continued development in semantic structuring in the L2 also after a preposition can be produced. Stringer (2011) maintains that acquisition of spatial language in the L2 involves

identifying spatial semantic features carried by lexical items. L2 learners know how features are bundled in the lexical items of their L1. In order to master the L2, the learner has to figure out whether and how features carried by lexical items are the same or different from the L1. The process is referred to as *feature reassembly*. It is a process that takes time, as the learner has to get sufficient input to establish the patterns in the L2. Lexical feature reassembly provides an explanation for transfer phenomena regarding how words co-occur in the target language as compared to the L1. According to Coventry et al. (2011) patterns of co-occurrence of prepositions and nouns in the target language may be the most difficult aspect for an L2 learner to acquire and the area that is the most prone to transfer from L1 to L2. In Stringer's terms, transfer occurs when L2 learners fail to reassemble spatial semantic features on lexical heads in the L2. For instance, the French noun *plat* would carry the feature "container" (although it would also allow the feature "support") and thus combine with the preposition *dans* (alternatively *sur*). Norwegian learners of French have to identify the difference between lexical features bundled in *plat* compared to those bundled in the Norwegian noun *fat,* which carries the feature "support"[7]. This accounts for the transfer seen in Norwegian users of French L2 when they predominantly use *sur* with the noun *plat*, whereas native speakers of French tend to prefer *dans* with this noun, although *sur* is also possible (Listhaug, 2014).

In sum, both production data and rating data show that variation diminishes with increasing proficiency in the L2. The present findings seem to indicate that, in the acquisition process, an unstable lexical system and shallow knowledge of prepositional meaning develops into a more structured lexical system where situation-specific knowledge of preposition usage and meaning emerges. This is consistent with the claim that lexical knowledge consolidates over time and that word knowledge gains in depth during this process. In future research, a longitudinal study would enable further insight into the entrenchment of prepositions in the L2 lexicon and the development of L2 users' semantic representations.

7. Acknowledgements

I would like to thank Kenny Coventry for the use of the pictures in the experiments. The pictures were originally used in AHRC grant number 112211 awarded to Kenny Coventry and Pedro Guijarro-Fuentes. The copyright for figures 5-9 is held by Kenny Coventry.

[7] A cognate of French *plat* is the English noun *plate,* which carries the feature "support". Furthermore, the Norwegian cognate noun *plate* 'board, disk, worktop' also carries the feature "support".

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9. Appendix

9.1 Table of variables in cluster analysis

The table gives an overview of the properties of each of the clustered items, i.e. pictures. The number in the table corresponds to the number of the items in the cluster analysis.

Table 1 Pictures in cluster analysis

Nr	RO	LO	Geometry	Function	Picture series
1	Lady	Umbrella	Canonical	Control	Series I
2	Lady	Umbrella	Canonical	Functional	Series I
3	Lady	Umbrella	Canonical	Non-functional	Series I
4	Lady	Umbrella	45 degrees	Control	Series I
5	Lady	Umbrella	45 degrees	Functional	Series I
6	Lady	Umbrella	45 degrees	Non-functional	Series I
7	Lady	Umbrella	90 degrees	Control	Series I
8	Lady	Umbrella	90 degrees	Functional	Series I
9	Lady	Umbrella	90 degrees	Non-functional	Series I
10	Umbrella	Lady	Canonical	Control	Series I
11	Umbrella	Lady	Canonical	Functional	Series I
12	Umbrella	Lady	Canonical	Non-functional	Series I
13	Umbrella	Lady	45 degrees	Control	Series I
14	Umbrella	Lady	45 degrees	Functional	Series I
15	Umbrella	Lady	45 degrees	Non-functional	Series I
16	Umbrella	Lady	90 degrees	Control	Series I
17	Umbrella	Lady	90 degrees	Functional	Series I
18	Umbrella	Lady	90 degrees	Non-functional	Series I
19	Box	Bowl	Canonical	Control	Series II
20	Box	Bowl	Canonical	Functional	Series II
21	Box	Bowl	Canonical	Non-functional	Series II
22	Box	Bowl	Elevated	Control	Series II
23	Box	Bowl	Elevated	Functional	Series II
24	Box	Bowl	Elevated	Non-functional	Series II
25	Bowl	Box	Canonical	Control	Series II
26	Bowl	Box	Canonical	Functional	Series II
27	Bowl	Box	Canonical	Non-functional	Series II
28	Bowl	Box	Elevated	Control	Series II
29	Bowl	Box	Elevated	Functional	Series II
30	Bowl	Box	Elevated	Non-functional	Series II
31	Bowl	Apple	Low	contact no alternative control	Series III
32	Bowl	Apple	Low	contact alternative control	Series III
33	Bowl	Apple	Mid	contact no alternative control	Series III
34	Bowl	Apple	Mid	contact alternative control	Series III
35	Bowl	Apple	High	contact no alternative control	Series III

Nr	RO	LO	Geometry	Function	Picture series
36	Bowl	Apple	High	contact alternative control	Series III
37	Plate	Apple	Low	contact no alternative control	Series III
38	Plate	Apple	Low	contact alternative control	Series III
39	Plate	Apple	Mid	contact no alternative control	Series III
40	Plate	Apple	Mid	contact alternative control	Series III
41	Plate	Apple	High	contact no alternative control	Series III
42	Plate	Apple	High	contact alternative control	Series III
43	Bowl	Apple	Low	no contact no alternative control	Series III
44	Bowl	Apple	Low	no contact alternative control	Series III
45	Bowl	Apple	Mid	no contact no alternative control	Series III
46	Bowl	Apple	Mid	no contact alternative control	Series III
47	Bowl	Apple	High	no contact no alternative control	Series III
48	Bowl	Apple	High	no contact alternative control	Series III
49	Plate	Apple	Low	no contact no alternative control	Series III
50	Plate	Apple	Low	no contact alternative control	Series III
51	Plate	Apple	Mid	no contact no alternative control	Series III
52	Plate	Apple	Mid	no contact alternative control	Series III
53	Plate	Apple	High	no contact no alternative control	Series III
54	Plate	Apple	High	no contact alternative control	Series III
55	Dish	Fly	Flat		Series IV
56	Dish	Fly	Mid		Series IV
57	Dish	Fly	Curved		Series IV
58	Dish	Padlock	Flat		Series IV
59	Dish	Padlock	Mid		Series IV
60	Dish	Padlock	Curved		Series IV
61	Hand	Fly	Flat		Series IV
62	Hand	Fly	Mid		Series IV
63	Hand	Fly	Curved		Series IV
64	Hand	Padlock	Flat		Series IV
65	Hand	Padlock	Mid		Series IV
66	Hand	Padlock	Curved		Series IV

9.2 Use of prepositions for pictures in the various clusters

The tables show use in % of the main contributing prepositions and the total percentage made up of these over all the pictures in each cluster for the first and the second-semester group. Remaining answers are distributed over several different answer types. The tables are based on the clusters for the second-semester group.

Table 2. ON-cluster. % responses with *sur* and *dans* over 8 pictures.

Use of prepositions in % ON-cluster			
	sur	**dans**	**Total**
1st semester	51	25	76
2nd semester	76	14	90

Table 3. IN-cluster. % responses with *sur* and *dans* over 16 picutres.

Use of prepositions in % IN-cluster			
	sur	**dans**	**Total**
1st semester	23	58	81
2nd semester	24	69	93

Table 4. OVER-cluster. % responses with *au-dessus de, sur, dessus* and null-answers over 21 pictures.

Use of prepositions in % OVER-cluster					
	au-dessus de	**sur**	**dessus**	**0-answers**	**Total**
1st semester	14	13	2	43	72
2nd semester	81	1	6	1	89

Table 5. UNDER-cluster. % responses containing *sous, au-dessous de/en dessous* de and null-answers over 10 pictures. (These pictures are distributed into two clusters in the first-semester group.)

Use of prepositions in % UNDER-cluster				
	sous	**au-dessous de en dessous de**	**0-answers**	**Total**
1st semester	27	4	23	54
2nd semester	53	10	1	64

Table 6. IN FRONT OF-cluster. % responses containing *devant, avant, à côté de, à droite de/à gauche* de and null-answers over 6 pictures.

Use of prepositions in % IN-FRONT-OF-cluster						
	devant	**avant**	**à côté de**	**à droite de à gauche de**	**0-answers**	**Total**
1st semester	21	15	21	15	13	85
2nd semester	42	23	16	1	5	87

Table 7. BEHIND-cluster. % responses containing *derrière, à côté de, à droite de/à gauche* de and null-answers over 5 pictures.

Use of prepositions in % BEHIND-cluster					
	derrière	**à côté de**	**à droite de à gauche de**	**0-answers**	**Total**
1st semester	22	21	13	17	73
2nd semester	50	16	1	3	70

9.3 Visual stimuli

9.3.1 Series I Lady and umbrella

Figure 5 Three levels of geometry: canonical, 45 degrees and 90 degrees. Functionality: control. Copyright Kenny Coventry.

9.3.2 Series II Box and bowl

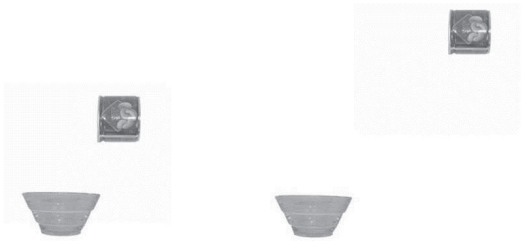

Figure 6 Two levels of geometry: near and far. Functionality: control. Copyright Kenny Coventry.

9.3.3 Series III Apple – bowl/plate

Figure 7 Three levels of geometry: high, middle, low. Reference object: plate. Copyright Kenny Coventry.

Figure 8 Three levels of geometry: high, middle, low. Reference object: Bowl. Location control: Alternative source. Copyright Kenny Coventry.

9.3.4 Series IV Dish/hand – fly/lock

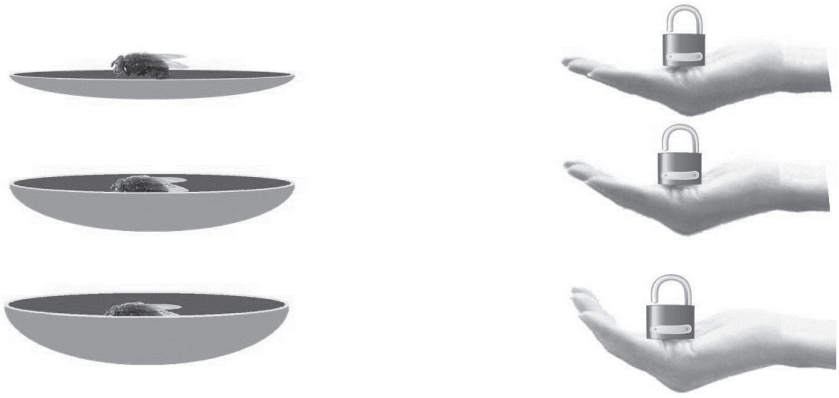

Figure 9 a) Reference object: dish. Located object: Fly. b) Reference object: hand. Located object: lock. Three levels of geometry: flat, middle, curved. Copyright Kenny Coventry.