

Modal Concepts and Compositionality: New Directions in Experimental Semantics

1. Relevance Relative to the Call for Proposals

In this project we propose to employ new experimental techniques to explore the complex semantic capabilities manifest in human language, *expanding our understanding of basic issues in human cognition and meaning production*. Specifically, the project will contribute to the field of the semantics of natural language in the realm of the expression of hypothetical and non-actual content, a particularly human ability. Much work on formal semantics has already been done on ‘modal meanings’ in this sense. The innovative aspect of the research is that we intend to build up a framework for the semantic composition of modal meaning that goes beyond the description of sentential truth conditions, aiming in addition to *distinguish competing semantic descriptions on the basis of psychological evidence*. In doing so, we will employ newly evolving methodologies and technologies within experimental semantics. We use these emerging techniques to explore new territory, and also to build up the expertise in this increasingly important area of linguistic research, allowing us to make a strong and novel contribution. The project is embedded within the CASTLFish research group at UiT, already with strong theoretical credentials, and with local and international connections to experimental research in semantics. We think that national strengths in semantics (UiO) and syntax-semantics interface (UiT) with respect to tense-aspect-modality can be combined with expertise in experimental semantics to build a real presence in this emerging research area. This will contribute to the visibility and influence of an already important national research strength. Because of the use of new and emerging methodologies, the project fulfils the strategic aims of supporting innovative and original new approaches to science.

2. The Research Project

2.1 Overview and Motivation: When Semantic Analysis Contradicts Typology

Modal meanings are found in all human languages, but for semanticists and philosophers they present a special kind of challenge because they deal with meanings where we as humans make assertions about hypothetical, counterfactual, or future events and in short, reason explicitly about things that are ‘not actual’ (Lewis 1973, Lewis 1986, Kratzer 1977, Kratzer 1981). In addition to modality, verbs in human languages are also commonly marked with tense information, aspectual information and explicit marking for causation and agency. However, it is a striking fact typologically that these markings, whether expressed as bound morphology or separate formatives, always show up in a particular order. Specifically, natural languages universally encode modal and temporal information hierarchically *outside* of aspectual, causal and force dynamical content (Cinque (1999), Julien (2002)). This universal fact about morpheme order is remarkable and seems to call for a quite general cognitive explanation, since it is found in languages with otherwise rather different syntactic, lexical and morphological properties. However, under current formal semantic implementations of event semantics, the rigid order of composing semantic features of the event does not fall out of the formal ontology in any deep way. This is because, on current understanding, events are semantic objects that exist in world and time, with particular causational and aspectual features, where all those event properties have equal status and are not structured cognitively in any order of priority. This makes it easy to write a formal semantic analysis of sentences where modality comes before aspect, or tense information is folded in before causation. Essentially, the tools of formal semantics are powerful enough to express mismatches between the morphological order found in languages and the order of semantic composition in this domain.

Analyses invoking mismatches of this type have indeed emerged recently in the field of verbal semantics. In this project, we aim to investigate a class of phenomena whereby modal meanings involving possible worlds are explicitly claimed to be required in a position of compositional interpretation *lower* than morphosyntactic factors or typology would suggest. In other words, cases where *classic semantic analysis contradicts broad typological generalizations*. In the domain of modality,

these phenomena fall into two subclasses:

Mismatches between Semantic Composition and Morphology

Problem Area I: Modal semantic accounts of aspectual or lexical verbal formatives where no actual modal morphology is present.

Problem Area II: Scope reversal between modal and aspectual elements when both are explicitly present in the clause (but in the wrong hierarchical order).

Both of these kinds of example undermine the typology found crosslinguistically, because if such compositional meanings are possible then there should be no cognitive reason for the typological orderings to emerge so robustly in the first place. We reject the possibility that syntactic ordering is simply a rich template, part of a pre-given Universal Grammar of formatives. Instead, we pursue the belief that the ordering is grounded in robust cognitive facts. To argue for an emergent cognitive explanation for linguistic typological ordering facts, we therefore have to systematically examine the kinds of counterexamples as those above and prove that they are not in fact what they seem.

2.2 Our Theoretical Approach.

There is a long tradition of formal semantic work which grounds all of our semantic definitions in objective particulars. This work leads up through Quine and Carnap and culminates in Lewis, perhaps the most influential of the analytic philosophers on modern semantic thinking. In this kind of tradition, atemporal and awordly statements are built from the mundanely worldly ones, by generalizing over times and ‘possible’ worlds. This hugely successful and productive intellectual tradition lies at the heart of our classical semantics of propositions and modality. The view from psycholinguistics and acquisition on the other hand has always been internalist, different from the externalist tradition of Lewis and Quine, with an emphasis on the associative declarative memory required to acquire and deploy lexical items. The link between words of a language and their semantics is acquired by exposure, mediated by perception and cognitive uptake of events in the external world. Lexical representations of linguistic symbols so acquired are clearly related to experience of the world, but they are, crucially, *generalizations* across particulars which can then be deployed by a speaker under novel circumstances. In this way, the lexical item is the codification of a certain implicit perceptual and cognitive generalization, *reusable* as a bridge between internal representations and external events (see also Barwise and Perry (1983)). In other words, alongside the external significance of language and its productivity and compositionality, we must also take account of the undeniable fact that words of a language are efficient members of the code in being able to be *reused in situation after situation*. So, for human language to get off the ground, we need to be in possession of symbols that are abstractions over the different actual situations encountered in the learning phase.

The theoretical position taken in this project builds on hypotheses recently proposed and developed by Ramchand,¹ which is an attempt to bring the formal semantic and psychological traditions closer together so that the theoretical understanding of semantic facts (usually stated at an abstract symbolic level) is reconceived in a more piecemeal and algorithmic fashion, and is thus made to productively engage with data from the psychological realities of memory and processing. Specifically, in the domain of modality, it is argued that what we need in the representation of events a notion of *essence* (essentially in the philosophical tradition of Kit Fine), which must precede *existence* in the cumulative building up of a natural language proposition. The proposal is that there is a more basic domain of event concepts which also in some sense transcend time and place but which are *prior* to extensional denotational force. Let us call these things in the event domain ‘concepts’ or ‘essences’. If event concepts are a linguistic reality, then they will have some of the intensional flavour of modal concepts, but without the compositional complexity. Moreover, such event concepts would be low in the build up of the clause. This proposal is intended to form a bridge between classical formal semantic treatments of modality and the psycholinguist’s understanding of lexical representation and

¹Ramchand, G. to appear. *Situations and Syntactic Structures*. MIT Press Monographs.

access. According to the proposal, there are genuinely complex modal notions in natural language such as the formal semanticists propose, but there are also more basic conceptual building blocks that are representationally primitive and which are integrated into sentential meaning in a more basic fashion. Given this general hypothesis, the question naturally arises how classical intensional meanings involving possible worlds ('external intensionality') are to be empirically distinguished from primitive event concept semantics ('internal intensionality') in practice.

2.3 Data and Choice of Methodology

Thus, in addition to theoretical criteria and analysis of particular phenomena, we need to be able to test the semantic phenomena in question from a psycholinguistic point of view. Recently, it has become possible to test subtle semantic judgements and complexity using online and offline experiments. In this project we will apply experimental techniques to test subtle semantic differences in judgements predicted by the two kinds of 'intensionality'. We will supplement this with studying of the time line of acquisition of the various types of intensionality under investigation. The aim of this is to draw an empirically and psychologically grounded distinction between basic internal intensionality on the one hand (primitive event concepts) and external intensionality on the other.

Because of the nature of the theories being compared, and because they largely agree on the truth conditions predicted for the different modal constructions, the testing ground consists in how well the different theories fare in accounting for psycholinguistic behavioural data. Thus the project will examine data from modal mismatches in English and Russian from an experimental point of view. We will use experimental methods to assess semantic complexity, and time course of processing, and we will also investigate ease and time of acquisition for construction types of varying complexity. The past decade has seen the increasing use of experimental approaches to the study of meaning, motivated both by a desire to confirm and augment intuition-based data and by the growing availability of accessible psycholinguistic techniques. Recent experimental work within semantics includes Bott & Rado (2007), Hackl (2009), Pietroski et al. (2009) on quantification, Musolino (2004), Geurts et al. (2010) on numerals, Frazier et al. (2008), Syrett et al. (2010), Alxatib & Pelletier (2011), Ripley (2011), McNabb (2012), Sassooun (2012), Solt & Gotzner (2012) on gradability, Sauerland et al. (2005), Pearson et al. (2010), Grimm (2013), on plurality and Chemla et al. (2011) on polarity sensitivity. But so far the field is still relatively new and there has been little experimental work on compositional order and scope reversals in the verbal domain, although the work on quantification and inverse scope shows that there are clear effects on processing to be exploited. One important outcome of this project is that it will *contribute to establishing methodologies for experimental semantics in the verbal domain of tense, aspect and modal interpretation.*

Our main empirical domains are drawn from English and Russian since they are two languages with explicit but rather different tense-aspect morphology.

2.4 Contributions to Formalization and Semantic Ontology

The theoretical concerns that motivate this project are part of a general drive to rethink the ontology that comes from theorizing in the classical linguistic tradition with the kinds of primitives and basic notions that are now increasingly being proposed and investigated in psycholinguistic work and computational modelling. So far the basic terms used in these different intellectual paradigms have been largely incommensurate. However, there has been a recent move to bring these areas closer together and effect changes in the way that formal semantic models are built up. To this end, the research group OASIS was formed and funded by the CNRS in Paris, with UiT as a core partner. The present project would be tightly connected to advancing the project goals of that pan-European project, and would be able to benefit from the network of cooperation that is already in place there. The project will use the tools of formal semantics to construct a satisfying formal analysis for our class of problems and empirical results that will attempt to rethink the ontology to avoid the mismatch with typology. In short, we hope to contribute to the project of *creating a more commensurate set of ontologies for formal semantic and psycholinguistic research in this domain.*

3. The Empirical Domain

3.1 Problem Area I: Modalized Analyses of Aspectual Constructions

3.1.1 *The English Progressive*

The English progressive is most famous for introducing a puzzle for semanticists called the imperfective paradox. A rich literature has arisen seeking to solve the basic puzzle and account for the increasingly subtle judgements people have about the relationship between a completed event and its progressivized version. The current consensus seems to be that some sort of modalized semantics is necessary. The earliest is the classic version proposed in Dowty (1979). He proposes that the progressivized version of the sentence is one which is true if the non-progressivized version *would have been true* in some inertial world that continues on from the current one in the most ‘normal’ way. Crucially, the inertial world in question need not be the actual one. The classic analysis of the progressive from Landman (1992) is somewhat more sophisticated and is based on a wider range of tricky examples where people have varying judgements. The crucial notion that does all the work in Landman’s approach is that of ‘continuation branch’ for an event in a world *w*. Once the event stops in the real world, we can ‘continue’ the event by moving over to the next closest world as long as it is ‘reasonable’. If the event stops there as well, we can move over again to the closest world and allow the event to continue. We can cobble together a continuation branch as long as the worlds we hop over to remain ‘close’ and ‘reasonable’, *and* we are still dealing with ‘stages of the same event’. The progressive states that the event in question will indeed culminate if we build one of those continuation branches. In subsequent work, Landman extends his analysis to make formal sense of what it means for something to be a ‘stage’ of an event. But this, we argue is just the formal correspondent of what we should really think of as the ‘essence’ or underived conceptual properties corresponding to an event.

It is also worth highlighting the fact that is implicit in a lot of the discussion around progressive meanings, which is that native speakers’ judgements of the truth of a progressivized sentence are highly dependent on not just the specifics of the description, but also on details of the context of utterance and what kind of information is in the common ground. For example, I am willing to assent to the truth of (1-a) in a particular scenario if I know that Mary is a robot with super-human skills in a science fiction movie where she is sent back in time, but not if she is the girl from the farm next door. If I knew Mary was training hard on her swimming and she just jumped into the water at Dover, I might well agree to (1-b), but not if she is my 6-year old daughter. Also, if I know that Mary was intending to cross the street, my answer to whether I think (1-c) is true when she sets off would be different from if I know her intention is simply to stand in the middle of the road and block the traffic.

- (1) (a) Mary is wiping out the Roman Army.
(b) Mary is swimming the English Channel
(c) Mary is crossing the street.

But one thing remains curiously robust in all of this contextual sensitivity and variability, and that is the fact that people will all agree that the following sentence in (2) is good.

- (2) Mary was crossing the bridge when earthquake hit, so she never made it to the other side.

So ways in which the world might be or necessarily must be are irrelevant to our willingness to agree to that statement. Internal facts about Mary, and about her own intentions *are* relevant, but external circumstances are not.

3.1.2 *The Perfective-Imperfective Contrast in Russian*

In Russian, verbs are aspectually marked as either *perfective* or *imperfective*. Imperfective verbs are associated with a range of distinct readings, including *event-in-progress* (3), *habitual/generic* (4) and *factual/existential* (5).

- (3) Kogda Lena voš-la, Vas'a je-l jablok-o
 When Lena came.in-PST.3.F Vas's eat.IPRF-PST.3.M apple-ACC.SG
 When Lena came in, Vas'a was eating an apple.
- (4) Lena čitaj-et lekci v universitete.
 Lena read.IPRF-PRS.3 lectures in university
 Lena gives lectures at the university.
- (5) Ona uže xodi-la na etu vystavku.
 She already go.IPRF-PST.3F on this exhibition
 She has already visited this exhibition.

A number of proposals have been made extending the modal analysis of the English progressive to the Slavic imperfective (cf. e.g. Deo 2009, Altschuler 2014). Furthermore, the modal analysis has been used as the basis for unifying the different readings of the imperfective (Arregui et al. 2014). Here, as in the case of the English progressive, our working hypothesis is that the 'modal flavour' associated with the imperfective is of a fundamentally different nature as compared to modal verbs. Our task then, is to apply an alternative account in terms of 'internal inensionality' (event concepts) to the Russian imperfective in such a way that it captures the core generalizations concerning the range of meanings assigned to this aspectual category.

Another phenomenon that the project will focus on concerns the semantics of the Russian perfective aspect. It has been noted that the use of perfective aspect in Russian induces a maximal (definite) interpretation of the bare plural incremental argument (Krifka 1992, Verkuyl 1999, Piñon 2001, Romanova 2006, Tatevosov 2014):

- (6) Vas'a s-je-l jablok-i (za dva čas-a / *dva časa).
 Vas'a PRF-eat-PST.3.M apple-ACC.PL in two.ACC hour-GEN / two.ACC hour-GEN
 'Vas'a ate (all) the apples (in two hours)' / *'Vas'a ate apples (for two hours)'

In this example the bare plural *jabloki* 'apples' must be interpreted as referring to the maximal sum of apples in the contextually relevant situation. This is evident from the infelicity of the following example from Tatevosov 2014:

- (7) #Vas'a s-je-l jablok-i, no osta-l-o-s' eščë neskol'ko.
 Vas'a PRF-eat-PST.3.M apple-ACC.PL but remain-PST-N-REFL more a.few
 'Vas'a ate (all) the apples, but there are a few more (apples to eat)'

Krifka (1992) proposes that the Russian perfective imposes a condition on the event predicate it combines with requiring for it to be *quantized*. Informally, this means that if the predicate applies to an event *e* it does not apply to any event that is a proper part of *e*. It follows that the perfective can combine with predicates involving a definite plural incremental theme, but not an indefinite bare plural one (cf. a similar idea in Piñon 2001 stated in terms of non-cumulativity). Although this approach captures the facts discussed above, it seems rather *ad hoc* and does not shed much light on the reason *why* the Russian perfective should impose this kind of restriction on the event predicate it combines with. Tatevosov (2014) proposes an explicitly modal account of the facts in (6)-(7). Informally, Tatevosov states the idea as follows: "In Slavic, perfective sentences assert that an event *e* of an event type *P* occurs in the evaluation world and that no continuation of *e* occurs in any accessible world provided that the continuation falls under *P* as well." In other words, the Russian perfective asserts that an event is the *maximal possible* event of the type defined by the event predicate. This condition cannot be met by cumulative predicates such as *eat apples*, because any event of eating apples can in principle (i.e. in some possible worlds) be extended to yield a larger event of the same type (i.e. eating more apples). On the other hand, events in the denotation of non-cumulative predicates such as *eat the apples* cannot possibly be extended and still remain in the denotation of that predicate. Thus, it is predicted that the perfective operator should be compatible with the definite interpretation of bare

plural incremental themes, but not with their indefinite interpretation.

The hypothesis we will test in the project is that once again, the Russian perfective does *not* involve the kind of possible world semantics interpretation that explicit modal auxiliaries do. We hypothesize that the semantics required is more basic and cognitively direct, and that the only way to test this is by subtle experimentation using online tasks.

3.1.3 The Experiments

Possible worlds accounts fall short of complete objective explicitness when it comes to the to internal event properties. In all cases, the appeal to possible worlds still leaves an unexplained residue completely independent of the possible worlds mechanisms themselves. The essential question of “What does it mean to be an in-progress version of an event?” remains a primitive.

The hypothesis being pursued and tested in our project concerning intensionality, is that the progressive is actually a formative in the domain of internal intensionality (event concepts) and not external intensionality (possible worlds) . Specifically, we hypothesize that the ability to identify a snapshot state of an event as being a *part* of that event, is a sensory/cognitive judgement that forms the basis of our ability to classify the world based on symbolic labels. Similarly, judgements about whether a particular state can be represented as the ‘final state’ of some eventuality are under this hypothesis, immediate, and free of explicitly modal inferencing. In all of these cases, we will test the hypothesis by explicitly comparing the behavioural properties of explicitly (externally intensional) modal forms with the internally intensional aspectual forms that we find in English and Russian.

To test the two types of intensionality against each other we propose to use a visual world paradigm to connect the presentation of a spoken description of a situation with their visual descriptions. Over the past 20 years, this has been established as a productive and powerful paradigm for probing linguistic processing (see Huettig et al 2011), and relies on the fact that listeners tend to look at relevant visual representations of things as they listen. A strength of this methodology is that listeners do not have to perform metalinguistic judgments, as opposed to say, grammaticality judgements, and effects can be tested in a more ecologically natural setting (see Grosjean and Frauenfelder 1996).

Recent work has shown that prediction is an important component of language processing and that this can be shown at work in a visual world paradigm, where language-mediated eye movements reflect the constant updating of mental representations of the event that the spoken utterance refers to and its relation to the visual representation (Altmann and Kamide 1999, Kamide, Scheepers and Altmann 2003, Altmann and Kamide 2007). This work has (i) demonstrated the importance of prediction during language processing and (ii) shown that language-mediated eye movements do not only reflect linguistic processing but also the constant updating of dynamically changing mental representations of the event that the scene and the spoken utterance refer to.

To give a specific example of the type of paradigm we will use, consider the two following sentences from English, one involving an explicit modal and the other involving the progressive.

- (8) a. John might now cross the street.
b. John is now crossing the street.

Even though modals and the progressive are different according to any account, the specific epistemic modal *might* precisely in the context of an already initiated telic event (the ones that give rise to the imperfective paradox), has the same symbolic structure and complexity as the progressive sentence. Moreover, both sentences would be judged true in the specific situation where Mary has taken her first step across the road. The sentences are also close minimal pairs with respect to length and lexical resources. Nevertheless, we predict that internal intensionality (as in the progressive) will be cognitively simpler and more basic than the interpretation of external intensionality (as with the overt modal). In a visual world paradigm where the listener’s eye movements anticipate and pick out the correct visual representation, we predict that accessing the verbal root *cross* when embedded under the the progressive will have more robust and rapid predictive power than when embedded under the modal.

Hypothesis: The progressive aspect in English and the aspectually perfective and imperfective forms in Russian are cognitively simpler and easier to process than their explicitly modal analogues.

Proposed Project Tasks:

We will run online experiments using a Visual World paradigm comparing speed of interpretational processing and prediction for the English progressive vs. existentially modalized utterances. We will also perform tests comparing the Russian aspectual forms to explicitly modalized counterparts. In the case of Russian, we have two aspectual forms in paradigmatic opposition to each other, which may create pragmatic effects, but they can still be fruitfully compared to each other and to explicit modal constructions. We understand that much care and consultation will be needed to create materials that are truly parallel and controlled. Ideally, we would also like to be able to test the aspectual constructions against non-aspectualized citation or nominalized versions of the verbal root, in terms of immediacy of prediction. Because the visual world paradigm does not involve explicit metalinguistic judgement, we will be able to test in both adults and school age children in both languages. We will also do a corpus analysis of child speech to assess the relative stage at which these different types of intensionality are acquired and successfully deployed.

3.2 Problem Area II: Modal-Aspectual Scope Reversals

3.2.1 English Modal Perfect Constructions

In these cases, the standard analysis proposes that a lower explicit aspectual auxiliary takes scope *over* a modal that is explicitly expressed in a higher position on the surface. Consider what happens when a modal like *could* or *might* embed the perfect in English. Such sentences are claimed to have at least two, and possibly three different readings (Condoravdi 2002, Stowell 2004, Demirdache and Uribe-Etxebarria 2008).

- (9) John could have won the race.
- a. ... let's go and find out. ('Past' Epistemic reading)
 - b. ... but he didn't in the end. (Counterfactual reading)
 - c. ... (still) at that point. (Backshifted or metaphysical reading)

The tricky reading here is the one in (9-c). Here we seem to need to interpret the past temporal contribution coming from the perfect *before* the epistemic modal contribution. In other words, (9-c) is thought to be paraphrased as 'at some past time, John had the possibility of winning the race.', while (9-a) has the 'normal' compositional order paraphrasable as 'it is possible now that at some past time John won the race'. Linguists differ with respect to whether they analyse (9-b) as a completely distinct reading, or whether it is derived from (9-c) by some form of pragmatic strengthening.

As discussed earlier, scope reversals such as this undermine the robustness of the crosslinguistic typology, because if they are systematically possible then there is no reason why language would exhibit a conspiracy across languages to place epistemic modals above aspect without exception. In fact there are empirical reasons to think that this is not the right analysis. As pointed out in Ramchand (2015), scope reversal involving a PAST operator overgenerates empirically. Only *some* show the backshifted and counterfactual readings. In fact, the modals allowing for the backshifted reading are the ones in English that possess moribund past tense morphology (*might, could, should*).

In the project we will test the standard analysis against an alternative account of the three readings that does not require 'scope reversal' but which ties the different possibilities to the different semantic anchoring properties of the epistemic modals themselves (as in Ramchand 2015).

3.2.2 Russian Perfectivized Modals

In Russian, on the other hand there is no aspectual auxiliary construction corresponding directly to the English perfect. It is therefore interesting to ask how Russian expresses these two different classes

of meaning that have been analysed as scope reversals in English. In fact, the Russian language expresses the two meanings using slightly different morphological resources:

- (10) Dzhon mog vyigrat' etu gonku
John can.PAST win this race
'John could have won this race (let's go and check!).'
- (11) Dzhon mog by vyigrat' etu gonku
John can.PAST BY win this race
'John could have won this race (if he hadn't tripped at the first hurdle).'

For both readings, the epistemic modal 'can' appears in the morphological past tense. The difference between (11) (only a counterfactual reading) and (10) (ambiguous, favouring the epistemic uncertainty reading) is encoded by the extra presence of the irrealis marker *by* in (11). The two readings that are analysed as MODAL > PAST vs. PAST > MODAL in English are represented also with a rigid morphological order of modal and past morphology in Russian. It seems unlikely that the irrealis particle simply cues a difference in scope between modality and tense. The Russian comparison here gives us a potential clue as to alternative semantic compositional strategies for accounting for the difference between the two readings, one that does not involve scope reversal.

3.2.3 The Experiments

Scope within the nominal quantifier domain has been the subject of much recent experimental work, and much is now known about the processing of these quantifiers both in surface and inverse interpretations. That the classical analysis of these constructions proposes scope inversions now produces clear predictions for the differential processing of scopally distinct readings. Anderson (2004), based on a number of different controlled studies, proposes the principle of processing scope economy, given in (12)

- (12) Principle of Processing Scope Economy:
The human sentence processing mechanism prefers to compute a scope configuration with the simplest syntactic representation (or derivation). Computing a more complex configuration is possible, but incurs a processing cost.

Crucially, Anderson (2004) showed that assigning an inverse scope interpretation to a doubly quantified sentence consumes more processing resources, "*even when extralinguistic factors conspire to make the inverse scope interpretation preferable*" or even required. The experiments in question involved a variety of online and offline measures. We intend to use online measures of picture matching and reaction time downstream of hearing the constructions in question, because previous experiments on nominal quantification show that these effects show up at the sentence level.

Hypothesis: The counterfactual reading of the English modal + perfect, does not accrue any extra processing cost and does not conform to the behavioural expectations of inverse scope constructions more generally.

Proposed Project Tasks:

We plan to set up controlled experiments to test whether any of these constructions show the hallmark of scope reversal, or whether some alternative formal compositional analysis should be entertained. Because of the two languages under consideration, we can also explicitly test whether differences in morphological scope correspond to differences in the semantic composition of the complex modal-aspectual forms.

4. Project Plan: Management, Organization and Cooperation

Apart from the principal investigator, Gillian Ramchand, we propose to hire a postdoctoral researcher with competence in formal semantics with fluency in Russian. In addition, we would hire a PhD student whose project would be on methodologies in experimental semantics aimed at targeting com-

positional issues. The difference between internal and external versions of intensionality need to be put on a firm formal basis from the point of view of the compositional semantics and its ontologies and this will be the job of the postdoctoral researcher. The postdoctoral researcher would also be involved in experiment design and in the final interpretation of the results, together with the principal investigator.

The project also involves international collaboration. On the formal semantic and philosophical side, we will work with Prof. Paul Pietroski (Rutgers University, from Fall 2017), who is a prominent researcher in philosophical semantics and ontology and who has been working in the domain of compositionality, as well as having collaborated on experimental work. Our Russian collaborator will be Dr Sergei Tatevosov at Moscow University, who will provide valuable consultation on the semantics of Russian and access to native speakers for our experiments. On the psycholinguistic side, we have teamed up with the two core partners which allow us to put together a methodologically sound and robust set of experiments for probing compositional issues in English and Russian: Dr Eva Wittenberg and the Language Comprehension Lab at the University of San Diego, and Prof. Irina Sekerina at CUNY. Nationally, we plan to consult and engage with the formal semantics group at the University of Oslo, who have strong credentials in the formal semantics of tense, aspect and mood, and in particular with Atle Grønn who is an expert in these domains for Russian.

● **WORK PACKAGE 1: COLLABORATIVE PLANNING**

Collaboration and consultation on experimental techniques; devising of experimental paradigms *Team:* Ramchand, Post-Doc, National and International consulting partners.

● **WORK PACKAGE 2: RUNNING OF EXPERIMENTS AND DATA ANALYSIS**

Testing of processing complexity in internal vs. external intensionality contexts in both English and Russian. Testing of processing complexity in scope reversals in cases of mismatch with morphological patterning. *Team:* Post-Doc, PhD Student

● **WORK PACKAGE 3: INTERPRETATION AND THEORY BUILDING**

Theory construction and analysis, proposed changes to the classical system. Interpretation of results for larger architectural consequences and the interfaces with other aspects of cognition. *Team:* Ramchand, Post-Doc, PhD student.

Time Line: March 2018-February 2022 (47 months)).

Work Package 1 will take up the first two quarters of the project, and thereafter run concurrently with Work Package 2 in less intense form. Work Package 2 will be completed by the end of the 3rd quarter of 2021. Work Package 3 will commence in the 3rd quarter of 2020 and continue until the end of the project. The post doc will be hired for the duration of the project. We expect the PhD position to commence in the 3rd quarter of 2018 and be finished by the 3rd quarter of 2021.

Outputs and Dissemination:

1. Two short experimental report papers will be sent to psycholinguistic journals for each of the two languages being tested (i.e. four in all). Each of these short reports will be submitted to AMLAP and CUNY, the field's most prominent psycholinguistic yearly conferences, for presentation there.
2. Ongoing results of our experiments and analysis will be presented in the yearly workshops in the OASIS network (Ontology as Structured by the Interfaces with Semantics) of which UiT is a core member. This will provide valuable input to the major research aims of that larger European network and contribute to the establishment and testing of new semantic ontologies, which is the main aim of that project (funded by the CNRS in Paris). We think that gives gives our work a natural channel to have a greater impact at the international level.
3. The experimental material for each language will be combined with the language acquisitional and corpus work as a longer full length article which will be sent to a more descriptive and theoretically oriented journals. (two in all, one for each language). These two papers will be written at the end of the project period.

4. By the final quarter of 2021, a completed doctoral dissertation on testing compositionality via experimental means, will be produced. The intention is for this to be a methodologically oriented work, using the experiments run as case studies.
5. Depending on the overall picture that emerges from the experiments that we run, we envisage a longer more general article examining the consequences of this work for semantic theory.
6. We plan to run at least one workshop during the course of the project on Experimental Semantics, exploring different methodologies and paradigms, and how they can be used to test compositionality. (Experimental Pragmatics is much more well established than experimental semantics, and there is a real need for collaborative work in this area). We plan to publish a volume of papers from that workshop in the UiT open access journal *linguistics journal Nordlyd*.

The Team: The team proposed here is in a unique position to make progress on a number of key issues at the interface of formal semantics and general psychological theory. Ramchand, the PI is the author of a recent book on the compositional issues underlying the tense-aspect system in English, and is a well known expert on verbal semantics. The UiT CASTLFish group is an internationally prominent group with a network (through OASIS) that is already working on issues of semantic ontology. At UiT, there is also a strong Russian department more generally with a lot of local expertise from which to draw on. Finally, the Institute for Language and Culture at UiT is host to a flowering of recent experimental and developmental work from its recent purchase of an eye tracker and use of experimental techniques in both adults and children (LAVA, AcqVA, Transitivity Alternations). This project would consolidate the expertise being developed by the research groups here, and contribute something new to the list of expert areas that the group is internationally known for. Experimental semantics has the potential for becoming a new influential area of research; UiT in Norway is well placed to become an early major player in this area if this project is funded and we are able to train closely with the acknowledged international experts in the field. Our close contact with the semantic group at UiO (Prof. Kjell Johan Sæbøis Prof II affiliated with CASTLFish, and Prof. Atle Grønn is a named collaborator on the project) means that we have a very strong formal semantic expertise to draw on in developing this as a long term research strength, both at UiT, and more generally within Norway.

Selected References

- Altmann, G. T. and Y. Kamide (2007). The real-time mediation of visual attention by language and world knowledge: Linking anticipatory (and other) eye movements to linguistic processing. *Journal of Memory and Language* 57, 502–518.
- Altschuler, D. (2014). A typology of partitive aspectual operators. *Natural Language and Linguistic Theory* 32, 735–775.
- Anderson, C. (2004). *The Structure and Real-Time Comprehension of Quantifier Scope Ambiguity*. Ph. D. thesis, Northwestern.
- Barwise, J. and J. Perry (1983). *Situations and attitudes*. Cambridge, Ma.: MIT press.
- Cinque, G. (1999). *Adverbs and Functional Heads: A Cross-Linguistic Perspective*. New York: Oxford University Press.
- Condoravdi, C. (2002). Temporal interpretation of modals. modals for the present and for the past. In S. K. David Beaver, Luis Casillas and B. Clark (Eds.), *The Construction of Meaning*, pp. 59–87. Stanford, CA: CSLI Publications.
- Falk Huettig, J. R. and A. Meyer (2011). Using the visual world paradigm to study language processing: A review and critical evaluation. *Acta Psychologica* 137, 151–171.
- Julien, M. (2002). *Syntactic Heads and Word Formation*. Oxford Studies in Comparative Syntax. New York: Oxford University Press.
- Landman, F. (1992). The progressive. *Natural Language Semantics* 1(1).
- Paul Pietroski, Jeffrey Lidz, T. H. and J. Halberda (2009). The meaning of ‘most’: Semantics, numerosity and psychology. *Mind and Language* 24, 554–585.
- Pietroski, P. (2005). Meaning before truth. In G. Preyer and G. Peter (Eds.), *Contextualism in Philosophy*, pp. 253–299. Oxford University Press.
- Ramchand, G. (2014). Stativity and present tense epistemics. In *Proceedings of SALT 24*, pp. 102–121.
- Romanova, E. (2006). Perfectivity in Russian. ms., (PhD dissertation) University of Tromsø.
- Tatevosov, S. (2014). Perfectivity in Russian: A modal analysis. In J. Iyer and L. Kusmer (Eds.), *Proceedings of NELS 44*, Volume 2, pp. 196–210.