

Title	One-world semantics for modals and attitudes
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Abstract	このプロジェクトは、形式的意味論研究を行うための新しい枠組みを開発した。この枠組みは、言語は心の産物であり、したがってその特性は個々の話し手に由来するというノーム・チョムスキーの洞察を形式意味論に拡張したものである。この新しい主観的枠組みは、信念帰属、同一性、モダルの新しい意味解析を定式化するために用いられた。 また、このような意味論が、異なる話者間の一致や不一致をどのように説明できるかを示した。 This project developed a novel framework for conducting formal semantic research. The framework extends to formal semantics Noam Chomsky's insight that language is a product of the mind and hence its properties derive from individual speakers. The new subjective framework was used to formulate novel semantic analyses of belief attribution, identity and modals. It was also shown how such a semantics can account for agreement and disagreement among different speakers.
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研究課題名 (和文) One-World Semantics for Modals and Attitudes

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研究成果の概要 (和文)：このプロジェクトは、形式的意味論研究を行うための新しい枠組みを開発した。この枠組みは、言語は心の産物であり、したがってその特性は個々の話し手に由来するというノーム・チョムスキーの洞察を形式意味論に拡張したものである。この新しい主観的枠組みは、信念帰属、同一性、モダルの新しい意味解析を定式化するために用いられた。また、このような意味論が、異なる話者間の一致や不一致をどのように説明できるかを示した。

研究成果の学術的意義や社会的意義

The standard approach to semantics takes meaning to be an objective property of language, but for over six decades it has faced recalcitrant problems analyzing belief statements and modals. The proposed framework has made it possible to at last overcome these problems.

研究成果の概要 (英文)：This project developed a novel framework for conducting formal semantic research. The framework extends to formal semantics Noam Chomsky's insight that language is a product of the mind and hence its properties derive from individual speakers. The new subjective framework was used to formulate novel semantic analyses of belief attribution, identity and modals. It was also shown how such a semantics can account for agreement and disagreement among different speakers.

研究分野：Linguistic semantics

キーワード：modals identity propositional attitudes subjective semantics one-world semantics

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様式 C-19、F-19-1 (共通)

1. 研究開始当初の背景

My initial interest in problems related to attitudes and modals goes back to 2005, when I gave a talk titled “Scoping Over Epistemics”. At that time I began pursuing a multiple model approach to problems involving the interaction of attitudes, modals and identity. In 2013 I gave joint talks with Yael Sharvit, arguing for the need to take an internalist perspective on attitude attribution. We took the conservative approach at that time of extending the possible worlds-based analysis of Cresswell and von Stechow, showing the need to base interpretation of at least some attitude attributions on the attitude subject's presumed I-language. The resulting analysis added a new level of ambiguity to existing analyses, imposing a *de translato*/non-*de translato* ambiguity on top of a *de re/de dicto/de qualitate* ambiguity. We soon found, however, that incorporation of *de translato* interpretation into our analysis made it possible to eliminate the standard *de re/de dicto/de qualitate* ambiguity. The elimination was made possible by reconceptualizing the role played by the embedded proposition. Rather than taking it to identify the content of a belief of the subject's, we analyzed it as denoting an inferable consequence of such a belief. The apparent *de re/de dicto/de qualitate* ambiguity fell out as an epiphenomenon deriving from scope differences and differences in whose beliefs are used in spelling out the inference. This new perspective constituted the starting point for the project.

Parallelisms between belief attributions and epistemic modal statements made modals a natural area in which to apply the insights gained from our work on belief attributions. Non-epistemic modals, on the other hand, behave differently. Our original idea was to relate epistemic modals to inference, similar to the analysis we developed of belief attribution, and to analyze non-epistemic modals in terms of causality. Our hope was that the two analyses could be made parallel except for the inference/causality distinction. Since the inference-based analysis of belief attribution succeeded in explaining the various properties of that construction without appeal to possible worlds, such an extension to both epistemic and non-epistemic modals held a clear promise to further eliminate the need for possible worlds in semantics.

2. 研究の目的

The initial goal of this research was to show unequivocally that problems involving necessary truths or falsities rule out possible worlds analyses not only of propositional attitude attributions but also of modals of all varieties - epistemic, deontic, bouletic, teleological and others. The second goal was to develop an alternative analysis of these phenomena that can handle necessities and impossibilities in these contexts. This analysis was to be built upon a preliminary analysis of belief attribution. The aim was to replace standard accounts based on infinities of possible but non-actual worlds with new accounts based on inferences among meanings and causations among events that could be calculated using only a single world - the actual world.

After establishing analyses of the core phenomena of attitude attributions and modals in the first two to three years of the project, the next task envisioned was to extend the analysis to other intensional phenomena, including intensional transitives, counterfactuals and modal subordination, and to then use these analyses as a basis for developing a full-fledged subjective semantics framework adequate for analyzing any semantic phenomena.

3. 研究の方法

The research methodology used was the standard methodology for conducting semantic research: examine prior theories, show their empirical inadequacies, develop alternative explanations to overcome those inadequacies, test the alternative explanations, and revise them as needed.

4. 研究成果

The first main result from this research was publication of the article “Belief or Consequences”. Initially this article was intended as a general analysis of belief attribution that could in principle be adapted to any framework. The core insight

was that it is possible to analyze belief attribution as a uniform phenomenon given a single formal analysis provided that the embedded clause in a belief attribution is taken to denote not a specific belief that the subject has but rather an inferable consequence of such a belief, with attributor beliefs playing a potential role in the inference. Comments from reviewers, however, made it clear that the full significance of the analysis was being missed because of a lack of understanding of how the analysis could be formally implemented. This led to our spelling out a specific framework in the paper highlighting the subjective nature of interpretation that and within which the analysis could easily be accommodated. The framework was our first version of subjective semantics, designed to most closely parallel Montague semantics in its formalism. The paper was published in 2022, and talks based on the paper were given at six institutions in Europe in 2023. The paper is starting to gain attention internationally.

Shortly after publication of this paper we asked Orin Percus to join our project. Orin discovered important shortcomings in our framework that led to wrong predictions about simple sentences in complex situations. In particular, he noticed that it is possible for someone to believe that the sentence "Dominique Dupont is French" is true without knowing who Dominique Dupont is, something our framework did not explicitly make room for. This led to our pursuing a supervaluation approach to interpretation: instead of assigning a single definitive subjective interpretation to every expression, we instead assigned multiple subjective interpretations compatible with an individual's beliefs. A person uncertain about whether Dominique Dupont is individual *a*, *b* or *c* could still be certain that he is French if they know that all three of *a*, *b* and *c* are French. By assigning a collection of interpretations to expressions, this combination of certainty and uncertainty is easily captured formally.

The change to a supervaluation approach to interpretation suggested a different way of formalizing interpretation in general. Instead of encoding meanings in interpretation functions, it was more straightforward to encode them in collections of vocabulary items that directly pair basic expressions with interpretations. Implementing this idea led to our current, second subjective semantic framework, one that we are continuing to work out in detail in the book we are writing. The basic idea is that a sentence is interpreted semantically with respect to a set containing one vocabulary item for each basic expression in the sentence, while pragmatically the sentence is interpreted with respect to all such collections of vocabulary items that are consistent with the beliefs of the speaker according to the hearer.

One of the most important consequences of this approach to interpretation is that it makes it possible for identity statements to be informative. Suppose that an individual uncertain about whether Dominique Dupont is *a*, *b* or *c* is equally uncertain about whether Pierre Petit is individual *b*, *c* or *d*. If they know nothing else about Dominique Dupont (DD) and Pierre Petit (PP), their beliefs are compatible with nine different combinations of vocabulary items connecting the names to individuals: {<DD,*a*>, <PP,*b*>}, {<DD,*b*>, <PP,*b*>}, {<DD,*c*>, <PP,*b*>}, {<DD,*a*>, <PP,*c*>}, {<DD,*b*>, <PP,*c*>}, {<DD,*c*>, <PP,*c*>}, {<DD,*a*>, <PP,*d*>}, {<DD,*a*>, <PP,*d*>}, and {<DD,*a*>, <PP,*d*>}. Upon learning that Dominique Dupont is Pierre Petit, these nine possibilities get reduced to two: {<DD,*b*>, <PP,*b*>} and {<DD,*c*>, <PP,*c*>}, illustrating the informative potential of the identity sentence. Accounting for the informativity of identity statements involving proper names represents an important improvement on the standard Kripkean analysis of such statements, which if translated into our framework would only allow for a single pairing of vocabulary items, the objectively correct pairing. As we have now shown, such an objective approach to interpretation, in particular of names, is incompatible with the phenomenon of informativity. We expect these results, once published, to have a strong impact on the field, both for the challenges they pose to the heretofore standard analysis and its various refinements as well as for the novel subjective approach developed that overcomes these challenges.

Our initial idea of analyzing non-epistemic modals in parallel with epistemic modals by substituting causality for inference turned out to be unworkable. The basic problem was that inference reduces to syntax in a way that causality does not: two events with different causal consequences can nonetheless be described identically, but neither causal consequence can be predicted from the syntactic form in which the event is described. The need to appeal to inference arose in the semantics of belief attribution in part from the need to incorporate both the beliefs

of a subject to whom beliefs are being attributed and those of the person attributing beliefs to that subject. Epistemic modal statements were found not to be sensitive to the beliefs of multiple individuals in this same way. They rather only encode information about the beliefs of the individual whose epistemic state they are taken to describe. This makes it possible to give a much simpler analysis of epistemic modals than was given for belief attribution statements: they can quantify over situations compatible with a single relevant individual's beliefs. For us, this reduces to quantifying over a set of sets of vocabulary items, each representing one way the world might be according to the individual in question.

This reconceptualization of how epistemic modals get interpreted accomplishes two things. First, it provides an explanation for why epistemic modals exist alongside of belief attribution. If the two were analyzed as doing the exact same work semantically, as has often been the case, it would be difficult to explain why in language after language both ways of describing beliefs persistently survive. If belief attribution relates to the beliefs of multiple individuals while modals relate to those of only one, in contrast, their persistent co-existence is easy to explain: they do different work. Second, the reconceptualization opens up simpler alternatives for distinguishing between epistemic and non-epistemic modal interpretation. The former can be analyzed as quantification over beliefs as outlined above, while the latter can be analyzed as quantification over alternatives to a single belief that maintain some aspect of the original. We have so far been focusing primarily on metaphysical modality as our test case for non-epistemic modal interpretation, though the analysis we have developed of metaphysical modality should extend straightforwardly to other non-epistemic modal interpretations.

Our approach to modal interpretation differs from the Kratzerian standard in several ways. Most importantly, it posits and predicts that there is only a single epistemic interpretation but that there are multiple non-epistemic interpretations. We take this prediction to align more closely with intuition. In particular, we see no examples of modal interpretation that can plausibly be said to be both epistemic and, say, deontic at the same time, something Kratzer's analysis straightforwardly generates. This is not to say that the interpretations of deontic modals and other non-epistemic modals are not related to beliefs. Like all interpretation, they are. Their relation to beliefs, however, is exactly the same as that of non-modal statements: they are interpreted with respect to each possibility compatible with the beliefs of a relevant individual. They do not involve an independent quantification over a set of possibilities compatible with these beliefs. Our novel approach to modality overcomes a massive overgeneration problem inherent in Kratzer's analysis while still allowing for a precise formal account of the range of actual modal interpretations that Kratzer accounts for.

We have now solved all of the major problems we set out to solve and are in the process of writing those solutions up as a book manuscript. We have completed one chapter of the book setting out motivation for a subjective semantics, and we are about 80% through a chapter setting out the formal framework, 70% through a chapter on names, identity and informativity, 30% through a chapter on modals, and at the outline stage of a chapter on propositional attitude attributions. We ultimately aim to analyze counterfactual conditionals and intensional transitive predicates as well, but have not yet decided whether to include these analyses in the book or to separate them off into independent papers.

5. 主な発表論文等

〔雑誌論文〕 計1件（うち査読付論文 1件／うち国際共著 1件／うちオープンアクセス 1件）

1. 著者名 Christopher Tancredi and Yael Sharvit	4. 巻 15
2. 論文標題 Belief or Consequences	5. 発行年 2022年
3. 雑誌名 Semantics and Pragmatics	6. 最初と最後の頁 1-45
掲載論文のDOI（デジタルオブジェクト識別子） 10.3765/sp.15.14	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 該当する

〔学会発表〕 計5件（うち招待講演 5件／うち国際学会 0件）

1. 発表者名 Christopher Tancredi
2. 発表標題 Subjective Semantics
3. 学会等名 Nantes University（招待講演）
4. 発表年 2024年

1. 発表者名 Christopher Tancredi
2. 発表標題 I-Semantics
3. 学会等名 University College London, University of York, University of Edinburgh, University of Nantes, University of Gothenburg, Leibniz-Zentrum Allgemeine Sprachwissenschaft (ZAS)（招待講演）
4. 発表年 2023年

1. 発表者名 Christopher Tancredi
2. 発表標題 Subjective Semantics in Five Minutes
3. 学会等名 Keio University（招待講演）
4. 発表年 2024年

1. 発表者名 Christopher Tancredi
2. 発表標題 Belief-Based Semantics
3. 学会等名 Meiji Gakuin University (招待講演)
4. 発表年 2022年

1. 発表者名 Christopher Tancredi
2. 発表標題 A One-world I-semantics of Belief Attribution
3. 学会等名 New York University, Tel Aviv University, Keio University (招待講演)
4. 発表年 2021年

〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

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7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関
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