"How" Questions and the Manner-Method Distinction

Abstract *How* questions are understudied in philosophy and linguistics. They can be answered in very different ways, some of which are poorly understood. Jaworski (2009) identifies several types: (i) 'manner', (ii) 'method, means or mechanism', (iii) 'cognitive resolution', and develops a logic designed to enable us to distinguish among them. Some key questions remain open, however, in particular, whether these distinctions derive from an ambiguity in *how*, from differences in the logical structure of the question or from contextual under-specification. Arguing from two classes of responses, adverbs and *by* gerunds, I give the answer that the logical structure of the question is indeed relevant: loosely, manners are adjuncts but methods are arguments.

1 Introduction: manners and methods

How questions and their answers are greatly understudied. In fact, although the meaning of questions has been a central concern in semantics for decades, with Hamblin (1973), Karttunen (1977) and Groenendijk and Stokhof (1984) as cornerstones, the attention *how* questions have received has mainly been from philosophers, most of whom, from Ryle (1946) to Stanley (2011), have, in turn, focused on the debate about Knowing How versus Knowing That.

The reason there is so little literature on *how* questions is not that they are trivial or that what is known about, say, *who* carries over to *how* without major changes; on the contrary, *how* questions seem to bring complications of their own and to defy easy solutions. For one thing, they can be answered in widely different ways, secondly, core classes of responses, like *by* gerunds, are not well understood. Accordingly, what type of entities *how* ranges over

is not immediately evident. However, both Dong (2009) and Stanley (2011) propose that it is the type of **properties of events**, and I will use this as a working hypothesis: *how* ranges over functions from points of evaluation to sets of events. Following Davidson (1967) and in line with the bulk of work on events in semantics, I take events to be a distinct sort of primitive entities, on a par with individuals, acting as additional arguments of verbs; properties of events are then what ordinary verb phrases express (see Moltmann (2003) for a discussion of this and alternative conceptions of events).

The hypothesis that *how* ranges over properties of events faces challenges from several sides. One challenge has recently been highlighted by Jaworski (2009): although a *how* question can in principle be answered with a manner adverb phrase like *very carefully*, such a response can be inappropriate, and a clash between expected and observed type of response can create a comic effect:[1]

(1)   – Headquarters, there's a high yield explosive timed to detonate
          in four minutes! How do we disarm it?
        – Very carefully!   [Jaworski 2009: 134]

Evidently, some *how* questions are not meant to be answered with adverbs; for the comic effect to occur, though, it would seem to be essential that they could also be answered with adverbs. (1) thus shows a tension between the intended interpretation and the interpretation taken by the respondent.

According to Jaworski, the asker in (1) asks a *how* question of **method**, whereas the answerer answers a *how* question of **manner**. He distinguishes three types: (i) *how* questions of manner, (ii) 'analytic' *how* questions about means, method, or mechanism, (iii) *how* questions of 'cognitive resolution'. The first type, (i), request a more determinate description of a determinable predicate, the second, (ii), ask for a description of steps contributing to the accomplishment of some activity or procedure, and the third, (iii), request information to relieve a cognitive tension arising from an apparent inconsistency.

I will mainly be concerned with the contrast between (i) and (ii), which I take to be more substantial and more tangible than, on the one hand, that between these two and (iii) and, on the other, the subtler distinctions within (ii). For simplicity, though, I will collapse the three terms 'means', 'method' and 'mechanism' and use 'method' to represent the 'analytic' type.

My aim is to clarify what the manner/method distinction derives from. Informally, (1) attests to an ambiguity of sorts; but whether this is actually an ambiguity in semantic terms, be it a lexical ambiguity in the word *how* or a structural ambiguity in the question, or a case of contextually resolved underspecification, is a wide-open issue. Jaworski (2009) provides a logic for *how* questions, based on the question logic of Belnap and Steel (1976), where

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[1] The example is easily replicated:

(i)   – How do hedgehogs make love?
        – Very, very carefully!   [http://jokes4us.com/animaljokes/hedgehogjokes.html]

the types are differentiated in terms of the notions of 'determinacy scheme' versus 'analysis scheme'. If (2) specifies a determinacy scheme, (2a) answers it; if it specifies a method or means scheme, (2b) or (2c) is an answer.

(2)   – How did Judith kill Holofernes?   [Jaworski 2009: 134]
        a.   – With a mixture of revulsion and determination.
        b.   – With a mixture of seduction and cunning.
        c.   – With a mixture of bile and snake venom.

Since this theory is not embedded in a standard semantic theory, however, it is difficult to assess what follows from it in regard to the general question about ambiguity formulated above, or generally what it would correspond to in a truth-conditional, compositional semantics. My aim is thus twofold: to explain the manner/method distinction and thereby to anchor Jaworski's determinates/analyses distinction in a standard semantic framework.

I will pursue this aim by arguing for the following claim, based on the above hypothesis that *how* consistently ranges over properties of events:

– In one kind of *how* question (the 'manner' kind), the predicate denotes a set of events, and when it is combined with *how*, the result denotes the **intersection** between this set and the extension of *how*; in another kind (the 'method' kind), the predicate denotes a function from properties of events to sets of events, and when it is combined with *how*, the result denotes the **application** of this function to the intension of *how*.[2]

In other words: in the 'manner' kind of question, *how* is an **adjunct**, but in the 'method' kind of question, *how* is an **argument**. Adjuncts do not alter the logical form of their sister constituents, so they can be iterated and they are usually not syntactically necessary; arguments, which saturate functions, do alter the logical form of their sister constituents, so they cannot be iterated and they are usually syntactically necessary. I will argue for the above claim from the characteristic responses to the one and the other kind of question, and from the predicate types that those responses typically combine with.

In many cases, like (1) or (2), the question can evidently be interpreted as of one kind although the predicate would predispose it to be of the other. What happens then, I will argue, is either

(i)   that a predicate of the type predictive of a manner reading undergoes type-shifting to a predicate of the higher type, or

(ii) that a predicate of the type predictive of a method reading is first applied to a covert existential quantifier, thus in effect attaining the lower type.

The ambivalence shown by (1) and (2) thus emerges as a semantic ambiguity, more particularly, not a lexical ambiguity in *how* but a structural ambiguity: *disarm it* and *kill Holofernes* are basically of the type that operate on event properties, but if they are applied to (the trace of) an existential quantifier, what (the trace of) *how* is eventually combined with denotes a set of events.

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[2] To be exact, what the predicate is combined with is the trace of *how*; cf. section 4.

The rest of the paper is structured as follows. In the next section, I survey the ways in which *how* questions can be answered and describe correlations between partial versus complete answers and two core categories of response. In section 3, I discuss the types of predicates that these two categories combine with, and in section 4, I argue from there to a manner-adjunct/method-argument distinction in *how* questions. Section 5 brings conclusions.

2 How *how* questions are answered

There is a pretheoretic notion, manifest in grammars and textbooks, that *how* corresponds to adverbs. But in reality, *how* questions are answered in a number of different ways, and adverbs are not particularly frequent. In this section, I give an overview of the main modes of response, focusing especially on two, adverbs and *by* gerunds. I further show that these two are correlated with differences in regard to the notion of a complete answer.

2.1 The range of responses

How questions can be answered in a variety of ways. By syntactic criteria, six categories can be distinguished: adjectives, adverbs, prepositional phrases (PPs), *by* gerunds, sentences, and texts:

(3)   – How is the road? – Bumpy, but safe enough.

(4)   – How did she speak? – Clearly and confidently.

(5)   – How did she speak? – With a broad Welsh accent.

(6)   – How did King John anger his barons?
        – By raising taxes and banning jury trials.

(7)   – How did you get here?
        – I rowed from the other side of the island.

(8)   – How did you start in music?

– I was raised in a small town, Brookfield, Illinois, which was absolutely devoid of music, dance or theater. Movies were my culture. At age 10 I saw drummer Ray Bauduc in a movie play *Big Noise from Winnetka* with bassist Bob Haggart and I was mesmerized. I hounded my father for a drum, and when I got it I immediately played the rhythms I heard Bauduc play in that movie. I soon formed my own band, 3 Jacks and a Jill, and started my career as a self-employed musician. I traveled into Chicago to hear the big bands and imitated every drummer I heard. Jazz was my only ambition up to age 19.

The responses in (3)–(6) are 'short responses', which when substituted for *how* turn the questions into 'propositional responses', as in (9).

(9)   – How did King John sign the Magna Carta?
        – He signed the Magna Carta by attaching his royal seal to it.

The responses in (7) and (8), while expressing propositions, are not in this sense propositional responses. For (7), such a response could be formed by rephrasing the sentence as a *by* gerund, but for (8) this is not an option.

In the following, I will focus especially on cases like (4) and (6) (returning to responses in the form of PPs, sentences or texts in section 4.2).

2.2 Partial versus complete answers

A response to a *how* question often does not provide an exhaustive answer; in terms of the theory of Groenendijk and Stokhof (1984), if it provides a semantic answer at all, it is in many cases not a **complete** answer, eliminating all but one cell in the partition of Logical Space induced by the question, but only a **partial** answer, eliminating some cell. Indeed, it can be unclear how to give a complete answer to a *how* question.

By comparison, note that it is mostly clear how to give a complete answer to a *who* question: with a referential term or a list of such terms. To be sure, it is possible to give only a partial answer to a *who* question as well; cf. (10a), which leaves it open who Elizabeth Taylor may have been married to beside Richard Burton. But (10b) leaves nothing open.

(10)   – Who was Elizabeth Taylor married to?

       a.   – Let me think. Well, Richard Burton, for one.
       b.   – Richard Burton, Eddie Fisher, Mike Todd, Conrad Hilton Jr., John Warner, Michael Wilding, Larry Fortensky, and nobody else.

By contrast, it is difficult to see how the following possible responses could be augmented in such a way as to provide complete answers:

(11)   – How was she dressed?

       (i)   – In blue.
       (ii) – Like you, kind of.
       (iii) – Conservatively, but not to an extreme.
       (iv) – She had on a fur coat of some kind, a palish fur. No hat.

It is well known that the notion of a complete answer is often, even regarding *who* questions, not so straightforward as cases like (10) would make it seem. For one thing, many question utterances have a 'mention-some', existential interpretation where several partial-only answers can be equally adequate. Generally, whether an answer **resolves** a question depends on the context, as discussed by, e.g., Ginzburg (1995), Aloni (2001), van Rooy (2003), and George (2011: 201ff.). But, as emphasized by Dekker (2007), we can usually imagine a context where the true complete answer is what is asked for. By contrast, *how* questions like in (3)–(5) or (11) are inherently indeterminate insofar as it is unclear how a 'mention-all' answer could be given.

Note that much the same indeterminacy is found elsewhere too, notably in connection with *what . . . like* and *what* querying descriptions of events:

(12)   A man came across three bricklayers busy at work.

> – What are you doing? – I'm laying bricks.
> – What are you doing? – I'm putting up a wall.
> – What are you doing? – I'm building a cathedral.

(http://www.huffingtonpost.com/naphtali-hoff/what-defines-you)

It seems a reasonable conjecture that the indeterminacy concerning complete answers to *how* (and sometimes *what*) questions stems from the fact that these questions are not about what entities some set contains but what sets contain some entity: only so many can have have been married to an individual, but an individual or event has infinitely many properties. Restricting the domain to relevant and suitable alternatives would help, but this is evidently less straightforward when the alternatives are properties than when they are individuals. It seems a fair guess that the resulting open-endedness is part of what makes question theorists reluctant to study *how* questions.

While adverbs, in particular, tend to furnish incomplete answers to *how* questions, the situation changes when we turn to *by* gerunds (or sentences): complete answers appear to constitute the rule, and moreover, it turns out that *how* questions can be used in quizzes, something which requires there to be a practical complete answer.[3] Consider:

(13)   – How did King Duncan reward Macbeth for his loyalty?
         – By making him Thane of Cawdor.

(14)   – How did Macbeth kill King Duncan?
         – By stabbing him in his sleep.

Thus there seems to be a three-member correlation between, on the one hand, **manner** questions, **adverbs**, and **partial** answers, and on the other, **method** questions, ***by* gerunds**, and **complete** answers. While this may go some way towards explicating the manner/method distinction, it leaves open why *by* gerunds are well-suited but adverbs are ill-suited as vehicles for complete answers. One answer which suggests itself is that *by* gerunds and adverbs have different meanings; and in an informal sense, that is plausible. However, it is difficult to justify a distinction in logical type between these two kinds; both the relevant adverbs and the *by* gerunds can be argued to express properties of events, which is also what the 'zero hypothesis' that *how* is not ambiguous but invariably ranges over properties of events would predict.

Instead of trying to explicate the manner/method distinction directly in terms of different responses, I will trace it to a difference in the questions, more specifically, in the predicates with which the responses can combine. These, I will argue, do show a difference in logical type: the predicate may express a property of events itself and can then compose semantically with another expression of this type by intersection, or it may express a function

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[3] Ideally, there should be a unique solution, just one true answer in terms of the question theory of Karttunen (1977); cf. George (2011: 208f.): "a trivia question . . . expects a unique answer that can be given briefly."

from properties of events – and then it can compose semantically with an expression of a property of events by (intensional) functional application.

3 Two types of predicates in *how* questions

This section offers arguments that responses like *by kissing him* in (15) and responses like *tenderly* in (16) have a common type of denotation, namely, sets of events, but that these two classes of responses are correlated with differences in regard to the type of predicate figuring in the question.

(15)   – How did Belle turn the Beast back into a prince?
          – By kissing him.
(16)   – How did Belle kiss the Beast?
          – Tenderly.

While *kiss the Beast* is an ordinary predicate at the level of sets of events,[4] *turn the Beast into a prince* will be argued to belong to a class of 'abstract' predicates at a higher level, denoting an operation on properties of events; whereas the former composes semantically with *how* (to be exact, its trace) or the response by intersection, the latter does so by functional application. In manner questions, then, *how* is an **adjunct**, like an adverb, while method questions emerge as questions where *how*, like a *by* gerund, is an **argument**. This can explain why method questions have determinate complete answers: these *how* questions do not query what sets some event is a member of but what properties of events are members of some set of properties of events. Put casually, what the questions in (13)–(15) query is what (s)he actually **did**.

3.1 Adverbs and basic-level predicates

The adverbs that figure as responses to *how* questions are predominantly, in the taxonomy of Maienborn and Schäfer (2011), 'manner' adverbs like *fast* or 'mental-attitude' adverbs like *carefully*. There are two main approaches to such adverb(ial)s. On one, going back to Thomason and Stalnaker (1973), the adverb is a **predicate operator** (of type $\langle\langle s,\langle e,t\rangle\rangle,\langle e,t\rangle\rangle$), on the other, going back to Davidson (1967), it is an **event predicate** (of type $\langle v,t\rangle$).[5]

This latter approach is currently favoured in semantics, although it faces two challenges: first, if, as seems reasonable, one assumes that one event e can be a witness to the truth of both (17a) and (17b), it is liable to predict that e is both fast and slow:

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[4] I follow common practice in linguistics since Kratzer 1996 in assuming that the agent is introduced by a separate functor above the verb phrase.

[5] The types s, e, v, and t are the types of points of evaluation (worlds), individuals, events, and truth values, respectively; any type $\langle a,b\rangle$ is the type of functions from things of type a to things of type b, so that, for example, $\langle v,t\rangle$ is the type of functions from events to truth values, equivalently, the type of sets of events.

(17) a.   She ran home fast.
      b.   She commuted home slowly.

The point is that *fast*, like many other manner adverbs, is a relative adverb, where the positive form is sensitive to a standard of comparison. But this is not necessarily problematic for the Davidsonian view: if, in line with the theory of adjectives proposed by Kennedy (2007), the standard is modelled as a contextual parameter, for which the contexts in (17a) and (17b) favour different settings, the adverb can still be taken to denote a set of events.

Second, mental-attitude adverbs like *carefully* or *reluctantly* refer to the mental attitude of the agent of the event and may seem to denote relations between individuals x and events e. However, if, as is customary, a role like **agent** is conceived as a function on events, the adverbs can still denote sets of events, along the lines of a definition like (18), indicating that the concept the event must fall under is dependent on its agent (cf. Eckardt 1998: 29ff.):[6]

(18) $[\![\, carefully \,]\!]^w = \lambda e \; \mathtt{careful}_w(\mathtt{agent}_w(e))(e)$

On what can be considered standard assumptions, then, manner adverbs and mental-attitude adverbs denote sets of events. Since the predicates they combine with, verb phrases like *dance*, *speak* (in (4)), *run home*, *lay bricks*, or *kiss the Beast* (in (16)), are also commonly taken to denote sets of events, the adverbs will attach to phrases of the same type as themselves, and semantic composition will follow the principle of generalized Predicate Modification (Heim and Kratzer 1998: 65), essentially, intersection.

3.2 The *by* locution and abstract predicates

In what follows, I will motivate the view that when a *how* question has a *by* gerund as an adequate response, what the predicate of the question denotes is not a set of events but a function from properties of events, so that *how* – 'method' *how* – is not an adjunct but an **argument**. It is useful to start by considering the meaning of sentences with *by* gerunds in them, sentences which are possible propositional responses to *how* questions.

The '*by* locution' – commonly referring to the form of sentence consisting of a matrix clause and a *by* gerund clause, for example, (19) or (20) – has been a focus of attention in the philosophy of action since Anscombe (1963).

(19)   King Duncan rewarded Macbeth by making him Thane of Cawdor.

(20)   Macbeth killed King Duncan by stabbing him in his sleep.

There are two broad views of it, divided over whether *by* is to be ascribed a substantial meaning of its own. On the one hand, this word has been seen as

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[6] The metalinguistic functor $[\![\cdot]\!]$ maps an expression to its meaning, or intension; when relativized to a point of evaluation, or world, w, the output is the expression's denotation, or extension, at that point. The metalanguage λ represents functional abstraction, so that the definiens stands for a function from events (e) to truth values, equivalently, a set of events.

expressing a relation between two actions or facts, be it one of (causal, conventional, simple, or augmentative) 'level generation', where a lower-level action generates a higher-level one (Goldman 1970), parthood, where one action is a part of another (Thomson 1977), causation or 'achievement', where one action is caused or achieved by another (Wreen 1987), or explanation, where the fact that something is done explains how something else is done (Schnieder 2009). Dowty (1979: 227f.) problematizes this sort of analysis, warning, specifically, that when the matrix predicate is causative, ascribing a causative meaning to *by* implies a double causation.

On the other view, *by* serves a purely formal purpose: that of identifying the two actions as one and the same (Davidson 1963, Anscombe 1963), or the content of the *by* gerund as what fills an open slot in the matrix clause (Bennett 1994). The 'Anscombe-Davidson thesis' of 'two descriptions of one event' is prima facie problematic in that it would seem to predict a symmetry between the two predicates (Goldman 1970):[7]

(21)   ?Macbeth stabbed King Duncan in his sleep by killing him.

While Bennett's (1994) theory is not vulnerable to this objection, it is not a compositional semantic analysis. However, the basic idea behind it can be developed into one. The key point is that the asymmetry between the matrix clause and the gerund is rooted in the former, which involves reference to a 'relational property' entailed to hold of the content of the gerund.

Bennett's 'namely' analysis of the *by* locution

x ϕ-ed by ψ-ing analyzes into 'some fact about how x behaved had relational property RP – namely the fact that – x ψ-ed'[8]

The move that can turn this into a compositional analysis is to make the gerund saturate an argument slot of the matrix. According to Bennett, *by* means 'namely'; I will say that it marks that the gerund is an argument.[9]

It has been noted that the two action descriptions figuring in a *by* locution differ in how 'basic' or 'non-basic' they are (in the sense of Danto 1965 and the subsequent literature); thus Hornsby and Goulder (2011) write: "Where someone ϕ-s by ψ-ing, ψ-ing is said to be more basic than ϕ-ing." There is a strong tendency for the matrix clause predicate to be, in a loose sense, at a higher level of abstraction than the *by* gerund predicate. This idea underlies Goldman's notion of 'level generation' (see above): the relatively basic, lower-level action, such as raising one's arm or lifting one's hat, 'generates' the less basic, higher-level action of signalling a turn or greeting a person. This suggests that the higher-level property which Bennett (1994) locates in the matrix clause is expressed by the predicate of that clause. In fact, on the

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[7] The symbol '?' indicates that the sentence is only marginally acceptable.

[8] In a given case, RP will be determined by ϕ and x; for example, if ϕ is *break a promise*, RP might be 'conflict with a promise made by x'. Mostly, though, RP will be more complex and difficult to spell out (Bennett 1994: 36).

[9] Key elements of the analysis to be presented were developed in (Sæbø 2008).

analysis I will propose, there is a distinction in logical type between the two predicates in the locution: the matrix predicate denotes a function from the type of entities the gerund predicate expresses.

Recent work in semantics and philosophy suggests that numerous verbal predicates do not have extensions at the same level as the others. Kearns (2003) identifies a category of 'individual-level predicates on events', Sæbø (2008) uses the term 'abstract predicates'. These predicates include the matrix predicates in all examples of the *by* locution given so far. They fall into two classes:

1. what Kearns (2003) calls 'criterion predicates', like *reward Macbeth* in (19) or *betray Jesus* in (22), and
2. what Sæbø (2008) calls 'manner-neutral causative predicates', like *turn the Beast back into a prince* in (15) or *kill King Duncan* in (20). To avoid confusion with the term 'manner' as it is used by Jaworski (2009) and in the present paper, I will employ the term 'method-neutral causatives'.

(22)   Judas betrayed Jesus by kissing him.

Criterion predicates are so called because to satisfy them, the entity of the relevant kind must meet some certain criterion over and above the satisfaction conditions associated with ordinary verbal predicates. The criteria at play are of various kinds: conventional, intentional, in any case not physical. To qualify as rewarding Macbeth, for example, the entity at issue must be intended, and intended to be understood, as a positive reciprocation. Something will count as signalling if we have agreed that it is to signify such-and-such or if the receiver can be counted on to interpret it that way. Although for the most part, it is far from easy to spell out the criteria in detail, there are relatively transparent cases such as *break the law*, which requires that the entity in question is illegal, or more particularly, that the law requires that it not be done. The following random list may give a sense of the range of English criterion predicates:

(23)   *do me a favour*, *keep a promise*, *obey doctor's orders*, *retaliate*, *spell "languor"*, *stand up to injustice*, *stand out*, *test my resolve*

There are good reasons to assume that the relevant kind of entity are event types, not tokens – that is to say, properties of events. It may be possible to conceive of criterion predicates as predicates of events (that is, event tokens), but in that case, events satisfy them in virtue of the properties they possess. One could say, for example, that *break the law* holds of event e in world w iff there is an event property P such that P is illegal in w and P holds of e in w. Further considerations, however, to which I will return presently, militate for taking the event properties into account as arguments, more or less as in (24):

(24) $[\![\,break\ the\ law\,]\!]^w = \lambda P_{\langle s, \langle v, t \rangle \rangle} \lambda e\ P$ is illegal in w and $P_w(e)$[10]

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[10] The logical-type subscript $\langle s, \langle v, t \rangle \rangle$ restricts the variable P to functions from worlds, or points of evaluation more generally, to sets of events; that is, to properties of events.

The other major class of predicates that arguably do not simply range over events but also and essentially over properties of events consists of method-neutral causatives – predicates like *open the safe*, *break the lamp*, or *change the course of history*. These can be contrasted with method-specific causative predicates (though the borderline is not fixed and sharp) like *saw down the tree*, *unzip the bag*, or complex predicates in resultative constructions like *shake her awake*. It is common practice in linguistics (see, e.g., Wunderlich 1997) to decompose causative predicates, either in the object language or in definitions like (25), where it is left to the P argument to specify the method:[11]

(25) $[\![\,open\ the\ cave\,]\!]^w = \lambda P_{\langle s, \langle v,t \rangle \rangle} \lambda e\ P_w(e)$ and the cave opens in w and
          the fact that the cave opens is caused by the fact $\lambda j P_j(e)$ in w

There are, in particular, three arguments for treating criterion predicates and method-neutral causative predicates as operators on ordinary predicates. First: when such predicates occur on their own, without a *by* phrase or anything filling a similar function, the sentence is often not interpreted as an existential quantification over properties of events; rather, it is taken to refer anaphorically to a property of events introduced in the discourse context.

(26)   You have damaged your own cause.

When this sentence is used, the speaker will typically have a certain type of action P in mind and rely on the context to supply it.
      Second: some criterion predicates cannot occur on their own – simple sentences like (27) are barely interpretable.[12]

(27)   #When Virginia Woolf's father died, she reacted.

This pattern of sometimes being obligatory, sometimes being discourse bound and sometimes being existentially closed off is typical of arguments. An analogy is offered by relational nouns like *grandmother*, where the 'internal' argument is often filled by a genitive phrase but can also be interpreted as a definite or an indefinite pronoun.
      Third: as observed by Thomson (1977), the subject of a predicate like *cure* can be a gerund or a nominalization, as in (28). This is to be expected if such predicates express functions from abstract objects like properties of events.[13]

(28)   Treating him with Difucan cured him.

Yet another reason for treating criterion predicates and method-neutral causatives as functions from properties of events is that this allows a compositional treatment of the *by* locution: its meaning can be built by standard principles if the *by* phrase is taken to supply the event property argument. To be sure, this strategy presupposes that the predicates that can figure in the

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[11] Causation is usually conceived in terms of counterfactual dependence.

[12] The symbol '#' indicates semantic anomaly.

[13] I am indebted to Hedde Zijlstra for pointing this out.

matrix clause of a *by* locution are all abstract, and although this is in significant measure indeed the case, the generalization needs to be argued carefully. This will be done in section 3.3.

Let me first state the analysis in some formal detail, starting by laying out the Logical Form of a sentence like (19) and annotating it with logical types:

(29) [tense [Duncan [voice [[reward Macbeth] [by [promoting him]]]]]]

$$\underbrace{\text{reward Macbeth}}_{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle} \quad \underbrace{\text{by promoting him}}_{\langle v,t\rangle}$$

$$\underbrace{}_{\langle v,t\rangle}$$

$$\underbrace{}_{\langle e,\langle v,t\rangle\rangle}$$

$$\underbrace{}_{\langle v,t\rangle}$$

$$\underbrace{}_{t}$$

Here I follow standard practice in assuming that tense comes into play as an operator at a late stage in the composition, transforming a set of events into a truth value, and in positing a functor 'voice' (Kratzer 1996) mapping a set of events to a relation between an individual – the agent – and an event.

The semantics of (29) is composed in these steps:

(30) – $[\![\,promoting\ him\,]\!]^w = [\![\,by\ promoting\ him\,]\!]^w =$
$\lambda e\ e$ is a promoting m event in w

– $[\![\,reward\ Macbeth\,]\!]^w = \lambda P_{\langle s,\langle v,t\rangle\rangle}\lambda e\ P$ is a reward for m
by the agent of e in w and $P_w(e)$

– $[\![\,reward\ Macbeth\ by\ promoting\ him\,]\!]^w = \lambda e\ e$ is a promoting m
in w and promoting m is a reward for m by the agent of e in w[14]

– $[\![\,Duncan\ reward\ Macbeth\ by\ promoting\ him\,]\!]^w = \lambda e\ e$ is a
promoting m in w and d is the agent of e and promoting m is
a reward for m by d in w

– $[\![\,Duncan\ rewarded\ Macbeth\ by\ promoting\ him\,]\!]^w = 1$ iff there is
an e occurring at a certain time prior to the time of utterance
which is a promoting m in w with d as its agent and
promoting m is a reward for m by d in w

As evident in the first line, the preposition *by* is not assumed to have a meaning of its own in the sense of contributing directly to the meaning of the whole. It does contribute indirectly, however, in that it marks grammatically that the gerund verb phrase is an argument of the matrix verb phrase; consequently, it has the semantic effect of ensuring that the composition principle to be used between the two VPs is not Predicate Modification but (Intensional) Functional Application, IFA (Heim and Kratzer 1998: 65 and 308).

There is precedent in the literature for treating *by* gerunds as arguments. Asher and Lascarides (1998: 274f.), concentrating on *by* locutions as responses

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[14] The composition principle at work in this step is Intensional Functional Application (Heim and Kratzer 1998: 308)

to *how* questions with the modal *can* (or the light verb *do*) in them, describe the *by* gerund as a first argument of this modal (or light verb):

(31)   – How can I get to the treasure?
          – You can get to the treasure by going to the secret valley.

(32)   – How did Billy Strayhorn get to Harlem?
          – He got to Harlem by taking the A train.

It remains unclear, though, how the (covert) light verb in the response in (32) is supposed to operate on the two structures.

   In the analysis presented above, by contrast, it is the matrix predicate that operates on the *by* phrase, in virtue of the more complex meaning it has. It is either a criterion predicate or a method-neutral causative, and either way, it denotes a function in need of the kind of entity that a gerund can supply; the word *by* is instrumental in the saturation of the function in that it marks the gerund phrase as argumental.

3.3 Coercion, quantification, and iteration

The analysis developed above leads to the following generalization:

(33)   **By locution generalization**
          In any meaningful *by* locution, the matrix predicate denotes a function from properties of events to sets of events.

There are three counterarguments to this generalization, all of which I will try to counter in turn.

1. On the one hand, a *by* phrase cannot meaningfully combine with just any predicate; manner-specific causatives like *unzip the bag*, say, are problematic. On the other hand, *by* gerunds often combine with predicates which are not, on the face of it, abstract. What happens then, I would suggest, is that under the pressure of the signal given by *by* that the gerund is an argument to which the matrix predicate is to apply, this predicate undergoes a slight shift in meaning and logical type. Within certain limits, concrete predicates can be 'coerced' into abstract predicates.[15] Two cases can be distinguished: (i) achievements (in the sense of Vendler 1957: 146ff.), like *find* or *get (to)*, can be coerced into accomplishments (which are causatives according to Dowty 1979: 91ff.), as in (32) above; (ii) activities can be coerced into causatives or criterion predicates, as in (34), where *breathe* is reinterpreted as 'do what serves the same function as breathing'.

(34)   The water spider breathes by trapping air in a bubble around its abdomen.

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[15] On the notion of lexical coercion, see, e.g., Asher 2011: 214ff.

Rothstein (2004: 45-50, 136-139) details a procedure by which achievements are shifted to activities culminating in achievements, that is, to accomplishments. To get to Harlem in such a broader sense can be thought of as doing something causing, or culminating in, one's getting to Harlem in the narrow sense.

2. Abstract predicates, be it criterion or manner-neutral causative predicates, often occur 'on their own', in simple sentences where the postulated argument apparently remains unsaturated, – as well as in *by* gerunds:

(35)   Macbeth betrayed Malcolm by killing his father.

What happens in such cases, I would suggest, is that the argument is covertly saturated, either in the form of a free variable, to be contextually determined, or in the form of an existential quantifier over properties of events. For the former case, see (26) in section 3.2; for the latter, consider (36):

(36)   A group of colonists boarded the ship and destroyed the tea.

The interpretation is that there was something they did which caused the tea to be destroyed, and this can be derived by positing a covert quantifier $\exists P$ next to the constituent *destroy the tea* which undergoes Quantifier Raising in a standard way (Heim and Kratzer 1998: 186), leaving a trace of type $\langle v,t\rangle$. Along these lines, (35) would be assigned the type-annotated LF in (37):

(37) $[\exists P\,[\,\lambda_1\,[\,\mathrm{T}\,[\,\mathrm{mac}\,[\,\mathrm{V}\,\underbrace{[\,\mathrm{betray\ mal}_i\,]}_{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle}\,]\,[\,\mathrm{by}\,[\,\underbrace{[\,\mathrm{killing\ his_i\ father}\,]}_{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle}\ \mathrm{t}_1\,]\,]\,]\,]\,]\,]\,]\,]$

$\underbrace{}_{\text{(by IFA) } \langle v,t\rangle}$

$\underbrace{}_{\text{(by IFA) } \langle v,t\rangle}$

3. Sometimes, *by* locutions occur in chains, and such iterations might seem to imply a cline in abstractness, in n stages if there are n-1 *by* phrases. The question may arise whether this does not predict a regress in logical types. The answer is that since the abstract predicate is an operation, which, applied to a property of events, returns a new property of events, no regress is implied; the same type of operation can be repeated without an increase in complexity. Consider the nested, right-branching structure of a chain like (38):

(38)   Macbeth $\underbrace{\text{betrayed Malcolm}}_{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle}$ by $\underbrace{\text{killing his father}}_{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle}$ by $\underbrace{\text{stabbing him}}_{\langle v,t\rangle}$.

$\underbrace{}_{\text{(by IFA) } \langle v,t\rangle}$

$\underbrace{}_{\text{(by IFA) } \langle v,t\rangle}$

Note that although killing Malcolm's father is not a predicate of events, killing his father by stabbing him is, and provides the argument for *betray Malcolm*.

4 Manners and methods: adjuncts and arguments

We are now in a position to distinguish between two types of *how* questions in terms of the semantics of the predicates in them and thus also in terms of the role played by *how* in the framework of the question, even though this word is not assumed to be ambiguous. This is summarized in section 4.1. We are also close to an answer to the question what is 'wrong' with dialogues like (39) or (40), but not yet quite there; two alternatives are discussed in section 4.2.
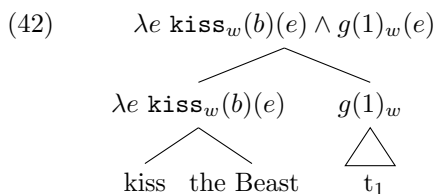
(39)   – How did Belle turn the Beast back into a prince? – ? Tenderly.

(40)   – How did Hou play Polgar? – ? By playing ingeniously.

There is also the question whether the bifurcation of *how* questions according to the logical type of the predicates in them is general enough to cover the full range of *how* questions and their responses, in particular regarding the responses which have hitherto almost been neglected, prepositional phrases, sentences and texts; in general, the question how these responses relate to the manner/method distinction; this is addressed in section 4.3.

4.1 *How* as an adjunct, *how* as an argument

A two-tier correlation has been established between, on the one hand, adverbs and concrete predicate sister constituents, invoking the composition principle Predicate Modification (PM) (essentially, intersection), and on the other hand, *by* gerunds and abstract predicate sister constituents, invoking Intensional Functional Application (IFA). Section 2.2 had established a correlation between manner questions and adverbial response as well as between method questions and *by* gerund response; tying these threads together, we arrive at a picture where 'manner *how*' is a sister to a concrete predicate while 'method *how*' is a sister to an abstract predicate; in formal terms:[16]

(41)   How$_1$ did Belle kiss the Beast   t$_1$

with brace over "kiss the Beast t$_1$" labeled (by PM) $\langle v,t \rangle$, and braces over "kiss the Beast" labeled $\langle v,t \rangle$ and over "t$_1$" labeled $\langle v,t \rangle$.

(42) $\lambda e \; \mathtt{kiss}_w(b)(e) \wedge g(1)_w(e)$

$\lambda e \; \mathtt{kiss}_w(b)(e)$ $g(1)_w$

kiss   the Beast   t$_1$

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[16] In (42) and (44), g is the current variable assignment, whereas w is the current world. The representations in (44) are a bit simplified; $P(e)$, $g(1)(e)$, and $\mathtt{Become}(\mathtt{prince}(b))(f)$ are short for, respectively, $\lambda i \, P_i(e)$, $\lambda i \, g(1)_i(e)$, and $\lambda i \, [\mathtt{Become}_i(\mathtt{prince}_i(b))(f)]$.

$$\overbrace{\overbrace{\langle\langle s,\langle v,t\rangle\rangle,\langle v,t\rangle\rangle}\quad\overbrace{\langle v,t\rangle}}^{\text{(by IFA) }\langle v,t\rangle}$$

(43)   How$_1$ did Belle turn the Beast into a prince   t$_1$

(44) $\lambda e \, \exists f \, \texttt{Cause}_w(\texttt{Become}(\texttt{prince}(b))(f))(g(1)(e))$

$\lambda P \lambda e \, \exists f \, \texttt{Cause}_w(\texttt{Become}(\texttt{prince}(b))(f))(P(e))$ $g(1)$

turn the Beast into a prince   t$_1$

(41) shows a manner question where the predicate, the trace of *how*, and the merge of the two are annotated with logical types; (43) shows the same for a method question. I am not going deeply into question semantics here, but it is essential that what the frame of the question composes semantically with is not the *wh-* word itself, which has a much higher logical type, but a variable at the position left by *wh-* raising.[17] This variable has in both cases the type of sets of events, but in the manner case, it merges with a predicate of the same type, while in the method case, it merges with a predicate denoting a function from properties of events. The semantic composition is represented in more detail in (42) and (44); in (42) the top line is the result of intersecting the two sets from the middle line, while in (44) it is the result of applying the lefthand extension to the righthand intension.[18]

Note that this difference is irreducible in the sense that in (44), the result depends on the full intension of the event property variable; in this case, because causation is a modal relation (here a relation between propositions), in a case with a criterion predicate instead of a method-neutral causative, because full event properties matter crucially for the relevant criteria, which may also be modal in nature: causal, conventional, intentional, or normative.[19]

This analysis can be viewed as a semantic explication of Jaworski's (2009) notion of an 'analysis scheme' underlying means or method questions, insofar as when a *by* locution is an adequate propositional response to a *how* question, the predicate of the question is decomposable and one component is an argument place which is filled by the short response. This component may itself be complex, as when the response is a complex sentence or a text, an issue I will return to in section 4.3.

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[17] A brief review of the Groenendijk and Stokhof theory is given in an appendix.

[18] That the trace variable has the type of sets of events is to say that the value assigned to it by an assignment function g relative to a point of evaluation w, $g(1)_w$ (its extension at g and w, $[\![\,\text{t}_1\,]\!]^{g,w}$), is a set of events. The value assigned to it by g as such, $g(1)$ (its intension at g, $[\![\,\text{t}_1\,]\!]^{g}$), is a property of events, a function from points of evaluation to sets of events.

[19] 'Extensional' criterion predicates do seem to exist, though, like *stand out*, which seems to only require a set of events, states, or individuals, a case I will return to in section 4.3.

4.2 Adverbs, *by*, and composition

The preceding has made a case for (45), where t stands for the trace of *how*:

(45)   **How question generalization**

        Whenever an adverb is an adequate response, t is an adjunct;
        whenever a *by* phrase is an adequate response, t is an argument.

The first part implies that the only way to make sense of responses like (46b)
to questions like (46a) is to read a covert existential quantifier over methods
into the question, taking the event property argument of the abstract predicate
to be saturated by its trace (cf. section 3.3), as indicated in the LF (46c).

(46)   a.   – How did she open the vault?
        b.   – Quietly.
        c. $[\, \mathrm{Q}_{how} \, [\, \mathrm{How}_1 \, [\, \exists P \, [\, \lambda_2 \, [\, \mathrm{T} \, [\, \text{she} \, [\, \mathrm{V} \, [\, \mathrm{t}_1 \, [[\, \text{open the vault} \,] \, \mathrm{t}_2 \,]]]]]]]]]$

And in fact, this seems to be the way in which such responses are, charitably,
understood, especially when, as in this case, a standard method can be inferred
(which could be captured by a domain restriction on the existential quantifier).
But in some cases where that is not possible, like (39), the response can barely
be made sense of at all; because, one may speculate, an adverb like *tenderly*
imposes relatively specific selectional restrictions.

So far, though, (45) is a descriptive generalization without an explanation,
and as long as we cannot point to some independent property of adverbs from
which it would follow that they cannot be arguments, the correlation remains
mysterious. If, as is usually assumed, logical types are the only determinants
of semantic composition ('type-driven composition'), there should be nothing
to prevent an adverb from composing with an abstract predicate; after all,
adverbs and *by* phrases supposedly share the same logical type $\langle v, t \rangle$.

Note, however, that for the second part of the generalization in (45), I have
already given a reason, arguing that *by* phrases cannot be adjuncts because *by*
is a grammatical marker of argumenthood (in the verbal domain), much like
other 'functional' prepositions. This is what can account for the awkwardness
of the response in (40), which cannot saturate the predicate in the question.[20]

Now if that much can be assumed, it is already a departure from type-
driven composition: *by* signals that the relevant composition principle is Inten-
sional Functional Application. And if the converse can be assumed for adverbs,
say, that their morphology is a marker of adjuncthood, signalling that the
relevant composition principle is Predicate Modification (Intersection), there
would be motivation in both directions for (45) as a universal generalization. A
precedent can be seen in adjectives as a separate part of speech, which cannot

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[20] Schnieder (2009: 664) takes an example of this kind to indicate that 'only an explanatory
how-she-did-it yields a correct 'by'-statement'.

be arguments of determiners (without undergoing conversion) even though the logical type is standardly assumed to be the same as for (standard) nouns.[21]

The alternative to this strategy is to say that in principle, adverbs can be arguments and adequate responses to method questions, but for some not well understood reason, they tend to not provide the right sort of information. If this is the correct interpretation, one would expect there to be exceptions, cases where an adverb response is capable after all of filling the argument slot of an abstract predicate in a meaningful way – and this seems to be borne out:

(47)   – How did she react? – Vehemently.

(48)   – How did she reward him? – Lavishly.

Here the questions contain clear cases of criterion predicates, which the adverbs seem to saturate, evidently providing the right sort of information for adequate responses. What characterizes these adverb responses, it would appear, is that it is possible to infer information which could also be formulated in a verbal way, with a *by* locution (for (48), something like *by giving him riches*). This throws doubt on the idea that adverbs come with a constraint that the only composition principle relevant for them is Intersection. Thus on balance, we cannot confidently conclude that the first half of (45) holds in full generality.

4.3 Residue responses and relations

So far, attention has been centered on two forms of response to *how* questions: adverbs and *by* gerunds, and a simple model has been developed on which (i) *how* always ranges over properties of events and (ii) adverbs are appropriate for questions where the predicate itself expresses a property of events because they are basically adjuncts, while (iii) *by* gerunds are appropriate for questions where the predicate denotes a function from properties of events because they are arguments. Manners are adjuncts, methods are arguments.

It may be thought that this restricted focus and this simple model exclude some ways of using *how* questions. For one thing, some categories of responses (some of which may seem to call for a more complex picture) have so far not been under serious consideration, secondly, some cases may indicate a need to widen what *how* can range over, and thirdly, there may be dimensions to *how* questions which the simple analysis fails to capture.

Note first, however, that methods as defined in the preceding paragraphs – as saturating the event property argument of an abstract predicate – subsume more than one might expect. Recall the discussion in section 3.3 on predicates that appear to be neither causative nor criterion predicates but still license *by* locutions; as the argument went, such predicates undergo 'lexical coercion' to acquire a causative or criterion-type meaning. In a typical case, an inchoative,

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[21] For discussions of modifiers and composition principles, see Castroviejo & Gehrke (2014) and Morzycki (to appear, chapter 5, sections 3 and 4).

or 'achievement', predicate like *escape*, *find the wizard*, or *win the chariot race* is coerced into a causative, or 'accomplishment', predicate.

(49)   – How did Dorothy <u>find the Wizard</u>?
         – By following the Yellow Brick Road.

Based on the derived, causative sense of *find the Wizard*, the question in (49) can be paraphrased like this: what P are such that there was an event e which was P and Dorothy was its agent and the fact that e was P caused the fact that the agent of e found (in the basic sense) the Wizard.

As it appears, this type-coercion operation is widely and readily available, and not only *by* locutions, but *how* itself can, in a suitable context, set it off. This may help explain the impression that *how* encodes (causal) explanation. Cross (1991), who builds on van Fraassen's (1980) model of *why* questions, is concerned with *how* questions as requests for explanations, i.e., answers that specify 'salient factors in the causal machinery' of the question's topic process. This sort of theory comes close to attributing an element of causality to *how*. The present analysis, by contrast, locates the dimension of causal explanation, when relevant, in the content of the question: causation is very often inherent in its predicate, if only through a reinterpretation of a noncausative predicate, induced by *how*. In addition, many criterion predicate cases of 'method' *how*, like (50), do not fit a pattern of causal explanation at all.

(50)   – How did the stork thank Hercules?   – By giving him a ruby.

The term 'method' (as well as 'means') carries an implication of agentivity, even of goal-directed action where the abstract predicate describes the goal. This feature is not essential to the notion as it has been defined here, however; hence 'method' subsumes cases where *how* ranges over event properties that are non-agentive or at any rate not directed at fulfilling the abstract predicate (Jaworski (2009: 135) reserves the term 'mechanism' for such cases). In many non-agentive cases, though, like (51), responses in the form of full sentences are for various reasons preferred to *by* gerund responses (see further below).

(51)   – How had the stream been dammed?   – A tree had fallen into it.

Generally, for manners and methods alike, it is important to keep in mind that the term 'event' must be taken in a wide or the widest sense, as subsuming processes (activities) and even (temporary, stage-level) states, so 'eventuality' as the common denominator of events and states would be a more apt term: to be accurate, what *how* (usually) ranges over are properties of eventualities.

That said, there may be reason to introduce some flexibility into what *how* can range over, particularly in view of cases where the responses express individual-level properties of individuals, which arguably do not involve eventualities of any sort (and are not agentive):

(52)   – How does Cordelia differ from her sisters?
         – By loving her father / In being good / She has a true heart.

Criterion predicates like *differ from her sisters* or *stand out* are evidently flexible regarding the type of arguments they take, properties of eventualities (events or states) or properties of individuals; hence *how* will in turn need to range over, from context to context, one or the other.

This is reminiscent of the *how* questions to which **adjectives** can provide answers, and brings us back to the categories of responses reviewed in section 2.1 but not considered since. When asking a question of the form *How is x* for some individual x, we seem to be asking what types of states x is in, asking, that is, for stage-level properties, more precisely, relations between individuals and states. In English, there seems to be a division of labour between *how* and *what...like* according to which the latter can range over individual-level properties.

(53)   a.   – How is the river after the rain?
        b.   – What is the river like after Dawson?

As for **prepositional phrases** as responses in the light of the distinction between manners and methods, they seem to do double duty: some express manners, some methods, and moreover, they can express methods in two ways. Jaworski's example (2), simplified here as (54), is instructive:

(54)   – How did Judith kill Holofernes?
        a.   – With revulsion.
        b.   – With seduction.
        c.   – With snake venom.

While the *with* phrase in (54a) plays the part of a manner,[22] those in (54b) and (54c) specify methods (in Jaworski's terms, (54c) would specify a means). These two PPs can be called **instrumental**, but they differ in that in (54b), the 'instrument' is an abstract object like a property of events, expressed by a nominalization, while in (54c), it is something that can be a participant in a property of events. Instrumental PPs remain ill-understood in semantics, but paraphrases in terms of *by* gerunds may be suggestive of an analysis:

(54)   d.   – By seducing him.
        e.   – By doing something (inferrable) involving snake venom.

With an analysis of the instrumental preposition along these lines, whether it takes a nominalization or an ordinary nominal complement, instrumental PPs can be taken to express event properties, which can fill the argument of abstract predicates. PPs like (54a) or as in (5), where the preposition is 'comitative' rather than instrumental, can also be taken to express event properties, but these are more like adverbs (for (54a) there is the alternative *revoltedly*) and better suited to modifying concrete predicates.

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[22] where the method of killing Holofernes is implicitly existentially quantified over, cf. (46) in section 4.2

Full sentences and sentence sequences remain – where 'sentences' refer to responses which do not, like propositional responses, come from the question by substituting some short response for *how*. These cases may seem to undermine the hypothesis that *how* ranges over properties (of events or individuals); specifically, they suggest a need for *how* to range over propositions (as seems to be (implicitly) assumed by Cross (1991), Bennett (1994), Jaworski (2009), and Schnieder (2009)). But in fact, sentential responses only form counterevidence to the property analysis of *how* if they are considered to be short responses – which, it would seem, they cannot be:

(55)   – How were the guards alerted?
      a.   – The alarm was activated.
      b.   – #The guards were alerted the alarm was activated.

Alternatively, they can be taken to only provide indirect answers, not semantic but pragmatic-only answers in the theory of Groenendijk and Stokhof (1984), that is, answers only in conjunction with background knowledge in the 'common ground', plus conversational maxims, in particular, Relevance. Two cases can be distinguished. First, a property of events can easily be reconstructed, so that only a minimum of inference is required to derive an answer. This is the case in (55) and (7) – 'method' cases – and also in (56), a 'manner' case:

(56)   – How did he change? – He got quieter.

A short response would in fact come from the sentence by removing tense, but there is no conventional linguistic format for that; the full sentence can thus be seen as the optimal solution when a *by* gerund is for some reason dispreferred.

This case is common when the response is a single simple clause. To some extent, it is also relevant for multi-membered sentence sequences, in particular, when they provide instructions for use or recipies. A direct-answer event property can be pieced together from the consecutive sentences $S_1, \ldots, S_n$ by removing (if they are not in the imperative mood) the tense and the subject and forming the property of events e such that e is the sum of consecutive events $e_1, \ldots, e_n$ with the respective properties expressed in $S_1, \ldots, S_n$.

In many cases of textual response, though, like the story told in (8), only some of the successive sentences can be taken to describe successive subevents of an event whose property, thus determined, makes for an answer to the question, a partial answer; some sentences, typically describing states or individual-level properties, are there to provide the kind of background information that helps narrow down the field of answers by excluding some complete ones.

5 Summary and outlook

I have aimed to take our understanding of *how* questions and their answers a few steps further by clarifying the defining characteristics of two basic kinds, 'manner' questions on the one hand and 'method' questions on the other.[23]

Manners are what the folk notion would make us believe *how* is all about: responses in the form of adverbs, no more likely to provide exhaustive answers than are responses to questions about, say, what somebody is like.

Methods, by contrast, although at least as frequent as manners, are rarely or never expressed by adverbs, and (short) responses to method questions are as likely to provide exhaustive answers as responses to questions about, say, what the age of somebody is. This calls for an account.

The two key questions are (i) what the meaning of *how* is and (ii) what role it plays in the context of the question. I have taken a conservative stance on (i), arguing that there is no strong case for assuming two different meanings, one for manners and another for methods, and that the differences between manners and methods can be accounted for through two different answers to (ii). In other words, 'manner *how*' and 'method *how*', while both ranging over properties, mostly properties of events, play two different roles in the question, according to the mode of semantic composition between them (or to be exact, their trace) and what they merge with, the predicate of the question.

This, in turn, depends on the logical type of the predicate of the question. On the default assumption, in line with the common Davidsonian conception, it itself expresses a property of events, and in that case, semantic composition takes the form of intersective modification, and *how* functions as an adjunct. This assumption meets no resistance from 'manner' questions.

Turning to 'method' questions, however, we see a more complex picture.[24] Building on work on the paradigmatic format for short responses, *by* gerunds, I have argued that the predicates of method questions do not only take events as arguments but also entities other predicates can express – event properties. Apparent counterexamples are accounted for as cases of 'coercion', by which a concrete predicate can be type-lifted to an abstract predicate. Accordingly, the semantic composition principle at play in method cases is not Predicate Modification but Functional Application, and *how* functions as an argument.

It is worth noting that this analysis amounts to a de-mystification of *how*: this word may have a more complex logical type than more familiar *wh*-words like *who*, but in principle, it is no different; concepts like 'exhaustive answer' and 'complete answer' make just as much sense here. In particular, a question introduced by *how* can, just like a *who* question, be a request for an argument to fit a function. The apparent variability of meaning can largely be traced to the context of *how*: depending, in particular, on the predicate it (or rather its trace) combines with, *how* can, but need not, play an explanatory role.

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[23] Jaworski (2009), who introduced the distinction, subdivides what I call method questions, 'analytic' questions in his term, into 'means', 'mechanism' and 'method' questions.

[24] The added complexity is evident in Jaworski's analysis in terms of **analysis schemes**.

In view of the broad range of possible responses to *how* questions, spanning several parts of speech and syntactic categories, including full sentences and stretches of text, the given analysis may appear meagre and limited. Indeed, it must be conceded that the borderline between manner and method can be difficult to draw in a given case, something which reflects the flexible boundary between concrete and abstract predicates; a basically inchoative predicate can be coerced into a method-neutral causative predicate, and something which appears as a concrete predicate in one perspective can reappear as a criterion predicate in another perspective; the verb *vote*, with which Searle (2001: 51f.) exemplifies the 'constitutive by-way-of-relation', is a case in point:

(57)   – How did she vote?
      a.   – She voted liberally.   [concrete; manner]
      b.   – She voted by raising her arm.   [criterial; method]

It is also important to note that *how* questions can be difficult to answer; it can be impossible to give a direct response translating into even a partial answer, so sometimes an indirect response is the best response. This is the locus of text responses that are not step-by-step descriptions of methods: the information offered goes some way towards resolving the question by excluding some possible complete answers, thus providing the most precise answer there can be in the given situation. This is not to deny that it is often possible to extract from sentences and texts the pieces of meaning that, when plugged into the question, do translate into answers; the reason they are used is then that the syntactic vehicles for short responses are just not available.

Although *how* questions are generally understudied, one kind has received extensive attention in recent literature, viz., infinitival *how to ...* embedded under *know*. Stanley and Williamson (2001) and Stanley (2011a, b) defend the 'intellectualist' thesis that Knowing How is a species of Knowing That, more particularly, that the interpretation of *know how to do* corresponding to French *savoir faire* can be derived from the semantics of *know*, the *how* clause and its parts. These '*how* questions' present additional complexities to do with genericity and modality beyond the finite, episodic cases under consideration in this paper. While I believe that the present analysis of *how* questions can throw light on the meaning of *know how to*, sharpening and deepening Stanley's argument from language, it seems clear that a serious treatment of the subject would exceed the scope of the present study and merit a study of its own.

I have said nothing about Jaworski's (2009) last category of *how* questions, questions of 'cognitive resolution', which involve a possibility modal, typically *can*, and answers to which are to resolve a cognitive tension. To some extent, I believe that the peculiarities of this kind of *how* questions can be reduced to general properties of *how* questions in interaction with possibility modality. Some problems may persist, though; and generally, it would be naïve to consider the full story about *how* to have been told in the preceding. What I

have mainly tried to show is that a fairly deep-cutting bifurcation of the field has a semantic underpinning with a considerable explanatory potential.

Appendix: Building *how* questions

Here I give a brief outline of the building blocks of the meaning of a question in general and a *how* question in particular, and how they are put together, in a compositional version of the theory of Groenendijk and Stokhof (1984), in main part due to Šimík (2011). I illustrate the general model by reference to the simplest case of *wh-* questions, *who* questions, before turning to *how*.

The semantics of a who question

Consider (58) and its logical form (59).

(58)   whom did Belle kiss

(59) Q_{who} [who_1 [Tense [Belle [Voice [kiss t_1]]]]]

Q_{who} who_1 [Tense [Belle [Voice [kiss t_1]]]]

who_1 Tense [Belle [Voice [kiss t_1]]]

Tense   Belle [Voice [kiss t_1]]

Belle   Voice [kiss t_1]

Voice   kiss t_1

kiss t_1
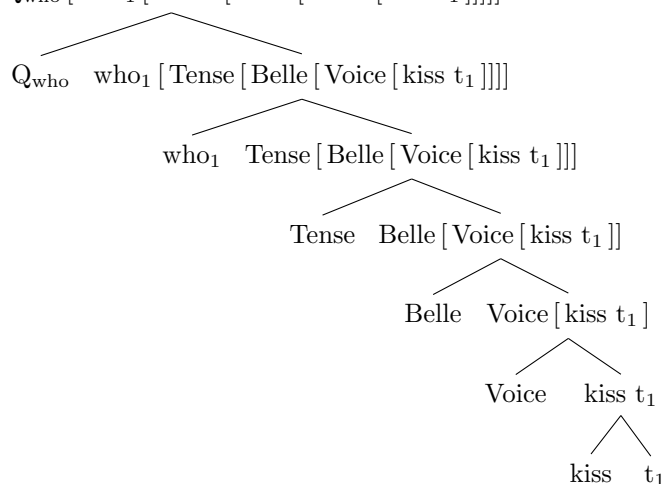
The extensions of who_1, the raised pronoun binding the trace t_1, and Q_{who}, the relevant covert question operator, are given in (60) and (61) (where a is the type of variable assignments and the domain restriction to humans is ignored).

(60) $[\![who_i]\!]^{g,w_0} = \lambda\phi_{a(st)}\lambda w \lambda x_e \; \phi_w^{g[i \to x]}$

(61) $[\![Q_{who}]\!]^{g,w_0} = \lambda P_{s(et)}\lambda w \; P_w = P_{w_0}$

Piecing the extensions of all terminal and branching nodes in (59) together, we arrive at (62) as the extension of (58) at the point of evaluation w_0:

(62) $\lambda w\,[\,\lambda x\,\exists e < n\ \mathrm{kiss}_w(x)(e) \wedge \mathrm{agent}_w(e)(b)\ =$
$\lambda x\,\exists e < n\ \mathrm{kiss}_{w_0}(x)(e) \wedge \mathrm{agent}_{w_0}(e)(b)\,]$

The corresponding intension is an equivalence relation between points of evaluation. As such, it induces a partition of Logical Space; if the domain contains just 3 individuals, a partition with 8 cells, where each is a complete answer; cf., e.g., Table 1.

Belle kissed Athos and only Athos
Belle kissed Aramis and only Aramis
Belle kissed Porthos and only Porthos
Belle kissed Athos and Aramis and did not kiss Porthos
Belle kissed Athos and Porthos and did not kiss Aramis
Belle kissed Porthos and Aramis and did not kiss Athos
Belle kissed Athos and Porthos and Aramis
Belle kissed neither Athos nor Porthos nor Aramis

Table 1: The complete answers to Whom did Belle kiss

The semantics of a manner how question

Consider now (63) and its logical form (64) (in a one-dimensional notation).

(63) how did Belle kiss the Beast

(64) $Q_{\mathrm{how}}\,[\,\mathrm{how}_1\,[\,\mathrm{Tense}\,[\,\mathrm{Belle}\,[\,\mathrm{Voice}\,[[\,\mathrm{kiss}\,\mathrm{Beast}\,]\,t_1\,]]]]]$

The extension of the raised how_1 binding the trace t_1 and the covert question operator of the appropriate type, Q_{how}, are given in (65) and (66).

(65) $[\![\,\mathrm{how}_i\,]\!]^{g,w_0}\ =\ \lambda\phi_{a(st)}\lambda w\lambda m_{s(vt)}\ \phi_w^{g[i\to m]}$

(66) $[\![\,Q_{\mathrm{how}}\,]\!]^{g,w_0}\ =\ \lambda M_{s((s(vt))t)}\lambda w\ M_w = M_{w_0}$

Piecing the extensions of all terminal and branching nodes in (64) together, we arrive at (67) as the extension of (63) at the point of evaluation w_0:

(67) $\lambda w\,[\,\lambda P\,\exists e < n\ \mathrm{kiss}_w(b_1)(e) \wedge \mathrm{agent}_w(e)(b_2) \wedge P_w(e)\ =$
$\lambda P\,\exists e < n\ \mathrm{kiss}_{w_0}(b_1)(e) \wedge \mathrm{agent}_{w_0}(e)(b_2) \wedge P_{w_0}(e)\,]$

Suppose – unrealistically, but anyway – that there are 3 relevant and suitable properties of events, the corresponding intension induces a partition of Logical Space with 8 cells, where each cell is a complete answer; cf., e.g., Table 2.

The semantics of a method how question

Consider (68) and its logical form (69), essentially the same structure as (64):

Belle kissed the Beast slowly and only slowly
Belle kissed the Beast tenderly and only tenderly
Belle kissed the Beast languorously and only languorously
Belle kissed the Beast slowly and tenderly but not languorously
Belle kissed the Beast slowly and languorously but not tenderly
Belle kissed the Beast tenderly and languorously but not slowly
Belle kissed the Beast slowly and tenderly and languorously
Belle kissed the Beast neither slowly nor tenderly nor languorously

Table 2: The complete answers to How did Belle kiss the Beast

(68)   how did Belle turn the Beast into a prince

(69) Q_{how} [how_1 [Tense [Belle [Voice [[turn [Beast into a prince]] t_1]]]]]

The semantics is different, though; while [kiss Beast] denotes a set of events which intersects with the extension of t_1, [turn [Beast into a prince]] denotes a function from properties of events which applies to the intension of t_1. Thus although *how* and the covert question operator Q_{how} continue to have the meaning specified in (65) and (66), the extension of (68) at w_0 becomes (70) (note that neither the relation between propositions $\texttt{Cause}_w$ nor the function from sets of states to sets of events $\texttt{Become}_w$ for a given w is spelt out here):

(70) $\lambda w\,[\,\lambda P\,\exists e\!<\!n\,\exists f\,\texttt{Cause}_w(\lambda i[\texttt{Become}_i(\texttt{prince}_i(b_1))(f)])(\lambda j P_j(e)) \wedge$
        $\texttt{agent}_w(e)(b_2) =$
        $\lambda P\,\exists e\!<\!n\,\exists f\,\texttt{Cause}_{w_0}(\lambda i[\texttt{Become}_i(\texttt{prince}_i(b_1))(f)])(\lambda j P_j(e)) \wedge$
        $\texttt{agent}_{w_0}(e)(b_2)\,]$

As usual, the partition of Logical Space induced by the corresponding intension will, if there are 3 relevant and suitable properties of events, consist of 8 cells, each a complete answer to the question, for example, those in Table 3.

Belle turned the Beast into a prince by crying
Belle turned the Beast into a prince by kissing him
Belle turned the Beast into a prince by hitting him
Belle turned the Beast into a prince by crying and by kissing him . . .
Belle turned the Beast into a prince by crying and by hitting him . . .
Belle turned the Beast into a prince by kissing him and by hitting him . . .
Belle turned the Beast into a prince by crying and by kissing him and by hitting him
Belle did not turn the Beast into a prince by crying or by kissing him or by hitting him

Table 3: The complete answers to How did Belle turn the Beast into a prince

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