The Semantics and Pragmatics of Argumentation

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1 Introduction

Arguments have been the object of philosophical interest for a long time. Logicians have studied the formal properties of arguments at least since Aristotle. The study of the structure of arguments by epistemologists (e.g., [Pollock, 1987]; [Pollock, 1991a], [Pollock, 1991b]; [Pollock, 2010]) has given rise to *formal argumentation theory*, that has developed into a branch of computer science in its own right (e.g., [Dung, 1995], [Wan et al., 2009], [Prakken, 2010]). Comparatively less attention has been paid to arguments and argumentations *qua* distinctive linguistic constructions with a distinctive semantics and pragmatics. While philosophers and linguists have quite widely discussed speech acts such as assertions (e.g., [Stalnaker, 1978], [Stalnaker, 1987]), questions (e.g., [Hamblin, 1971], [Groenendijk and Stokhof, 1982a],   [Groenendijk and Stokhof, 1985], [Groenendijk and Stokhof, 1982b], [Roberts, 1996]), orders (e.g., [Portner, 2004], [Portner, 2007a],   [Charlow, 2014],   [Starr, 2014a],   [Starr, 2019], [Murray and Starr, 2020],   [Murray and Starr, 2018a]),   and   predictions ([Benton, 2011], [Benton and Turri, 2014], [Cariani, 2020]), the speech act of giving an argument has not been studied as intensively by speech act theorists and semanticists.[1] And yet, just like we use language for exchanging information, for

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[1]Most work on speech act theory fails to discuss arguments as a kind of speech act (cf. [Austin, 1975] nor [Searle, 1969], [Searle, 1968], [Searle et al., 1985]). Even recent discussions of speech acts tend to focus primarily on assertions, orders, imperatives, and interrogatives. Cf. [Murray and Starr, 2020], [Murray and Starr, 2018a], and [Fogal et al., 2018]. There are some isolated discussions of arguments, mostly in connection to logic and a study of reason-

raising questions, for issuing orders, for making suppositions and predictions, we also use language to give arguments, as when we argue on behalf of a certain conclusion, or when we share our reasonings. Indeed, giving arguments is one among philosophers' favorite speech acts; and it is quite remarkably widespread outside the philosophy classroom.

This chapter overviews recent work on the semantics and pragmatics of arguments. In natural languages, arguments are conventionally associated with particular grammatical constructions, such as:

(1)   a.   P1, . . . , Pn. Therefore, C;
        b.   Suppose P1, . . . , Pn. Then, C.

These constructions involve argument words such as 'therefore', 'thus', 'then, 'hence' — or *argument connectives* as [Beaver, 2001](p. 209) calls them — which are used in natural languages to signal the presence of arguments.[2] It is, therefore, natural to study the speech act of giving an argument by looking at semantics and pragmatics of argument connectives.

1.1   The Plan

The first part of the chapter looks at the semantics of argument connectives. Here, it is natural to start with approaches that take discourses rather than sentences to be the main unit of semantic analysis. Recent developments in linguistics provide ample new resources for a semantics of argumentation. In particular, I will discuss the resources that discourse coherence approaches as well as dynamic approaches to the study of language have to understand the semantics of argument connectives. §2 compares argument connectives in English to their formal

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ing. [Parsons, 1996] cast some important insight on the abstract notion of an argument as used in logic and in philosophy, as a set of premises and a conclusion and rules. For example, [Rumfitt, 2015] discusses the act of inferring, by which he seems to mean a mental process. [Van Eemeren et al., 2004], [Van Eemeren et al., 1982] approach the topic of arguments and argumentations but from a very different angle, as they understand argumentation as a tool to overcome dialectical conflict. Another interesting study of arguments for philosophical purposes is [Mercier and Sperber, 2011], who use arguments and argumentation theory for a theory of reasoning. [Hamblin, 1970] (Chapter 7)'s "The Concept of An Argument" entertains the question of what an argument is but then declares it too difficult and goes on to analyze instead what a good argument or a bad argument is. [Walton, 1990] surveys different possible conceptions of arguments, from the logical conception of an argument as a set of premises and conclusions, to the dialectical conception of an argument.

    [2][Brasoveanu, 2007] calls the same words 'entailment words'.

counterparts in proof theory. §3 explores thinking of argument connectives as expressing *discourse coherence relations* (e.g., [Asher, 1993]; [Asher et al., 2003]; [Bras et al., 2001a], [Bras et al., 2001b]; [Le Draoulec and Bras, 2007]; [Bras et al., 2009]; [Jasinskaja and Karagjosova, 2015]). §4 discusses Grice's view according to which argument connectives come with an associated conventional implicature and compares it to the competing analysis on which 'therefore' is a presupposition trigger ([Pavese, 2017]; [Stokke, 2017], [Pavese, 2021]). §5 discusses [Brasoveanu, 2007]'s proposal that semantically 'therefore' works as a modal, akin to epistemic 'must'. §6 examines dynamic analyses of argument connectives ([Pavese, 2017]; [Kocurek and Pavese, 2021]), with an eye to highlight the scope and the advantages of these sorts of analyses. §7 identifies open issues in the study of the pragmatics of arguments.

The second part of the chapter (§8) looks at the pragmatics of argument connectives and at the difference between arguments and explanations. §7 discusses issues that arise for the pragmatics of arguments and compares the speech act of giving an argument to that of explaining. §9 concludes.

2 Preliminaries

Consider **Argument Schema**, with the horizontal line taking a list of premises and a conclusion into an argument:

Argument Schema

$$\frac{\phi_1\ ,\ \ldots,\ \phi_n}{\psi}$$

Now, compare **Argument Schema** to the following arguments in English:

(2)   a.   There is no on-going epidemic crisis. Therefore, there is no need for vaccines.
       b.   It is raining. Therefore, the streets are wet.
       c.   I am smelling gas in the kitchen. Therefore, there is a gas leak.
       d.   This substance turns litmus paper red. Therefore, this substance is an acid.

These arguments have all the form "Φ, Therefore ψ" where Φ is the ordered set of premises $\phi_1, \ldots, \phi_n$ and ψ is the conclusion. Because of the syntactic resemblance of **Argument Schema** and (2-a)-(2-d), it is tempting to think of 'therefore'

and other argument connectives such as 'hence' and 'so' as having the same meaning as the horizontal line (e.g., [Rumfitt, 2015], p. 53).

However, **Argument Schema** is not perfectly translated by the construction "Φ, Therefore/Hence/So/Then ψ"; nor is the horizontal line perfectly translated by the argument connectives available in English. First of all, the horizontal line does not require *premises*, for it tolerates conclusions without premises, as in the case of theorems:

Theorem

$$\overline{\psi \vee \neg \psi}$$

By contrast, 'therefore' and 'hence' etc. do require explicit premises:[3]

(3)   a. ??Therefore/hence, we should leave (looking at one's partner uncomfortable face).
       b. ??Therefore/hence, streets are wet (looking the rain pouring outside).
       c. ??Therefore/hence, either it is raining or it is not raining.

A plausible explanation for this contrast is that 'therefore' and 'hence' differ from the horizontal line in that they contain an anaphoric element — (cf. [Brasoveanu, 2007], p. 296; [Kocurek and Pavese, 2021]). Like anaphors, argument connectives require not just an antecedent but its *explicit* occurrence.[4]

That is the first difference between 'therefore' and the horizontal line. Here is a second difference (cf. [Pavese, 2017], pp. 94-5; [Pavese, 2021]). In **Argument Schema**, the premises can be supposed, rather than asserted. By contrast, 'therefore' (and 'hence' and 'so') is not always allowed in the context of a supposition:

(4)   a.   It is raining. Therefore/so/hence, the streets are wet.
       b. ??Suppose it is raining; therefore/so/hence the streets are wet.
       c.   If it is raining, therefore/so/hence the streets are wet.

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[3]As Pauline Jacobson has pointed out to me (p.c.), the use of 'so' strikingly differs from the use of 'therefore' in this regard, in that 'so' can also be used without premises, as in "So, you have arrived!". Hence, 'so' seems to have a *deictic* use as well as an anaphoric use. By contrast, 'therefore' seems to privilege an anaphoric use. However, see [Neta, 2013] (pp. 399–406) for the claim that 'therefore' is a deictic expression. I am grateful to Janice Dowell for discussion here.

[4]There is not to say that premise-less arguments cannot be made in natural languages. Natural languages seem to resort to other devices to express premise-less arguments, —i.e., locutions such as 'by logic'. Cf. [Pavese, 2021] for a discussion of these issues.

d.???If Mary is English, therefore/so/hence she is brave.

e.???Suppose Mark is an Englishman. Therefore/so/hence, he is brave.

Under supposition, connectives like 'then' are much preferred to 'therefore':

(5)   a.   Suppose Φ; then, ψ.
       b.   Suppose it is raining. Then, the streets are wet.
       c.   If it is raining, then the streets are wet.
       d.   If Mary is English, then she is brave.
       e.   Suppose Mark is an Englishman. Then, he is brave.

For this reason, [Pavese, 2017] speculates that the slight infelicity of (4-b) may indicate that 'therefore' is more similar to the square — i.e., '$\square$' — that ends proofs than to the horizontal line in **Argument Schema**:

[Proof of Theorem] Theorem $\ldots \square$

Just like '$\square$', 'therefore' would require its premises having been discharged and not being conditionally dependent on other premises.

However, the data is more complex than [Pavese, 2017] recognizes and should be assessed with caution. [Pavese, 2021] observes that 'therefore' can be licensed in the context of supposition. For example, consider:

(6)   a.   If it were raining, streets would, therefore, be wet.
       b.   Suppose it were raining; the streets would, therefore, be wet.
       c.   If Mary were English, she would, therefore, be brave.
       d.   Suppose Mark were Englishman. He would, therefore, be brave.

'Therefore' is licensed in this construction, where the mood of the linguistic environment is subjunctive. In this respect, 'therefore' and 'hence', on one hand, differ from 'then', on the other, for 'then' is permitted within the scope of a supposition whether or not the mood is indicative:

(7)   a.   Suppose it were raining. Then, the streets would be wet.
       b.   If it wee raining, then the streets would be wet.
       c.   If Mary were English, then she would brave.
       d.   Suppose Mark were an Englishman. Then, he would be brave.

Moreover, 'therefore' is at least tolerated with so-called 'advertising conditionals' — interrogatives that play a role in discourse similar to that of antecedents of conditionals:

(8)   a.   Single? (Then) You have not visited Match.com. ([Starr, 2014], p. 4)
        b.   Single? Therefore, you have not visited Match.com.
        c.   Still looking for a good pizzeria? Therefore you have not tried Franco's yet.

This suggests that at least under certain conditions, 'therefore' can appear in suppositional contexts.

Another respect under which argument connectives in English differ from the horizontal line in **Argument Schema** is that while their premises have to be declarative, their conclusion does not need to be.[5] Several philosophers have observed that imperatives can appear as conclusions of arguments (e.g., [Parsons, 2011], [Parsons, 2013], [Charlow, 2014], and [Starr, 2019]):

(9)   If May arrives late tonight, you should go to the store. As a matter of fact, Mary is arriving late. Therefore, go to the store!

In addition to allowing imperative conclusions, argument connectives can also have *interrogative* conclusions. Here is one example (I will provide more in the following):

(10)   The doctor and the lawyer were the two main and only suspects. But then the detective has found a stethoscope near the location of the murder. Therefore, who is the chief suspect now?

Finally, argument connectives in English differ from the horizontal line in that they can also appear in non-deductive arguments, both in inductive arguments such as (11-a)-(11-c), in abductive arguments such as (11-d), as well as practical arguments, such as (11-e):

(11)   a.   It happened, therefore it can happen again: this is the core of what we have to say. It can happen, and it can happen everywhere. (from Primo Levi The Drowned and the Saved, Vintage; New York, 1989. pg. 199). [INDUCTIVE ARGUMENT]
        b.   Almost every raven is black, and the animal that we are about to observe is a raven. Therefore, it will be black too. [INDUCTIVE ARGUMENT]

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[5]I will be assuming throughout that arguments cannot have imperatives or interrogatives as premises but even here the data is rather subtle. See [Kocurek and Pavese, 2021] for a detailed discussion of this point.

c. Mark owns a Bentley. Therefore, he must be rich (Douven et al. 2013) [ABDUCTIVE ARGUMENT]

d. The victim has been killed with a screwdriver. Therefore, it must have been the carpenter. [ABDUCTIVE ARGUMENT]

e. We cannot put the face of a person on a stamp unless said person is deceased. My suggestion, therefore, is that you drop dead (attributed to J. Edward Day; letter, never mailed, to a petitioner who wanted himself portrayed on a postage stamp). ([Brasoveanu, 2007], p. 279) [PRACTICAL ARGUMENT]

Ideally, a semantics for arguments must be able to vindicate the distinction between inductive, abductive, practical, and deductive arguments while providing a unified semantics for argument connectives that can appear in different types of arguments.

In conclusion, there are at least four dimensions along which argument connectives differ from the horizontal line in deductive logic. First, they differ in that they have an *anaphoric component*; secondly, they are *mood-sensitive*, in that whether they allow embedding under supposition and sub-arguments might depend on the mood of the linguistic environment. Thirdly, argument connectives can allow for *non-declarative conclusions* and, fourthly, they can occur in *deductive* as well as *non-deductive* arguments.

3 Argument Connectives within Discourse Coherence Theory

Giving an argument is a speech act that stretches through a discourse — i.e., from its premises to its conclusion. It is therefore natural to start an analysis of arguments by looking at the resources provided by *discourse coherence analysis* — an approach to the study of language and communication that aims at interpreting discourses by uncovering coherence relations between their segments. Because the most developed such a theory of discourse relations is *Segmented Discourse Representation Theory* ([Asher, 1993], [Asher et al., 2003]), in assessing the resources that this general approach provides to analyze arguments and the semantics of argument connectives, I will focus on this particular coherence theory.

In SDRT, a discourse is represented by an SDRS (i.e., *Segmented Discourse Representation Structure*). A SDRS is a recursive structure consisting of labelled elementary DRSs (i.e., *Discourse Representation Structures*) representing a single

clause and labelled sub-SDRSs linked together by Discourse Relations. Within this framework, it is natural to take argument connectives such as 'therefore', 'then', and 'thus' to be among the *discourse connectors* in SDRT. *Discourse connectors* express different kinds of coherence relations. The crucial question behind a coherence discourse theoretic approach to the meaning of argument connectives is, then, *what kind* of coherence relation they express. The most notable discourse relations studied by discourse coherence theorists are NARRATION, ELABORATION, BACKGROUND, CONTINUATION, RESULT, CONTRAST, and EXPLANATION.

Although the literature has focused much more on *temporal* discourse connectives than on argument connectives, the general tendency in this literature is to assimilate the meaning of 'therefore' to the meaning of 'then' in its temporal uses and to its French counterpart 'alors' (cf. [Bras et al., 2001a], [Bras et al., 2001b], [Bras et al., 2009]). According to the analysis prevailing in this literature, 'therefore' would then introduce the relation of RESULT ([Hobbs, 1985], [Asher, 1993], [Asher et al., 2003], [Asher and Gillies, 2003], [Kehler and Kehler, 2002]).[6]

How are we to model the relation of RESULT? As [Bras et al., 2001a] puts it, a RESULT relation between constituents α and β represents the narrator's intention to signify that β is a result of α (cf. also [Bras et al., 2001b]). Expressing RESULT has the effect of implying a causal link between the main eventualities of the constituents it relates. If the relation of RESULT holds between two constituents, then the former causes the latter:

RESULT $(\alpha;\beta) \rightarrow$ CAUSES (α, β).

An example might help to illustrate the idea. On this analysis, the following discourse is taken to express RESULT ([Asher, 1993], [Asher et al., 2003]):

(12)   John pushed Max. He fell.

In (12), the event of second constituent (= "He fell") results from the event of the first constituent (= "John pushed Max"), being caused by it. RESULT is the inverse of the discourse relation of EXPLANATION. For example, compare (12) and (13):

(13)   Max fell. John pushed him.

In (13), the event of first constituent (= "He fell") results from the event of second constituent (= "John pushed Max") but the second constituent is naturally

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construed as *explaining* the event of the first constituent, as the order of the discourse in (13), by inverting the RESULT relation in (12), makes explicit. RESULT is standardly analyzed as having a causal semantics for which these authors appeal to [Lewis, 2013]'s theory of counterfactuals. Accordingly, a relation of RESULT holds between two constituent α and β (i.e., RESULT (α;β)) only if

Dependence α hadn't occurred then β wouldn't have;

Normality events of type α normally yield events of type β.

This is the general idea. Now onto assessing it. There are indeed uses of 'therefore' that fit well with this general semantics. To illustrate, when telling the story of how Max fell, it would be quite natural to develop (12) by adding a 'therefore' between the first and the second constituent, as follows:

(14)   John pushed Max. Therefore, Max fell.

More generally, we often use 'therefore' to express a *causal relation* between events. Here are a few more examples:

(15)   a.   John was desperate for financial reasons. Therefore, he killed himself.
        b.   Mary qualified for the exam. Therefore, she enrolled.
        c.   Max passed his A-levels. Therefore he could go to the university. (cf. [Bras et al., 2001a], [Bras et al., 2001b], [Le Draoulec and Bras, 2007], [Bras et al., 2009]).
        d.   Reviewers are usually people who would have been poets, historians, biographers, etc., if they could; they have tried their talents at one or the other, and have failed; therefore they turn critics. (Samuel Taylor Coleridge, Lectures on Shakespeare and Milton) (cf. [Brasoveanu, 2007], p. 278).

These uses are *narrative*, in that they occur in narrations of a series of events.
However, not every use of 'therefore' satisfies both **Dependence** and **Normality**. For example, in the following arguments, the truth of the premises does not cause the truth of the conclusion:

(16)   a.   All the girls have arrived. Therefore, also Mary has arrived.
        b.   Mary has arrived. Therefore, somebody has arrived.

Consider for example (16-b): it violates **Dependence**, for if Mary had not have arrived, somebody might still have arrived. Or consider a mathematical inference, such as (17), which cannot be accounted for by **Dependence**, for the counterfactual "If 2 were note even, it would be false that either 2 is even or 3 is" is a useless counterpossible:

(17)   2 is even. Therefore either 2 is even or 3 is.

These uses of argument connectives cannot plausibly be analyzed in terms of RE-SULT for they violate **Dependence**. There might also examples where 'therefore' is permitted which violate **Normality**. For example, consider [Schlöder et al., 2016] (p. 7)'s examples:

(18)   a.   John is ill. Therefore, he is in the hospital.
         b.   Walnut street is a shorter street. Therefore, we should take it instead
                of Albany.

Being ill does not typically result into being admitted to the hospital — only in some cases being ill brings you to the hospital — yet the use of 'therefore' in this example is totally felicitous. Similarly, (18-b) can be uttered felicitously even though it is not true that one should typically take the shorter street.

In order to extend their discourse coherence analysis to uses of 'therefore' that are recalcitrant to the causal analysis as spelt out by the conjunction of **Normality** and **Dependence**, [Bras et al., 2009] (p. 166) proposes to appeal to INFERENTIAL RESULT — i.e., a relation holding between two events or propositions just in case the latter is a logical consequence of the former. [Bras et al., 2009] uses K to indicate a constituent's way of describing an event α and the arrow stands for the material conditional. Then, [Bras et al., 2009] (p. 166) defines INFERENTIAL RESULT as follows:

INFERENTIAL RESULT (α, β) iff $\Box(K_\alpha \rightarrow K_\beta)$.

However, not every non-narrative use of argument connectives can be analyzed in terms of INFERENTIAL RESULT. For example, consider the use of argument connectives such as 'therefore', or 'so' and 'thus', in inductive, abductive, or practical arguments, as in (11-c)-(11-e). One might contend that in these cases, 'therefore' still expresses INFERENTIAL RESULT, and those discourses are felicitous whenever they presuppose, for example, that some inductive, abductive, prudential principle holds. On this analysis, however, every argument is implicitly deductive. Moreover, even if we restrict INFERENTIAL RESULT to the deductive

uses of argument connectives, the problem remains that this approach would result in a rather disunified theory of the meaning of argument connectives. We are told that sometimes discourses involving 'therefore' express RESULT — a causal relation — sometimes they express a different relation altogether — i.e., INFERENTIAL RESULT or classical entailment. The prospects, within this framework, for reaching a general approach to the meaning of argument connectives, one that captures what is common to *all* the different uses of argument connectives, seem rather dim.

Here is a unifying proposal, one that preserves the discourse coherence theorists' important insight that 'therefore' is a discourse connector expressing some or other discourse relation. Suppose we understand the causal relation of RESULT in terms of a *restricted* notion of entailment. For example, we might understand RESULT in terms of nomological entailment — entailment given the laws of nature — or default entailment, as in [Asher and Morreau, 1990] and [Morreau, 1992]. (cf. also, [Meyer and van der Hoek, 1993], [Weydert, 1995], [Veltman, 1996]). We might then take argument connectives in their inferential deductive uses to express non-restricted forms of entailment — i.e., classical (or relevantist) entailment; and partial entailment (as defined, for example, by [Crupi and Tentori, 2013], [Crupi, 2015]), probabilistic entailment (as defined, for example, by [Jaeger, 2005]), in their inductive and abductive uses, and some notion of practical entailment — entailment given the prudential/practical/moral laws — in its practical uses. On this proposal, every use of argument connectives expresses some more or less general relation of entailment. We thereby reach unification across uses of argument connectives while preserving the differences.

Quite independently of the consideration of argument connectives, [Altshuler, 2016] has proposed that we understand RESULT in terms of *enthymematic nomological entailment*.[7] ϕ enthymematically entails the proposition ψ, if and only if there is a nonempty set of propositions Φ such that $\Phi \cup \{\phi\}$ logically entails ψ. For example, consider again the discourse (14). John's having pushed Max does not entail that Max fell. According to [Altshuler, 2016] (p. 70-1)'s proposal, John's having pushed Max might enthymematically entail that Max fell, for John's having pushed Max in conjunction with an appropriate set of background propositions might entail that Max fell. When we interpret (14), we might assume that in normal circumstances, if one is pushed sufficiently strongly, then one will fell and that Josh must have pushed Max sufficiently strongly. As [Altshuler, 2016] observes, these background propositions may come from a wide variety of sources, from

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[7]See also [Kehler and Kehler, 2002] (section 3.1).

shared knowledge or from the discourse itself. In the case of RESULT, Altshuler proposes that we might understand the relation between two constituents as a form of entailment —i.e., *nomological entailment*. This discourse relation between a constituent σ_1 and a constituent σ_2 holds just in case σ_1 entails σ_2, together with the relevant laws L as well as the other relevant background propositions.

If we extend this proposal to the meaning of 'therefore', we can analyze narrative uses of 'therefore' (e.g., (14), (15-a)-(15-c)) in terms of nomological entailment. And we might analyze uses of argument connectives as in (17), for example, as expressing a *more abstract entailment relation* — that of classical, or relevantist entailment; finally, we might analyze uses of argument connectives in inductive, abductive, and practical arguments such as (11-b), (11-d), and (11-e) as expressing some restricted notion of entailment (cf. [Kocurek and Pavese, 2021] for a formal implementation of this unifying idea).

In conclusion, discourse coherence theory provides us with the resources to study the semantics and pragmatics of arguments from the correct methodological standpoint: because arguments are discourses, this approach analyzes argument connectives as discourse connectors and thus as expressing discourse relations. From our discussion, it emerges that argument connectives appear with a variety of different flavors (narrative, causal, inferential, etc.). In order to capture what is common to all of these uses, the proposal seems promising of analyzing argument connectives as expressing some or other notion of entailment.

4 Conventional implicature or presupposition?

Discourse coherence theory is silent about the status of the relation expressed by argument connectives — is it asserted, conventionally implied, or presupposed? — and, relatedly, about the mechanisms by which that relation is expressed. In "Logic and Conversation", [Grice, 1975] uses the case of 'therefore' to illustrate the notion of a *conventional implicature*. [Grice, 1975] (pp. 44–45) observes that in an argument such as (19-a) and in a sentence such as (19-b), 'therefore' contributes the content that the premise entails the conclusion — in other words, it contributes *Target Content*:

(19)   a.   Jill is English. Therefore, she is brave. (*'therefore'-argument*)
          b.   Jill is English and she is, therefore, brave. (*'therefore'-sentence*)
          c.   Jill is English and she is brave.
          d.   Her being brave follows from her being English. (*Target Content*)

[Grice, 1975] (pp. 44-45) pointed out that in an argument such as (19-a) or in a sentence such as (19-b), *Target Content* is communicated without being asserted, for while by saying (19-b), one commits to *Target Content*'s being true, whether *Target Content* is true does not contribute to what is said by (19-b):

> If I say (smugly), "He is an Englishman; he is, therefore, brave," I have certainly committed myself, by virtue of the meaning of my words, to its being the case that his being brave is a consequence of (follows from) his being an Englishman. But while I have said that he is an Englishman and said that he is brave . . . I do not want to say that my utterance of this sentence would be, strictly speaking, false should the consequence in question fail to hold. So some implicatures are conventional . . .

Grice took this to indicate that *Target Content* is only conventionally implicated by 'therefore', for he further thought that (19-b) would not be false, if *Target Content* were false. It is customary for linguists and philosophers to follow Grice here. For example, [Potts, 2007] (p. 2) tells us that the content associated with 'therefore' is a relatively uncontroversial example of a conventional implicature (see also [Neta, 2013] and [Wayne, 2014] (section 2)).

Whether the conventional implicature analysis of 'therefore' is best at capturing the behavior of 'therefore' is, however, questionable. [Pavese, 2017] argues that several considerations suggest that the explanatory category of *presuppositions*, rather than that of conventional implicatures, might actually better capture the status of the sort of content that is conveyed by argument connectives (see also [Stokke, 2017], [Pavese, 2021]). The first kind of evidence for this claim is that 'therefore' satisfies the usual tests for presupposition triggers: *Projectability* and *Not-At-Issuedness*.

Start with *Projectability*. Presuppositions project out of embeddings. For example, the proposition expressed by (20-b) is presupposed by (20-a) because it is still conveyed by the negation of (21-a), by the question (21-b), by the conditional (21-c), when embedded under possibility modals (21-d), as well as under evidential modal and probability adverbs ((21-e)):

(20)   a.   It is the knave that stole the tarts.
        b.   Somebody stole the tarts. (*Implicit Content*)

(21)   a.   It is not the knave that stole the tarts. (*Negation*)
        b.   Is the knave that stole the tarts? (*Question*)

13

     c.   If it is the the knave that stole the tarts, he will be punished. (*Antecedent of a conditional*)

     d.   Maybe/It is possible that it's the knave that stole the tarts. (*Possibility Modals*)

     e.   Presumably/probably it's the knave that stole the tarts. (*Evidential modal, probability adverb*) [8]

Like standard presupposition triggers, *Target Content* projects out of embeddings — i.e., out of negation (22-a), out of questions (22-b), in the antecedents of conditionals (22-c), out of possibility modals (22-d) and out of evidential modal and probability adverbs (22-e), as can be seen from the fact that all of the following sentences still convey that Mary's braveness follows from her being English:

(22)   a.   It is not the case that Mary is English and, therefore, brave. (*Negation*)

          b.   Is Maria English and, therefore, brave? (*Question*)

          c.   If Mary is English and, therefore, brave, she will act as such. (*Antecedent of a conditional*)

          d.   It might be that Maria is English and, therefore, brave. (*Possibility Modals*)

          e.   Presumably Mary is English and therefore brave. (*Evidential modal, probability adverb*)

Some speakers also hear a non-projective reading for *Negation* (22-a). On this projective reading, we are not simply denying that Mary is English. We are denying that her braveness follows from her being English. However, the claim that 'therefore' works as a presupposition trigger in (22-a) is compatible with (22-a) also having a non-projective reading. For example, consider (23):

(23)   The tarts were not stolen by the knave: there is no knave.

Clearly, the definite article in 'the knave' must have a non-projective reading in "The tarts were not stolen by the knave," for else (23) would have to be infelicitous. Presumably, whatever explains the non-projective reading in (23) can explain the non-projective reading in (22-a) (cf. [Abrusán, 2016]). The standard explanations for non-projective readings under negation are available here: maybe we are dealing with two different kinds of negation (metalinguistic negation *versus*

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[8]Cf. [Langendoen and Savin, 1971]; [Karttunen, 1973]; [Karttunen, 1974]; [Beaver, 2001].

negation *simpliciter* (cf. [Horn, 1972], [Horn, 1985]); or we might be dealing with an example of local accommodation (cf. [Heim, 1983]); or we might appeal to [Bochvar, 1939]'s A operator (cf. [Beaver, 1985], [Beaver and Krahmer, 2001]).

Hence, *Target Content* is projectable to the extent to which presuppositions are usually taken to be projectable. Moreover, *Target Content* satisfies the second standard set of tests for spotting presupposition triggers — i.e., the *not-at-issuedness* tests. Presuppositions cannot be directly challenged — i.e., for example, by using (24-c) in response to (24-a), one cannot directly challenge the content that somebody stole the tarts — i.e., (24-b):

(24) a. It is the knave who stole the tarts.
      b. Somebody stole the tarts.
      c. *That is not true/That is false![9]

'Therefore' and other argument connectives also satisfy this non-at-issuedness test. *Target Content* also cannot be directly challenged — i.e., (25-a) and (25-b) — in striking contrast to when it is instead made explicit — i.e., (25-c)-(25-d):

(25) a. Jill is English and, therefore, she is brave.
          *That is false/That is not true.
      b. Jill is English. Therefore, she is brave.
          *That is false/That is not true.
      c. Jill is English and from that it follows that she is brave.
          That is false/that is not true.
      d. Jill is English. It follows from that that she is brave.
          That is false/that is not true.
      e. Jill is English and, therefore, she is brave. Hey, wait a
          minute! Not all English people are brave!
      f. Jill is English. Therefore, she is brave. What? Not all
          English people are brave!

While the *Target Content* cannot be directly challenged, it can be *indirectly* challenged, by taking some distance from the utterance, as evidenced by (25-e) and (25-f), through locutions such as 'wait a minute' and 'what?'. Note that this phenomenon is not just observable for inferential uses of 'therefore'. The same pattern is observable for narrative uses of 'therefore' too:

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[9]Cf. Tonhauser.

(26) a. John was desperate for financial reasons. Therefore, he killed him-
          self.
      b. *That is false/*That is not true. He did not kill himself for financial
          reasons.
      c.   Wait a moment!!! He did not kill himself for financial reasons.
      d. What?? He did not kill himself for financial reasons.

That suggests that whether the relation expressed by 'therefore' is classical entailment (in inferential uses of 'therefore') or some restricted notion of entailment (as in narrative uses of 'therefore'), such relation is backgrounded in the way presuppositions are.

The final standard set of tests for presuppositions has to do with the contexts in which they are *cancelable*. Presuppositions are not cancelable when unembedded (e.g., (27-a)). Moreover, commitment to presuppositions cannot be retracted, on pain of Moorean paradoxicality (e.g., (27-b)):

(27) a. ??It is the knave who stole the tarts, but nobody stole the
          tarts.
      b. ??It is the knave who stole the tarts, but I do not believe/know
          that anybody stole the tarts.

In addition to this standard cancelability test, other tests for the retraction of presuppositions have been proposed in the recent literature. As [Pearson, 2010] notes, strong presuppositions' triggers cannot felicitously follow a report where the speaker retracts commitment to their presuppositions. For example, in (28-a) and (28-b), one cannot felicitously withdraw commitment to the proposition presupposed by the sentences "Jill stopped now" and "Mary knows that Jill smoked" — i.e., the proposition that Jill smoked:

(28) a. ??Well, I do not know if Jill ever smoked. But she stopped now.
      b. ??Well, I do not know if Jill ever smoked. But Mary knows that Jill
          smoked.

Finally, strong triggers' presuppositions cannot even be suspended, as observed by [Abrusán, 2016]:[10]

_____

[10]In (29-b), it is worth noting that the presupposition can be accommodated locally as in "I have no idea whether Jane ever rented Manhattan but perhaps she did and she is renting it again".

(29)   a. ??I have no idea whether John read the proposal. But if Bill read it too, let's ask them to confer and simply give us a yes/no response. ([Abusch, 2010])

    b. ??I have no idea whether Jane ever rented Manhattan, but perhaps she is renting it again.

    c. ??I have no idea whether my husband is cheating on me. But if I discover that he is, I am going to kill him.

Now, 'therefore' satisfies all of these tests for cancelability. *Target Content* also cannot be canceled when unembedded, on pain of Moorean paradoxicality:

(30)   a. ??Jill is English. Therefore, she is brave. But her braveness does not follow from her being English.

    b. ??Jill is English. Therefore, she is brave. But I do not believe/know that her being brave follows from her being English.

Moreover, 'therefore' satisfies both [Pearson, 2010]'s and [Abrusán, 2016]'s tests, as evidenced by the infelicity of (31-a), (31-b), and (31-c):

(31)   a. ??Well, I do not know if her braveness follow from her being English. But Mary is English. And therefore, she is brave.

    b. ??Well, I do not know if her being from the North follow from her being progressive. But Mary is from progressive. And therefore, she is from the North.

    c. ??I have no idea whether all English people are brave. But if Mary is English and therefore brave, she will act as such.

Does the fact that *Target Content* satisfy all these tests for presuppositions (*non-at-issuedness*, *projectability*, *cancelability*) tell against the conventional implicature analysis? The boundaries between conventional implicatures and presuppositions are notoriously hard to draw. And many supposed examples of conventional implicatures also satisfy many of the aforementioned tests. However, there are three additional considerations that suggest that the presuppositional analysis is more explanatory of the behavior of argument connectives.

[Potts, 2015] (p. 31) proposes we distinguish presuppositions and conventional implicatures on the basis of their pattern of projectability — the idea being that conventional implicatures project *even more massively* than presuppositions. For example, additive articles such as 'too' and 'also' project out of standard plugs such as attitude reports (cf. [Karttunen, 1973]). By contrast, as many have pointed

17

out to me, the presupposition associated with 'therefore' can be plugged by belief reports:

(32)   George believes that Mary is English and, therefore, brave. (*Belief operator*)

(32) can be used to ascribe to George the belief in the entailment from Mary's being English to her being brave. On this reading, *Target Content* does not project.

The second consideration in favor of the presuppositional analysis is that 'therefore' satisfies a test recently proposed by [Mandelkern, 2016] for telling apart presuppositions from conventional implicatures. [Mandelkern, 2016] takes the following property to be necessary of presuppositions (as opposed to conventional implicatures):

Lack of preservation in entailment-canceling environment (LPECE) A sentence s presupposes p only if s does not warrant an inference to p when s is in an entailment-canceling environment and when p is locally entailed, as in sentences like:

1. If p, then s.
2. Not p or s.

For example, the presupposition that Mary used to smoke projects in (33):

(33)   If Mary stopped smoking then she can come to the party.

But it does not project in the following examples, where the proposition that Mary used to smoke is locally entailed:

(34)   a.   If Mary used to smoke then she stopped smoking.
        b.   If Mary used to smoke and she stopped smoking then she can come to the party.

By contrast, the content of appositives such as 'who is fun' still projects even when the proposition that Mary is fun is locally entailed:

(35)   a.   If Mary is fun, then she'll, who is fun, come to the party.
        b.   If Mary is fun and Mary, who is fun, is in town, then she'll come to the party.

Hence, **(LPECE)** seems to be a good test for telling apart presuppositions from conventional implicatures.

Now, **(LPECE)** is satisfied by discourses featuring 'therefore' (cf. [Pavese, 2021] for discussion), suggests that we might be dealing with a real presupposition rather than a conventional implicature. For example, the following conditionals (36-a) and (36-b) do not entail *Target Content*:

(36)   a.   If being brave follows from being English, Mary is English and, therefore, brave.

        b.   If liking the Steelers follows from being from Pittsburgh, then Mary likes the Steelers and, therefore, she is from Pittsburgh.

5   'Therefore' as a Modal

Another important observation about the meaning of 'therefore' is that it closely resembles that of necessity modals. For example, (37) is very close in meaning to the modalized conditional (38).

(37)   A man saw a woman, therefore he noticed her.

(38)   If a man saw a woman, he (obviously/necessarily/must have) noticed her.

provided that we add to (38) the premise (39):

(39)   A man saw a woman.

Moreover, as we have seen in (11-a)–(11-e), 'therefore' comes in different flavors (logical, causal, practical, inductive, abductive). So in this respect too it resembles modals (cf. [Kratzer, 1977], [Kratzer et al., 2002]). On these bases, following Kratzer's analysis of modals, [Brasoveanu, 2007] proposes we understand different flavors of 'therefore' as resulting from a restriction of the corresponding 'modal base'. A modal base is a variable function from a world to a set of propositions, modeling the nature of the contextual assumptions — whether causal, practical, or epistemic. Its intersection returns the set of possible words in which all the propositions in the modal base are true. The logical consequence flavor of 'therefore' derives from an empty modal base, whose intersection is the universe. This formally captures the fact that logical consequence is the unrestricted flavor of 'therefore'.

While this approach captures both the similarity between 'therefore' and 'must'

and several possible flavors with which 'therefore' is used, [Kocurek and Pavese, 2021] argues that it is unclear that this approach resorting to modal bases can effectively model inductive and abductive uses of 'therefore', such as (11-a)-(11-b). Inductive arguments are notoriously non-monotonic. So for example, consider:

(40) a. The sun has risen every day in the past. Therefore, the sun will rise again tomorrow.
      b. The sun has risen every day in the past. And today is the end of the world. ??Therefore, the sun will rise again tomorrow.

If we apply the modal base approach to (40-a), we get that in any context where (40-a) is felicitious, (40-b) should be, too. For suppose in our current state s, when we update s with the premises in (40-a), each world in the resulting state s' is assigned by the modal base a set of propositions whose intersection supports the conclusion. Let s'' be the result of updating s with the premises in (40-b). Since every world in s'' is a world in s', when we apply the modal base to a world in s'', it also supports the conclusion. One way Brasoveanu's approach could be extended to model the non-monotonicity of inductive arguments could be by appeal to some context-shift. But it is difficult to see how the sort of context-shifts needed could be motivated.

This observation does not undermine the important similarity between 'therefore' and 'must' observed by [Brasoveanu, 2007], for 'must' seems to be amenable to inductive uses too, as in:

(41) All swans observed so far have been white. The next must be white too.

However, it does seem to suggest that a standard way of accounting for different flavors of modals that appeal to [Kratzer, 1977]'s modal bases might not provide a suitable analysis of their inductive and abductive uses.

6   Dynamic Treatments of Argument Connectives

So far, we have observed that argument connectives appear to behave as presupposition triggers and that they also resembles modals. Any semantic analysis ought to capture these two sets of data. [Pavese, 2017] suggests that dynamic semantics offers the tools to develop an analysis that meets this desiderata. [Kocurek and Pavese, 2021] improves on [Pavese, 2017]'s analysis and develops this proposal in some detail. Here I review some of the most important aspect of

these dynamic analyses.

In dynamic semantics, a test is an expression whose role is to check that the context satisfies certain constraints, as [Veltman, 1996]'s 'might' or [Von Fintel and Gillies, 2007]'s 'must'. These expressions check that the context supports their prejacent: so "It might be raining" checks that the context supports the sentence that it is raining. This of support is a crucial notion in dynamic semantics . Let $\llbracket p \rrbracket$ be the set of possible worlds where p. The relation of support between a context c and a sentence σ — which I will indicate by $c \vDash \sigma$ — can be defined inductively as follows:

Support   1. If σ has the form p, $c \vDash \sigma$ just in case, for all $w \in c$: $w \in \llbracket p \rrbracket$;

2. If σ has the form $\neg \phi$, $c \vDash \sigma$ just in case $c \nvDash \neg \sigma$;

3. If σ has the form $\phi \, \& \, \psi$, $c \vDash \sigma$ just in case $c \vDash \phi$ and $c \vDash \psi$.

A context c so conceived is said to *support* a sentence ψ ($\vDash$) just in case ψ is true at every world in c. In the simplest case, a context c augmented with ψ (= $c + \psi$) is just the intersection of c with the set of ψ-worlds — the worlds where ψ is true (= $c \cap \llbracket \psi \rrbracket$). Finally, say that ψ is true at c just in case $c \cap \llbracket \psi \rrbracket = c$.

Given these preliminaries, perhaps most paradigmatic example of a test is [9]Veltman's dynamic entry for 'might':

Dynamic Might $c[\text{might-}\phi] = \begin{cases} c & \text{if c}+\psi \neq \varnothing \\ \varnothing & \text{if c}+\psi = \varnothing \end{cases}$

Suppose you also endorse **Duality**:

Duality must-$\phi =_{def} \neg$ might $\neg$-ϕ.

As [Von Fintel and Gillies, 2007] (p. 54) point out, from **Dynamic Might** plus **Duality**, we get the following entry for dynamic 'must':

Dynamic Must $c[\text{must-}\phi] = \begin{cases} c & \text{if } c \vDash \phi \\ \varnothing & \text{if } c \nvDash \phi \end{cases}$

Dynamic Might and **Dynamic Must** are tests, for the sentences where it occurs "test" whether the context satisfies a certain constraint — that of entailing the sentence which 'must' embeds.

'Therefore' is similar to 'must': 'must' imposes that the context support a conclusion and 'therefore' imposes that the context *augmented with the premisses* entail the conclusion. Moreover, as [Brasoveanu, 2007] observes, it seems correct to assimilate 'therefore' and modals, as they both can receive different sorts of interpretations, depending on the modal base (epistemic, causal, narratives, practical, ect). The analogy with 'must' suggests the following natural semantic entry for 'therefore' (where Φ is a set of premises, and $c + \Phi$ is the intersection of c with every element in ϕ ($c{+}\Phi = c \cap [\![\phi_1]\!] \cap [\![\phi_2]\!] \cap \ldots [\![\phi_n]\!]$, for $\phi_1, \ldots, \phi_n$ in Φ):

On a dynamic treatment of presuppositions, it is natural to think of presuppositions as SPECIAL kinds of 'tests'.[11]

Dynamic Therefore $c[\Phi, \text{therefore-}\psi] = \begin{cases} c & \text{if c}{+}\Phi \vDash \psi \\ \varnothing & \text{if c}{+}\Phi \nvDash \psi \end{cases}$

Dynamic Therefore closely resembles [Veltman, 1985]'s conditional: the latter tests whether the context augmented with the antecedent supports the consequent; **Dynamic Therefore** tests whether the context augmented with the premises support the conclusion. Moreover, it allows to capture the similarities between necessity modals such as 'must' and 'necessarily', on one hand, and 'therefore' that we have observed in the previous section.

So much for the virtues of **Dynamic Therefore**. As it stands, however, it cannot account for an important difference between epistemic modals such as 'must' and [Veltman, 1985]'s conditional, on one hand, and argument connectives. Conditionals and 'must' are not plausibly presupposition trigger. Conditionals do not project out when embedded in antecedent:

(42)   If Jen gets angry if irritated, you should not mock her.

(42) does not presuppose that Jen will get angry follows from her being irritated. Similarly, 'must'-sentences, and in general sentences containing modals, do not need to presuppose that the context supports their prejacent. For example, the following is not infelicitous if it is not known in the context that Mary is in Holland:

(43)   If Mary must be in Holland, she cannot be in Paris.

Or consider:

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[11]Some theories of local context have been formulated within an explicitly dynamic framework ([Heim, 1983]; [Karttunen, 1974], [Rothschild, 2011]); others within an explicitly non-dynamic framework ([Schlenker, 2009], [Schlenker, 2010]).

(44)   a.   It is not the case that Mark is a progressive and must be from the North.
       b.   Is Mark a progressive and must be from the North?
       c.   If Mark is a progressive and must be from the North, he will not vote for Trump.
       d.   It might be that Mark is a progressive and must be from the North.

None of these convey that Mark's being from the North follows in any way from him being a progressive. So an analysis of 'must' and 'therefore' and [Veltman, 1985]'s conditional ought to be able to capture this contrast too.

'therefore' seems to differ from other tests such as conditionals and 'must', in that the checking is done by the presupposition triggered by 'therefore. 'Therefore'-discourses are infelicitous if the checking is not positive, like in the case of 'must'-sentences and [Veltman, 1985]'s conditional. But in the case of 'therefore', the infelicity is due to *presupposition failure*. Because of its behavior as a presupposition trigger, it is more accurate to give 'therefore' a semantic entry similar to the one that [Beaver, 2001] (p. 156-162) assigns to the presuppositional operator 'δ':

Dynamic δ $c[\delta\text{-}\phi] = \begin{cases} c & \text{if } c \vDash \phi \\ undefined & \text{if } c \nvDash \phi \end{cases}$

Compare **Dynamic Must** and **Dynamic** δ. They only differ in that the former returns the empty set if the context does not support ϕ, whereas the latter returns an undefined value. The difference between these two 'fail' values — undefinedness *versus* the empty set — is important. A semantic entry that returns the empty set receives a non-fail value — that of a tautology — under negation. But in order to account for the projection of the presupposition from a sentence containing 'therefore' to its negation, the negation of that sentence must also receive a fail value if the the sentence does. Choosing 'undefined', rather than the empty set, gives the desired result here — i.e., that the negation of the sentence containing 'therefore' will also be undefined.

A second respect in which discourses containing 'therefore' differ from [Veltman, 1985]'s conditional might be the following. [Veltman, 1985] conditionals return the initial context after the test. But intuitively, an argument updates the context with the premises. For example, an argument with assertoric premises P after the checking must return the context updated with P. To see why this must be so, consider:

(45)   Paolo is from Turin$_i$. Therefore$_i$ he is from Piedmont$_j$. And, therefore$_j$ he is from Italy.

If in (45), 'therefore$_i$ he is from Piedmont$_j$ ' returned the context antecedent to the update with 'Paolo is in Turin$_i$', the output context might not support the proposition that Paolo is from Italy. So we cannot explain why (45) is a good argument.

Suppose we take the "therefore" in discourse "P, therefore Q" be simply a binary connective (as we will see in the next section, this is oversimplified). Then "therefore" both updates the context with P and then tests whether the resulting context supports the conclusion Q. Alternatively, and perhaps more accurately, we might decompose the contribution of "therefore" into two components:

1. an anaphoric component, corresponding to the anaphora "there", that picks up the context updated with the premise Φ;

2. and the 'test' component, corresponding to "fore," that does the checking.

Then the resulting dynamic entry for 'therefore' is:

Dynamic Therefore* $c[\Phi, \text{therefore-}\psi] = \begin{cases} c[\Phi] & \text{if } c + \Phi \vDash \psi \\ undefined & \text{if } c + \Phi \nvDash \psi \end{cases}$

7   Refining the Analysis: Supposition, Parenthetical, and Subarguments

[Pavese, 2017] treats 'therefore' as a binary connective, taking premises and a conclusion into an argument (cf. also [Pavese, 2021]). While this analysis might a good starting point, it is oversimplified in several ways. One way in which it is oversimplified is that it says nothing about how to model arguments that have not premises but other arguments as antecedents, such as:

(46)   Suppose Paolo is from Turin, Then he is from Piedmont. Therefore, if Paolo is from Turin he is from Piedmont.

Moreover, argumentative discourses seem to have a layered structure: suppositions introduce new states of information, at a different level from categorical states of information, and suppositions can be embed to add further levels. For example, consider:

(47)   Paolo is either from Turin or from Madrid. Suppose$_1$, on the one hand, that he is from Turin. Then$_1$ either he did his PhD there or he did it in the US. Suppose$_{1.1}$ he did his PhD in Turin. Then$_{1.1}$, he studied Umberto Eco's work. Suppose$_{1.2}$ instead he did his PhD in the US. Then$_{1.2}$ he studied linguistics. Therefore$_1$, he either did continental philosophy or philosophy of language. Now on the other hand, suppose$_2$ he is from Madrid. Then$_2$ he definitely did his PhD in the US. Therefore$_2$, he studied linguistics. Either way, therefore, he did either continental philosophy or philosophy of language.

As the indexes indicate, in (47), supposition$_1$ introduces a new layer, over and above the categorical context where 'Paolo is either from Turin or from Madrid'. Moreover, suppositions can be embed one after the other (as supposition 1 and supposition 1.1) or might be independent (as supposition 1 and supposition 2). 'therefore' and 'then' might test the context introduced by the most recent premises or suppositions (as 'then$_2$' and 'therefore$_2$') or refer back to suppositions introduced earlier (as 'therefore$_1$'. Finally, after a supposition, parentheticals can be used to add information to the categorical level and to every level above. For example, consider:

(48)   Suppose Mary went to the grocery store this morning. [Have you been? It's a great store with great fruit.] She bought some fruit. Therefore, she can make a fruit salad.

To model the discourse in (48), we need to be able to exit the suppositional context, update the categorical context, and then return back to that suppositional context. In (48), however, the information added by the parenthetical to the categorical content seems to percolate up to the suppositional context too. Ideally, a theory of argumentative discourse ought to be able to account for these complexities. It seems that in order to model discourses such as (48), we need to refine [Pavese, 2017]'s analysis in some important ways.

[Kocurek and Pavese, 2021] proposes we can model these data by adding structure both to the syntax of discourses as well as to the contexts used to interpret them. In order to capture the syntax of argumentative discourses such as the above, they propose we take discourses not just sequences of sentences but rather as sequences of *labeled sentences*. A labeled sentence is a pair of the form $\langle n, \phi \rangle$, which we write as $n \colon \phi$ for short (Throughout, we use $\varnothing$ to stand for the empty tuple $\langle \rangle$). So parts of discourses are labeled sentences. Here, n is a label, which is a sequence of numbers (where, for shorthand, we write $\langle n_1, \ldots, n_k \rangle$ as

$n_1.n_2.\ldots.n_k)$ that represents which suppositions are active, and ϕ is a sentence. Labels enable to keep track of which suppositions are active when and to model the function of parentheticals of going back to the categorical contexts. So for example, the following is a representation of (48) with labeled sentences (where m = 'Mary went to the grocery this morning'; g = 'Have you been? It's a great store with great fruit'; b = 'She bought some fruit'; f = 'She can make a fruit salad').

$$1\colon m, \quad \varnothing\colon g, \quad 1\colon b, \quad 1\colon \therefore f$$

The second move is to distinguish between the meaning of a sentence and the meaning of a part of a discourse — or labeled sentence. The meaning of a sentence is simply its update effect on information states — i.e., a function from information states to information states. Define an INFORMATION STATE as a set $s \subseteq W$ of worlds. We define the update effect of a sentence on an information state recursively:

$$
\begin{aligned}
s[p] &= \{w \in s \mid w(p) = 1\} \\
s[\neg\phi] &= s - s[\phi] \\
s[\phi \wedge \psi] &= s[\phi][\psi] \\
s[\phi \vee \psi] &= s[\phi] \cup s[\psi] \\
s[\Box\phi] &= \{w \in s \mid s[\phi] = s\} \\
s[\Diamond\phi] &= \{w \in s \mid s[\phi] \neq \varnothing\} \\
s[\therefore \phi] &= \begin{cases} s & \text{if } s[\phi] = s \\ \text{undefined} & \text{otherwise} \end{cases}
\end{aligned}
$$

This analysis can be illustrated with the following example. Consider:

(49)   It's not the case that Mark is progressive and, therefore, from the North.

$$\neg(p \wedge \therefore n)$$

Compositionally, we get that the meaning of (49) is the following function:

26

$$s[\neg(p \wedge \therefore n)] = s - s[p \wedge \therefore n]$$
$$= s - s[p][\therefore n]$$
$$= \begin{cases} s - s[p] & \text{if } s[p][n] = s[p] \\ \text{undefined} & \text{otherwise} \end{cases}$$

This semantics for argument connectives would suffice if argumentative discourse did not have the layered structure we have seen it does have and if argument connectives did not license different anaphoric relations towards their antecedents. This further information is captured by parts of discourses or labeled sentences. So, in order to capture suppositional reasoning as well as these anaphoric relations, we ought to interpret labeled sentences as well. While the meaning of sentences is a function from information states to information states, the meaning of parts of discourses is its update effects on a context. Instead of modeling contexts as information states, [Kocurek and Pavese, 2021] model contexts rather as *labelled trees* — i.e., a tree where each node is an information state which is given its own label. Labelled trees contain much more structure than simple information states or even stacks of information states of the sort proposed by [Kaufmann, 2000] to model suppositional reasoning. Labelled trees differs from stacks of information states in that (1) they allow non-linear branching, so that independent suppositions can be modeled at the same "level" as well as at different levels and (2) can model anaphoric relations, which will allow us to temporarily exit a suppositional context and later to return to that context. This also allows us to capture the distinctive ability of 'therefore' to be anaphoric on different suppositional contexts. A CONTEXT is a partial function $c \colon \mathbb{N}^{<\omega} \to \wp W$ from labels (i.e., sequences of numbers) to information states, where:

- $\varnothing \in \text{dom}(c)$ (i.e., the categorical state is always defined);

- if $\langle n_1, \ldots, n_{k+1} \rangle \in \text{dom}(c)$, then $\langle n_1, \ldots, n_k \rangle \in \text{dom}(c)$ (i.e., a subsuppositional state is defined only when its parent suppositional state is defined).

The value of a context applied to the empty sequence is the CATEGORICAL STATE, denoted by $c_\varnothing$. The value of a context applied to a non-empty sequence is a SUPPOSITIONAL STATE. So for example, $n \colon \phi$ will tell us to update c_n with ϕ. However, when we introduce a new supposition in a discourse, we don't simply update the current information state with that supposition (suppositions are

not just assertions). Rather, we *create* a new information state updated with that supposition so that subsequent updates concern this new state as opposed to (say) the categorical state ([Starr, 2014b], [Starr, 2014]). The new supposition effectively copies the information state of its parent and then updates that state with the supposition.

Formalizing, where $n = \langle n_1, \ldots, n_{k+1} \rangle$ is a label, let $n^- = \langle n_1, \ldots, n_k \rangle$ ($\varnothing^-$ is undefined). This will allow us to keep track of which information state gets copied when a new supposition is introduced. For labels n and k, we write $n \sqsubseteq k$ just in case n is an initial segment of k and $n \sqsubset k$ just in case n is a proper initial segment of k (i.e., k is "above" n in the labeled tree). Where c is a context, let $c \uparrow_n \phi$ be the result of replacing c_k with $c_k[\phi]$ for each $k \in \text{dom}(c)$ such that $k \sqsupseteq n$ (i.e., $c \uparrow_n \phi$ updates c_n and all information states "above" c_n in the tree with ϕ). Finally, where s is an information state, let $c[n \mapsto s]$ be just like c except that $c_n = s$:

$$c[n\colon \phi] = \begin{cases} c \uparrow_n \phi & \text{if } c_n \text{ is defined} \\ c[n \mapsto c_{n^-}[\phi]] & \text{if } c_n \text{ is not defined but } c_{n^-} \text{ is defined} \\ \text{undefined} & \text{otherwise} \end{cases}$$

Unpacking this semantic clause: If c_n is defined, we update c_n and all subsequent states above it with ϕ. If $n = \varnothing$ (the categorical state), then every state that's currently defined is updated with ϕ. If $n = \langle n_1, \ldots, n_k \rangle$, then we only update states assigned to a label that starts with $n_1, \ldots, n_k$. If c_n is undefined, that means we're creating a new suppositional state:

- First, find the state whose label is right below n (so, e.g., if $n = \langle 1 \rangle$, then the label right below n is $\langle \rangle$, i.e., the label of the categorical state).

- Next, copy the state with that label and assign n to that state. Finally, update that copied state with ϕ.

This semantics for parts of discourses can be illustrated by considering two examples. Under a plausible interpretation, the following discourse is represented as the following sequence of labeled sentences:

(50)   Either it is raining or not. Suppose it's raining. Then better to take the umbrella. Suppose it is not raining. Then, taking the umbrella will do no harm. Therefore, you should take the umbrella.

28

$$\varnothing\colon (r \vee \neg r), \quad 1\colon r, \quad 1\colon \therefore u, \quad 2\colon \neg r, \quad 2\colon \therefore u, \quad \varnothing\colon \therefore u$$

The dynamics of this discourse can be summarized as follows: First, we update the categorical state s with the trivial disjunction $r \vee \neg r$ (so no change). Next, $1\colon r$ requires setting $c_1 = s[r]$. Then $1\colon \therefore u$ tests $s[r][u] = s[r]$. If it passes, it returns $s[r]$ as c_1. Otherwise, the context is undefined. Assuming $s[r]$ passes the test, $2\colon \neg r$ requires defining a new information state $c_2 = s[\neg r]$. Then $2\colon \therefore u$ tests $s[\neg r][u] = s[\neg r]$. If it passes, it returns $s[\neg r]$ as c_2. Otherwise, the context is undefined. Assuming $s[\neg r]$ passes the test, $\therefore u$ tests $s[u] = s$. Since $s[r]$ and $s[\neg r]$ have passed this test, s will, too. Or consider the following example with a parenthetical:

(51)   Suppose Mary went to the grocery store this morning. [Have you been? It's a great store.] Then she bought some fruit. Therefore, she can make a fruit salad.

This is represented as:

$$1\colon m, \quad \varnothing\colon g, \quad 1\colon \therefore b, \quad 1\colon \therefore f$$

First, we introduce a suppositional context c_1 by copying s and updating it with $s[m]$. Next, $\varnothing\colon g$ updates both the categorical context s and the suppositional context $s[m]$ with g. Then $1\colon \therefore b$ tests $s[m][g][b] = s[m][g]$. If it passes, it returns $s[m][g]$ as c_1. Otherwise, the context crashes. Likewise for $1\colon \therefore f$.

8   Further Issues

In conclusion, a dynamic treatment of argument connectives as the one sketched in the last section promises to capture their presuppositional behaviors as well as their analogies with modals. It also has the resources to account for the variety of discourse constructions where argument connectives can occur. It can capture complex arguments such as argument by conditional proof, reductio and arguments by cases and in general suppositional arguments. Let me conclude this discussion of the semantics of arguments by looking at some further open issues.

Consequences of the presuppositional analysis   The dynamic analysis of argument connectives presented in the previous two sections takes argument connectives to be 'presuppositional' tests. On this analysis, a categorical argument

is a matter of first asserting the premises and then drawing a conclusion from the premises, by presupposing that the conclusion follows from the premises. It might therefore seem as if arguments can never be informative. However, this conclusion is not correct, for presuppositions *can* be informative. Suppose it is not known in the context that Pittsburgh is in Pennsylvania. The presupposition triggered by (52) is most likely to be accommodated in this context and this accommodation will result in restricting the context set, by ruling out possibilities where Pittsburgh is located in a state other than Pennsylvania:

(52)   John is in Pittsburgh. Therefore, John is in Pennsylvania.

Hence, although the presupposition associated with 'therefore' generally works as a test checking that the context satisfies certain constraints, just like other kinds of presuppositions, it can sometimes be informative (cf. [Pavese, 2021] for discussion of these issues and how they relate to the problem of deduction).

Classical versus relevantist validity   Arguments such as (52) sound weird to common speakers and so do arguments such as the following:

(53)   a.   Paris is in France. Therefore, either it is raining in Ecuador now or it is not.
         b.   Paris is in France. Therefore, if today is Wednesday then today is Wednesday.
         c.   Paris is in France. Therefore, if today is Wednesday, then Paris is in France.

Because they are all classically valid, and also sound, the current semantics cannot predict their infelicity. One might blame it on the pragmatics and allege that their weirdness has to do with their conclusions not being relevant to the premises. An alternative thought is, nonetheless, worth exploring. Notoriously, the weirdness of these patterns of inferences has motivated relevance logic ([MacColl, 1908]; [Belnap, 1960]; [Anderson et al., 2017]). Argument connectives might test for relevantist, rather than classical, support.

Non-declarative conclusions   As we have seen in §2, arguments can have non-declarative conclusions too. These kinds of arguments suggest that drawing a conclusion from certain premises can be a matter of checking that the context supports the conclusion even if the conclusion is not declarative. It might be helpful

to draw again a comparison with epistemic modals like 'must' and 'might'. Although not every use of these epistemic modals in the scope of questions is always felicitous (cfr. [Dorr and Hawthorne, 2013]), many have observed that some uses of these modals are acceptable in questions. For example, [Papafragou, 2006], p. 1692 observes that the following exchange is felicitous:

(54)   a.   If it might rain tomorrow, people should take their umbrella.
        b.   But may it rain tomorrow?

Along similar lines, [Hacquard and Wellwood, 2012], p. 7 observe that the following interrogatives also have a distinctively epistemic interpretation:

(55)   a.   With the owners and the players on opposite sides philosophically and economically, what might they talk about at the next bargaining session?
        b.   Might he be blackballed by all institutions of higher learning?

In this respect, then, 'therefore,' 'hence,' and 'so' resemble standard tests. There is an important difference between 'must' and 'might', on one hand, and 'therefore', 'hence', 'so', on the other. As we have seen, argument connectives can also tolerate imperative conclusions, whereas neither 'might' nor 'must' can occur in imperatives (although the reason for this infelicity might be syntactic):

(56)   a. ??Might go to the store![12]
        b. ??Must go to the store![13]

[Kocurek and Pavese, 2021] shows how to model these uses of 'therefore' with non-declarative conclusions. Start with arguments with imperative conclusions, as in "Ψ; therefore, ϕ!". Here, 'therefore' might be understood as testing that a context augmented with the premises in Ψ supports ϕ!. What support of an imperative amounts to depends on one's semantics of imperatives. On a propositionalist semantics of imperatives (e.g., [Lewis, 1976], [Aloni, 2007], [Schwager, 2006]), we might model 'therefore' as checking that the context augmented with the premises entail that the imperative "go to the store!" should be fulfilled. If this condition is equivalent to $\Box\phi$, then we might define support of an imperative by a context

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[12]As Julien Schlöder pointed out to me, "Maybe go to the store" is instead perfectly fine. See [Incurvati and Schlöder, 2019] for a helpful discussion of the differences between 'might', on one hand, and 'maybe' and 'perhaps' on the other.

[13]This sentence does have an acceptable reading, on which 'must' receives a deontic interpretation.

as equivalent to the context supporting $\Box\phi$. On an expressivist semantics, like [Portner, 2007b] or [Starr, 2020]'s preference semantics for imperatives, context ought to be modeled as involving a set of preferences and testing for support of an imperative amounts to testing that the preferences expressed by the imperatives are already in the context. Finally, consider how to model uses of 'therefore' that embed interrogatives, such as (10). [Kocurek and Pavese, 2021] propose we piggyback on recent dynamic theories, which take the change effect potential of interrogatives to be that of raising issues. Following [Groenendijk et al., 2003] and [Aloni and Van Rooy, 2002], we can model this idea by thinking of a information state, not as a set of possible worlds, but rather as a partition on possible worlds — i.e., as a set of mutually disjoint but jointly exhaustive sets, or *cells*. An interrogative might refine the partition by dividing current cells into smaller subsets. Finally, when we use 'therefore' with an interrogative $?\phi$, all we do is to test that the issue raised by $?\phi$ is already represented in the current partition. So effectively, when using 'therefore' with an interrogative conclusions, we are testing that adding $?\phi$ would not further refine the partition.

9   The Pragmatics of Arguments

So much for the semantics of arguments. Onto the pragmatics. How are we to model the speech act of giving an argument? To begin, compare the following two discourses:

(57)   a.   It is raining. I conclude that the streets are wet.
       b.   It is raining. Therefore, the streets are wet.

Prima facie, these two discourses are equivalent. The locution "I conclude that..." seems to mark the speech act of concluding. It is tempting, then, to assimilate the meaning of 'therefore' to the meaning of 'I conclude that...".[14] On this analysis, it is tempting to take argument connectives such as 'therefore' to work as *speech act modifiers*. A speech act modifier is an expression in the language whose function is to modify the speech act that a sentence type is typically associated with. For example, some suggest that expressions such as hedges that take assertions, or declarative sentences, and return a speech act different from that of assertions. It is at least initially tempting to treat argument connectives as speech act modifiers

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[14]On several differences between 'therefore' and 'I conclude that...", see [Kocurek and Pavese, 2021].

— ones taking pairs of sentence type, into a distinctive kind of speech act — i.e., the speech act of giving an argument for a certain conclusion.[15]

This analysis, though tempting, should be resisted. Perhaps surprisingly, argument connectives are not always used to make arguments. Consider again (58-a)-(58-d) from §2:

(58)   a.   John pushed Max. Therefore, Max fell.
           b.   John was desperate for financial reasons. Therefore, he killed himself.
           c.   Mary qualified for the exam. Therefore, she enrolled.
           d.   Max passed his A-levels. Therefore he could go to the university.

Superficially, these discourses have the *same form* of an argument. And yet they don't need to be used to make an argument. For example, one may utter, say, (58-a) without arguing for the conclusion that Max fell. In fact, the most common use of (58-a) is simply to explain what happened when John pushed Max (suppose (58-a) is used in the process of reporting what happened yesterday). In this use, the discourse does not have argumentative force. Rather, this discourse uses 'therefore' *narratively* or *explanatorily*. Similarly for (58-b).

Arguments and explanations are different kinds of speech acts. That can be seen simply by observing that while an explanation might presuppose the truth of its explanandum, an argument cannot presuppose the truth of its conclusion, on pain of being question-begging. So, one might think that the causal uses are explanatory, whereas the logical uses argumentative. However, this cannot be correct, as there are causal and *yet* argumentative uses of 'therefore'. For example, consider **TRIAL**:

TRIAL In a trial where John is accused of murdering his wife, the prosecutor argues for his conviction, as follows:

    (59)   John was financially desperate, ruthless, and knew about her wife's savings. Therefore, he killed her wife to get her money.

The discourse (59) in **TRIAL** can undeniably be used in an argument — for example, an argument aiming to convince the jury of the fact that John has killed

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[15]For example, some take epistemic modals such as "might" to be speech act modifiers in that they 'modulate' assertoric force. See for example, [Westmoreland, 1998] and [Yalcin, 2005, 251], Others argue that intonation is a speech act modifier. See [Heim et al., 2016].

her wife. And yet the relation expressed by this use of 'therefore' is causal, if anything is. This suggests that argumentative/inferential uses of 'therefore' that can nonetheless be causal. Hence, there are causal uses of argument connectives that have argumentative force. There are also deductive uses of 'therefore' in *explanations* as the following ([Hempel, 1962], [Railton, 1978]):

1 Whenever knees impact tables on which an inkwell sits and further conditions K are met (where K specifies that the impact is sufficiently forceful, etc.), the inkwell will tip over. (Reference to K is necessary since the impact of knees on table with inkwells does not always result in tipping.)

2 My knee impacted a table on which an inkwell sits and further conditions K are met.

Explanandum Therefore, the inkwell tipped over.

In this explanation of why the inkwell tipped over, that the inkwell tipped over deductively follows from the premises. Hence there are logical uses of 'therefore' in explanations too. Hence, the dichotomy posited by this analysis between argumentative uses of 'therefore' and explanatory uses of 'therefore' is unwarranted. So the distinction between argumentative uses of 'therefore' and explanatory uses of 'therefore' cuts across the distinction between causal and logical meaning of 'therefore'.

How are we to capture this distinction between argumentative uses of 'therefore' and explanatory uses of 'therefore'? This distinction might have to be captured not at the level of the semantics of arguments but rather at the level of the pragmatics of arguments. [Chierchia and McConnell-Ginet, 2000] have introduced an important distinction then defended and elaborated by [Murray and Starr, 2018a] and [Murray and Starr, 2018b] between CONVENTIONAL, FORCE and UTTERANCE FORCE. The **conventional force** of a sentence type consists in the distinctive ways different sentence types are used to change the context — e.g., declaratives are used to change the common ground, by adding a proposition to the common ground ([Stalnaker, 1978]); interrogatives affect the questions under discussion (e.g., [Groenendijk and Stokhof, 1982b], [Roberts, 1996]) and imperatives the to do list (e.g., [Portner, 2004], [Portner, 2007a], [Starr, 2019], [Roberts, 1996]). This aspect of the force of a speech act — the way in which it affects the context — can be associated with the force that a sentence type has. **Utterance force**, by contrast, consists in the distinctive ways *utterance types* change the context. This is is the *total force* of an utterance, while the conventional

force is the way a sentence's semantics constrains utterance force. Crucially, as [Murray and Starr, 2018b] argues, conventional force underdetermines utterance force. For example, assertions are conventionally associated with declarative sentences. However, declarative sentences can also be used to make conjectures, lies, to pretend, etc. In the sense the conventional force of declarative underdetermines their utterance force. On this analysis, while the conventional force of a speech act is conventionalized and can be modeled by looking at its conversational effects, the utterance force of a speech act is undetermined by its conventional force and varies depending on the effects of the speech act on the private mental states of the participants to the conversations as well as on the mental state of the utterer. So while conventional force has a conversational effect, that conversational effect underdetermines utterance force, that can be modeled fully by looking at its private causes and effects.

Suppose we export a version of this distinction between conventional force and utterance force to the case of argument connectives and discourses that feature them. The proposal is that across all of its uses — causal, explanatory, all sorts of argumentative uses — argument connectives have the same conventional force. As we have seen, following [Pavese, 2017], [Kocurek and Pavese, 2021], the core meaning might be dynamic across the board: all uses of 'therefore' express that the premises in the context (logically, causally, nomologically, probabilistically) support the conclusion. This relation of support is expressed through a test and this test is modeled as a presupposition. Moreover, addition to argument connectives' having this dynamic meaning, uses of discourses with argument connectives come with an utterance force. Their utterance force is underdetermined by the conventional force of argument connectives. So the same conventional force can be used to make an argument or an explanation. If that is correct, then the distinctive force of arguing versus explaining can be found at the level of argument connectives' utterance force.

To conclude: at the outset, I proposed we make progress on the question of how to model the speech act of giving an argument by looking at the semantics of argument connectives, with the hope that a semantic analysis for argument connectives could cast light on the speech act of giving an argument. However, this project is complicated by the fact that there are such things as *non-argumentative uses* of argument connectives. In this section, I argued that while the meaning of 'therefore' is unified across its uses — causal, logical, practical, inductive — the difference between argumentative uses and explanatory uses of 'therefore' might be located in the realm of pragmatics and in particular at the level of utterance force.

10 Conclusions

This chapter has overviewed recent studies on the semantics and pragmatics of arguments. From this discussion several issues emerge for further research. These include: How are we to think of the syntax of argumentative discourses and how are we to model contexts in order to model the dynamics of argumentative discourses? What consequences does the presuppositional nature of 'therefore' have on how to think of arguments? What is the nature of the support relation tested by argument connectives? What makes a discourse an argument, rather than an explanation? At which level of linguistic analysis lies the difference between arguments and explanations? How are we to characterize the utterance force distinctive of arguments? Although many issues pertaining the semantics and pragmatics of argumentation are left open for further research, I hope to have made a plausible case that they deserve attention for foundational questions concerning the nature of context and discourse, as well as their dynamics, turn on them.

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