Confidence Reports

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Abstract We develop a states-based semantics for nominal and adjectival confidence reports like *Ann is confident/has confidence that it's raining*, and their comparative forms. Our account leverages a Neodavidsonian analysis of adjectival comparatives in which adjectives denote properties of states and measure functions are introduced compositionally. We hereby provide the first systematic semantics for confidence reports, in addition to providing a needed modal extension to the states-based semantics of comparatives. As we show, the flexibility accorded by the Neodavidsonian implementation supports analysis of grammatical constructions with *confident/confidence* that might otherwise be puzzling, and it lends itself to certain natural ideas about the semantics of cross-categorial probabilistic language using, e.g., *likely* and *probability*. In the end, we sketch some immediate connections between confidence-reporting discourse (e.g., *I am confident that...*) and belief reports about probabilistic discourse (e.g., *I think it's likely that...*).

Keywords: confidence reports, confidence states, gradability, propositional attitudes, comparatives, degree semantics, Neodavidsonian semantics

1 Introduction

Our goal in this paper is to provide an analysis of confidence reports, i.e., sentences like (1a). A reasonable starting assumption is that these express a confidence relation between an attitude holder and a proposition. Importantly, these attitudes are gradable, as is evidenced by (1b). Reports with *confident* are thus part of a broader family of gradable attitude expressions, which includes verbs like *want* and adjectives like *sure/unsure* and *certain/uncertain*.

(1) a. Ann is confident that it's raining.
b. Ann is more confident that it's raining than that it's snowing.

Despite extensive research on propositional attitudes, the semantics of confidence reports is under-theorized. This might be because semanticists and philosophers expect that we can simply apply an off-the-shelf scalar semantics for gradable adjectives to *confident*. Indeed, in recent years a number of theorists have worked on extending standard degree semantics frameworks to modal adjectives like *likely*.[1]

1 See e.g. Yalcin 2010, Lassiter 2011, 2016.

Offhand, we might try to apply an analysis of this sort to attitude adjectives like *confident*, with perhaps minor adjustments.

A first worry about such a strategy is that it would be insufficiently general. The standard degree-based framework, based in the analysis of gradable adjectives, cannot be generalized to comparative constructions targeting nominals without issue. Whether one chooses a contemporary degree semantics in the style of Kennedy (1999) (adjectives-as-measure functions) or Heim (2001) (adjectives-as-degree relations), one ends up assigning a distinct element to introduce measure functions (or degree relations) in the nominal correspondents. This means that an off-the-shelf degree-theoretic account of (1) will fail to extend in a uniform fashion to sentences like (2a)-(2b) involving the nominal *confidence*.

(2) a. Ann has confidence that it's raining.
    b. Ann has more confidence that it's raining than that it's snowing.

Fortunately, the literature includes a proposal to support a unified treatment of adjectival and nominal confidence reports, namely Wellwood's (2014, 2015) treatment of gradability and comparison. She interprets gradable adjectives as properties of states in a broadly Davidsonian setting. This proposal supports the unification of nominal and adjectival comparison, but modal gradable adjectives have not been analyzed in such a framework. Their treatment requires accounting for distinctive complexities, some familiar from the extensive literature on attitudes and modal semantics, and others particular to the Davidsonian interpretation.

A second worry is that the simple, off-the-shelf strategy requires the well-known stipulation of a covert morpheme POS (or something like it) wherever a gradable adjective occurs without overt degree morphology. This is compositionally necessary on the standard degree semantics, but there is little independent evidence to support its existence (see Grano & Davis 2018 for recent discussion and references). Moreover, considering the semantic relationships between gradable adjectives and their nominal counterparts as in (1)-(2), implementing the simple strategy would mean extending this stipulation to the nominal domain as well. We propose instead to integrate the analysis of confidence reports within the POS-free framework independently developed in Cariani et al. 2023.

So we are in the following predicament. On the one hand, there are developed analyses of modal gradable adjectives in degree semantics, but these analyses don't generalize easily to the nominal case and they rely on stipulating POS. On the other hand, there is a unified analysis of adjectival and nominal comparison, but as yet no rigorous attempt has been made to bring modal expressions within its purview. Our goal in this paper is precisely to address this gap. We develop a unified analysis of adjectival and nominal comparison that applies seamlessly to the modal case.

Confidence reports are an excellent case study for this integration, given that their occurrence in nominal form is exceedingly commonplace.

A third motivating consideration fueling our proposal is internal to event-based projects in semantics. While there are contributions that aim to integrate Neodavidsonian event semantics with standard possible world semantics, there is comparatively little of this work with respect to graded modality and graded propositional attitudes. By comparison, graded modalities and, to a lesser extent, gradable attitudes are well studied within the classical degree framework (e.g., Lassiter 2011, 2016, Pasternak 2019). Given the necessity of an account along these lines, our efforts here profile as the first systematic foray into this territory within the Neodavidsonian paradigm.[2]

Here is a brief summary of our proposal. We develop a semantics that interprets *confident* as a property of states, measures of which are introduced compositionally in constructions like (1b) (Wellwood 2015, 2019). Using states supports a degree of semantic flexibility that we exploit in our analysis of both positive and comparative occurrences of *confident* and *confidence*. According to our proposal, the positive forms of *confident* and *confidence* involve reference to an initial ordering on states introduced by the lexical items (i.e., the "background ordering" of Cariani et al. 2023), while the comparative form involves reference to degrees introduced by *more* (i.e., a more familiar "degree ordering").

The resulting semantics directly accomplishes the primary goal for which it was designed: it provides a unified semantics for *confident* and *confidence* across their positive and comparative occurrences. And it does so without recourse to anything like a covert POS morpheme, all while affording a flexibility of composition that supports analysis of other varieties of confidence reports (e.g., *Ann is confident in Bill*, *Ann is a confident person*) that may elude an off-the-shelf scalar semantics.

As we flag in the final pages, our states-based analysis can in principle be extended to modal adjectives like *likely* and *probable*, e.g., (3). Unlike existing accounts, this analysis would also generalize seamlessly to nominal probability claims, such as (4).

(3) a. It is likely that it's raining.
    b. It is more likely that it's raining than that it's snowing.

(4) a. There's a chance that it's raining.
    b. There is more likelihood that it's raining than that it's snowing.

Relatedly, our analysis can capture inferential relations between confidence reports and reports of probabilistic belief. Here, the target of explanation is the intuition that

2 Wellwood 2019 sketches a modal analysis of so-called metalinguistic comparatives as modalized 'accuracy' reports. See her chapter 7.

a confidence report like (1b) sounds roughly equivalent to *Ann thinks that it's more likely to rain than to snow*.

We proceed as follows. We motivate the demand for a unified semantics for *confident* and *confidence* as against an off-the-shelf scalar strategy in §2. We lay out our compositional states-based analysis in §3, and explain the semantics of our target cases and other varieties of confidence reports in §4.2. Finally, §5 briefly discusses extensions of our approach beyond the domain of confidence reports, including conditionals, attitudinal scale-mates (e.g., *sure*, *doubtful*) and probability operators (e.g., *likely*, *chance*).

2 Confidence reports in a scalar setting

We consider reports with adjectival *confident* and nominal *confidence*, and their interpretation in the positive and comparative forms. A central assumption of our project is that it is desirable to pursue a unified semantics for these reports. This cannot be accommodated on the standard scalar semantics, since it assigns different compositional roles to adjectives and nouns in degree constructions: on classic accounts like those exemplified by Heim 1985, 2000 and Kennedy 1999, gradable adjectives lexically introduce/express measure functions, but that semantic role is played by a functional item like *much* or *many* with nouns.[3]

By itself, the fact that we have an adjective and a noun that are obviously morphologically related doesn't settle the question of whether a unified semantics is appropriate. Nevertheless, we think that there are strong compositional and logical reasons to pursue unification.

One compositional reason is that the very same comparative morphology applies to both the nominal and adjectival forms. As illustrated by (5), repeated from above, the same form, *more*, is used in comparative confidence reports regardless of the lexical category targeted.

(5) a. Ann is more confident that it will rain than that it will snow.
b. Ann has more confidence that it will rain than that it will snow.

The standard scalar analysis will assign *confident* and *confidence* different semantic types, and so it must postulate systematic ambiguity in the meaning of *more*. A unified account opens up the prospect of a single meaning for *more*.

And there are logical reasons. The inferential connections between nominal and adjectival confidence reports are visible already in the positive form: plausibly, the adjectival *Ann is confident that it's raining* entails the nominal *Ann has confidence*

3 This item may play its role covertly, given a surface form like *more*, or it may do so overtly, as in surface forms like *as much/many*, etc.

that it's raining. (Whether the entailment runs in the opposite direction is, as we will highlight, a more complex matter.) But the connection is even clearer in the comparative form: the pair in (5a) and (5b) are straightforwardly equivalent.

Such reasons strongly suggest to us the desirability of a unified account. Pursuing that goal will, however, steer us away from the standard framework commonly used to model gradability in the modal domain, and towards a framework based on states. It will be important for that move, then, to understand how the standard framework would apply in this case. A typical move is to begin with the adjectival case, and to treat the nominal one separately, if at all. Let us briefly tell a plausible version of such a story.

Applying the classic degree-theoretic account to an adjective first involves drawing attention to the available distributional evidence for gradability. This is, of course, found in abundance for adjectival *confident*: in addition to its comfortable occurrence in the comparative, (1b), it sensibly combines with the full panoply of comparative forms (e.g., *as confident*, *too confident*, *confident enough*, etc.), and with modifiers like *very* and *100%*. Such evidence is typically thought sufficient to posit that the relevant adjective directly lexicalizes a degree semantics.

Assume for now the version of the standard framework which assigns gradable adjectives like *tall* a measure function type (e.g., Kennedy 1999), i.e., the type that maps individuals to degrees.[4] In this framework, *confident* would be assigned the interpretation in (6), where **confident** maps a proposition p to x's degree of confidence in the truth of that proposition, and g is a variable assignment. (This treatment parallels recent analyses of *likely*, such as Yalcin 2010, Lassiter 2011, 2015, 2016.) Importantly, we needn't assume that degrees of confidence are probabilities, or indeed that they have any structure besides what is provided by the standard scalar framework.

(6) $\text{confident}^g = \lambda p_{st} \lambda x_e . \mathbf{confident}_x(p)$
type $\langle \langle s,t \rangle, \langle e,d \rangle \rangle$

For occurrences of the adjective without overt degree morphology, this framework typically assumes the presence of a covert morpheme, usually indicated by 'POS'.[5] While the details vary, the general function of this morpheme is to introduce comparison to a contextually-salient "standard" degree. Given these assumptions, the LF of (1a) has the additional structure indicated in (7a), and truth conditions

4 The prominent alternative in the style of Heim 1985, 2000 analyzes them as having a higher quantificational type which embeds a measure function. Everything we say in the text with the simpler types will apply equally well to this alternative, *mutatis mutandis*.

5 But see Rett 2015 for an attempt to deploy Gricean pragmatics to dispense with POS.

like those in (7b). This says that Ann's confidence in the truth of the proposition expressed by *it's raining* is greater than the standard for confidence in the context.[6]

(7) a. Ann is POS confident that it's raining.
b. $[\![(1a)]\!]^g$ = true iff $\textbf{confident}_a(\textbf{rain}) \geq \textbf{standard}_C(\textbf{confident})$

By design, this framework makes simple work of the interpretation of a comparative like (1b). Continuing in the style of Kennedy (1999), adjectival *more* would be interpreted as in (8), the core contribution of which is a strict greater-than relation between degrees. Here, d indicates the semantic value of the *than*-clause, and μ indicates a measure function (e.g., a map from the subject to their degree of μ-ness, in a predicative occurrence).

(8) $[\![\text{more}]\!]^g = \lambda d_d \lambda \mu_{ed} \lambda x_e . \mu(x) > d$
type $\langle d, \langle \langle e,d \rangle, \langle e,t \rangle \rangle \rangle$

Given these assumptions, (1b), repeated in (9a),[7] will have the truth conditions in (9b), so long as *confident* saturates its propositional argument prior to combination with *more*. This says that Ann's degree of confidence in the truth of proposition expressed by *it's raining* strictly exceeds her degree of confidence in the proposition expressed by *it's snowing*.

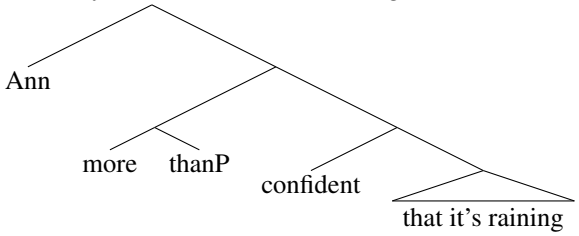
(9) a. Ann is more confident that it will rain than that it will snow.
b. $[\![(1b)]\!]^g$ = true iff $\textbf{confident}_a(\textbf{rain}) > \textbf{confident}_a(\textbf{snow})$

This proposal is simple and elegant. As it stands, however, it is not obvious how nominal confidence reports should be analyzed within the same framework.

6 The interpretation of POS on the Kennedy-style account we outline looks as in (i) below, assuming that *confident* combines with its propositional complement before combining with POS.

i. $[\![\text{POS}]\!]^g = \lambda \mu_{ed} . \lambda x_e .\ \mu(x) \geq \mathit{standard}_C(\mu)$

7 Here, the LF must be like that depicted in the tree below, ignoring the copular verb and the internal structure of the *than*-clause. This makes the standard assumption that *more* is discontinuous with the *than*-clause in the string due to obligatory extraposition (Bresnan 1973; cf. Bhatt & Pancheva 2004, Alrenga et al. 2012). Our proposal will revise this structure, in part, so that *more thanP* first combines with *confident* before *that it's raining*. See §4.4.



While we would not say that extending this analysis of adjectival reports to their nominal counterparts is impossible, no fully developed extension of this sort yet exists.[8] Meanwhile, *Ann has confidence that it will rain* just seems like it will require different compositional resources than what the standard account provides for the adjectival case. And while the account of nominal comparatives with *confidence* will overlap in important respects with better-considered nominal cases like *Ann has coffee* (though cf. Francez & Koontz-Garboden 2017), its abstract and modal character are different and will require care.

In the next section, we show how the picture looks if we start with an account of the nominal reports. In this direction of assimilation, we are able to leverage an existing alternative proposal towards a unified semantics — one that starts with gradability in the nominal domain and extends it to the adjectival case. As it stands, we know of no attempt to assimilate in the other direction, and the challenges facing such an attempt would be substantial.

3 The states-based analysis

Unlike the off-the-shelf degree-theoretic analysis just discussed, our states-based analysis takes as basic the nominal form, exemplified by (10a) and (10b).

(10) a. Ann has confidence that it's raining.
b. Ann has more confidence that it's raining than that it's snowing.

For some initial indications of its semantic role, observe that *confidence* is a mass noun.[9] On a first pass, this is just to say that it has a certain syntactic-semantic distribution. It appears comfortably with *much*, (11a), just like other mass nouns both concrete (*much mud*) and abstract (*much justice*). Like these nouns, it fails to appear comfortably with plural morphology, (11b), cardinal number words, (11c), or distributive quantifiers, (11d).[10]

(11) a. The men didn't express much confidence that the globe is warming.
b. ? The women expressed their confidences that the globe is warming.

8 This does not seem to be an accident, either. Some of the compositional worries that flow from the degree-theoretic treatment of gradable adjectives — e.g., the necessity of a covert POS or POS-like element whenever the gradable adjective occurs in the positive form — would be multiplied for any noun (e.g., *confidence*, *coffee*, *toys*) and any verb (e.g., *run*, *jump*, *like*) when it occurs outside of the comparative form.

9 Note that, plausibly, gradable adjectives like *confident* nominalize as mass because they bear the 'subinterval property', e.g., P has the subinterval property just in case whenever P is true over an interval i, P is also true over non-arbitrary sub-intervals of i. The closely-related notion of 'divisiveness' generally holds of concrete mass nouns like *water*.

10 (11a) is negative because such occurrences of *much* have an NPI-like distribution. See Solt 2015.

c. ? The reports suggested two confidence(s) that the globe is warming.

d. ? Each confidence was high.

In this section, we do three things. First, we introduce a standard Neodavidsonian analysis of abstract mass nouns. Second, we introduce Wellwood's (2015, 2019) extension of the Neodavidsonian framework to gradable adjectives. Third, we modify and update that analysis by showing how it can produce plausible truth conditions for the positive form. As we observe, the updated Wellwood framework we land on is silent on the treatment of modals and propositional attitudes. Addressing that task will be the focus of the rest of the paper.

3.1 The analysis of abstract mass nouns

Mass nouns like *height*, *swagger*, *confidence*, *pleasure*, and *ambition* denote properties of states, the 'mass' subtype of the type of eventualities, v.[11] For example, consider (12). (From now on, we use boldface in lexical entries to denote properties of states.)

(12) $[\![\text{swagger}]\!]^g = \lambda s_v.\mathbf{swagger}(s)$
type $\langle v,t\rangle$

Bare ascriptions of the form *S has F* where *F* is an abstract noun like that in (13) can then be interpreted along standard Neodavidsonian lines.

(13) Ann has swagger.

We adopt the 'total separation' hypothesis in which all syntactic arguments are mapped to conjuncts in logical form (cf. Castaneda 1967, Parsons 1990, Schein 1993, Pietroski 2005).[12] Here, we suppose that the name *Ann* contributes the entity *a*, but the interpretive result of theta-marking on that expression is the property of states in (14).[13]

11 We choose the formulation 'states' for simplicity. Related possibilities for valuing the *s*s are, for example, tropes (e.g., Moltmann 2009) or abstract substances (Francez & Koontz-Garboden 2015). We have little to say about the metaphysics of such entities. All we require is that, whatever they are, they show ordering relations and have thematic participants.

12 This generalizes the 'partial separation' analysis of Kratzer 1996, wherein it is assumed that while the external argument — in our cases, the phrase indicating the holder of the state — corresponds to a conjunct in logical form, the internal argument fills an argument slot in the relation lexically denoted by — in our target case — a noun like *confidence*. We furthermore assume that thematic relations are *functions*: a state determines its holder, if any, just like an event can determine its agent (see discussion and extensive citations in Williams 2015): the entities named as participating in these roles are assumed to do so exhaustively, and uniquely. Hence, we use the functional notation in the text.

13 The interpretation of the subject (indeed, that of any syntactic argument), then, composes conjunctively with that of the noun. In the framework of Heim & Kratzer 1998, the relevant composition rule

(14) $[\![\text{Ann}_{[\text{Ho}]}]\!]^g = [\lambda s_v.\textbf{holder}(s) = a]$
type $\langle v,t\rangle$

(13), then, is interpreted as an existential claim about states involving Ann as the 'holder' or 'bearer' of the state; see (15).[14]

(15) $\exists s_v[\textbf{holder}(s) = a \wedge \textbf{swagger}(s)]$

The comparative targeting an abstract mass noun, then, looks just like a comparative targeting any other mass noun, modulo the distinction between individuals and eventualities carried by the basic types e and v. In (16), a component of nominal *more* introduces the measure function (e.g., Heim 1985, Bhatt & Pancheva 2004, Bale & Barner 2009; cf. Solt 2015). Here, $g(\mu)$ stands for the value of g at index μ (one way of encoding the context-sensitivity of measures)[15], s is an eventuality to be measured, and d is provided by the *than*-clause.

(16) $[\![\text{more}_\mu]\!]^g = \lambda d_d \lambda s_v.g(\mu)(s) > d$
type $\langle d,\langle v,t\rangle\rangle$

Given these assumptions, the comparative (17) is interpreted as in (18) — momentarily abbreviating the *than*-clause degree as δ. This logical form may be read, 'there is a state of swagger s that Ann is in, the measure of which is greater than δ.'

(17) Ann has more swagger than Kim does.

(18) $\exists s_v[\textbf{holder}(s) = a \wedge \textbf{swagger}(s) \wedge g(\mu)(s) > \delta]$

The type d interpretation of the *than*-clause is derived via standard assumptions in the syntax and semantics of degree constructions.[16] First, *than* indicates the maximum of a set of degrees, (19).

(19) $[\![\text{than}]\!]^g = \lambda D_{\langle d,t\rangle}.max(D)$
type $\langle\langle d,t\rangle,d\rangle$

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linking subject and predicate is a version of Predicate Modification that applies to phrases of type $\langle v,t\rangle$.

14 We remain neutral as to which part of the sentence introduces the closure of the event argument. Often, this is taken to be performed by Tense or Aspect.

15 Wellwood 2014, 2019 discusses empirical and theoretical issues surrounding the handling of this component of *more*'s indeterminacy.

16 *Than*-clauses contain a silent instance of the matrix gradable predicate as well as an instance of *wh*-movement (see, e.g., Bresnan 1973 and Chomsky 1977). The movement chain is interpreted as an abstraction over degrees in relation to a covert degree morpheme (see, e.g., Kennedy 1999, Heim 2001, and Bhatt & Pancheva 2004).

Second, a covert instance of *as much* (parallel to *more* in (16)) introduces a greater-than-or-equal-to relation to degree d, which is abstracted over by an operator, OP. These moves are summarized in (20), expanding the interpretation of δ above.

(20) $[\![\text{than } [\text{OP}_d \text{ Kim}_{[Ho]} \text{ has } [[d \text{ as much}_\mu] \text{ swagger}]]]\!]^g =$
$max(\lambda d.\exists s_v[\textbf{holder}(s) = k \wedge \textbf{swagger}(s) \wedge g(\mu)(s) \geq d])$

The selection of values for $g(\mu)$ must meet one further condition which guarantees that the (strict) ordering relations on the measured domain are preserved in the corresponding degree ordering. This condition may be stated as in (21) (cf. Schwarzschild 2006, Nakanishi 2007, and Wellwood 2015, 2019), which says that if any two states are strictly ordered in a certain way, then their μ-measures are ordered in the same way in the degree ordering.

(21) $\forall s, s' \in Dom(\langle D, \succsim \rangle)$, if $s \succ s'$, then $g(\mu)(s) > g(\mu)(s')$.

The general idea is that the function expressed by a (measurable) abstract mass noun has a structured domain (of states), and the structure of such domains must be preserved in the mapping to degrees by the comparative operator. The details might look complicated, but they just extend how nominal comparatives work in other cases: the analysis of *more coffee*, for instance, assumes that *coffee* expresses a function whose domain is ordered by a part-of relation on portions of coffee, as maintained by much prior literature,[17] and that permissible values of μ in the comparative (e.g., a volume or weight measure) respect strict part-whole relations on those portions.

The upshot, then, is that ascriptions of abstract properties are states-based. Comparative confidence reports in the nominal domain will still involve confidence measures (i.e., $g(\mu)$ will map confidence states to degrees). But measures are introduced compositionally, and are not part of the lexical semantics of adjectives and nouns.

3.2 Gradable adjectives in a states-based framework

As anticipated, we mostly build on the Neodavidsonian semantics for gradable adjectives in Wellwood (2015, 2019). On this semantics, gradable adjectives express properties of ordered states. We first illustrate these details using *tall*.

Following Wellwood, computing the interpretation of a simple sentence like (22) involves interpreting *tall* as a property of states, as in (23a), with the resulting logical form for (22) in (23b).

17 For the assumption that common nouns like this lexically express functions of type $\langle e,t \rangle$ (modulo intensional contexts), see e.g., Montague 1974 and Krifka 2003 (cp. Chierchia 1998). That their domains are mereologically structured similarly to plural terms, see e.g., Cartwright 1975, Link 1983, and Champollion & Krifka 2016.

(22) Mary is tall.

(23) a. $[\![\text{tall}]\!]^g = \lambda s_v.\textbf{tallness}(s)$

b. $\exists s_v[\textbf{holder}(s) = m \wedge \textbf{tallness}(s)]$

The advantage of this states-based analysis is that it makes quick work of the comparative case.[18] The denotation for *more* provided in (16) composes just as easily with the denotations that emerge from this account of gradable adjectives. (In fact, according to this account these denotations have the exact same type.)

(24) Mary is taller (=more tall) than Beth.

(25) $\exists s_v[\textbf{holder}(s) = m \wedge \textbf{tallness}(s) \wedge g(\mu)(s) > \delta]$

$\delta = max(\lambda d.\exists s_v[\textbf{holder}(s) = b \wedge \textbf{tallness}(s) \wedge g(\mu)(s) > \delta])$

An initial concern about this framework is that it leaves open exactly what counts as a state of tallness. If having any degree of height is enough to count as having tallness, the meaning for the positive form will be too weak. (22) would end up simply saying that Mary has a state of height. Since even the shortest person in the world has some degree of height, though, we should expect that (22) is true so long as Mary exists. Alternatively, **tallness** could be strengthened so as to apply to states of height that exceed a certain threshold — say, six feet. The problem then is that this would generate unwanted entailments for the comparative form: a comparative of the form *a is F-er than b* would be predicted to entail that at least *a* is *F*.

One solution to this problem would be to import a move from the scalar playbook and introduce a special POS morpheme, which works with the types presumed in the nominal setting. (26) shows the truth conditions that we would get by positing an appropriate POS morpheme. The basic idea is that POS compares the tallness of the holder of the state, to a contextual standard.[19]

(26) $\exists s_v[\textbf{holder}(s) = m \wedge \textbf{tallness}(s) \wedge g(\mu)(s) \geq standard_C(g(\mu))]$

18 Wellwood (2014, 2019) cites general evidence for states in adjectival denotations, in line with which it is easy enough to observe that sentences 'about' John's confidence, whether reported with adjective or noun, introduce something that can be the antecedent for anaphors like *that* and *it*. Going beyond her diagnostics, we note that: (i) those things must be of the sort that can figure into explicitly causal language, contributing either cause (*John's confidence/being confident that it would rain made it snow*) or effect (*The cloud's appearance made John confident/gave John confidence that it would rain*); and (ii) their presence can straightforwardly help explain scopal interactions between confidence reports and *because*-clauses (i.e., the evident ambiguity of sentences like *Ann is confident/has confidence that Mary is in Paris because Gary is in Paris*).

19 Here is how to define POS. Take *more* in (16), replacing $>$ with $\geq$, and filling in the appropriate assumptions about the right-hand side of the relation instead of saturation by a *than*-clause denotation, etc.

Such a POS operator would, compositionally, turn a predicate of states (e.g., *tall*) into a different predicate of states, one which holds when a state has the relevant property to a sufficient degree in context C.

This move would be available in principle. The drawback of making it is that assuming the POS morpheme is stipulative. Here we pursue an option that eliminates this stipulation.

3.3 Positive form without positive morphemes

Our characterization of the positive form exploits the ideas developed in Cariani et al. 2023. This approach capitalizes on the order-theoretic properties of gradable stative predicates.

To begin, we draw a basic distinction between states of height and states of having tallness. Every state of having tallness is a state of height, but not vice versa. States of height are ordered with respect to one another. Positive occurrences of *tall* apply to height states in a certain region—the 'positive region'—of this ordered set, while forms like *taller* apply to any state of height.

In this proposal, the domains of gradable adjectives consist of elements in the domain of an ordering on states. Formally, this ordering is modeled as a pair $\langle D, \succsim \rangle$ of a set of states and (at least) a total pre-order on those states. For concreteness, assume that this ordering is tracked via a presupposition on the domain of the function expressed by the adjective, (27). (The subscript '**height**' flags that the relevant states are states of height — more on this momentarily.)

(27) $[\![\text{tall}]\!]^g = \lambda s_v \colon\ s \in Dom(\langle D_{\textbf{height}}, \succsim \rangle).\textbf{tallness}(s)$
type $\langle v,t \rangle$

Crucially, 'height states' are distinguished from 'tallness states'. So for example, the tallest individuals in a context will instantiate states of height and states of tallness, while the shortest individuals will instantiate states of height but not states of tallness. Thus, the meaning of *tall* isolates which of the height states count as tallness states. Going forward, we will call the broad domain that the adjective invokes the *background ordering*, and the set of states that an adjective like *tall* is true of the *positive region* of that ordering.[20] The relationship between the background ordering and the positive region can be seen in Figure 1.

Under this approach, the well-known context-dependence of gradable adjectives is reflected in how the positive region of the background ordering is determined.

20 Our terminology is meant to overlap with that of vagueness-based approaches like that of Klein 1980, 1982. Such approaches also posit an ordering on the domain of the adjective, though it holds between individuals. See also Francez & Koontz-Garboden 2017: ch.3 for a related proposal with a different implementation.

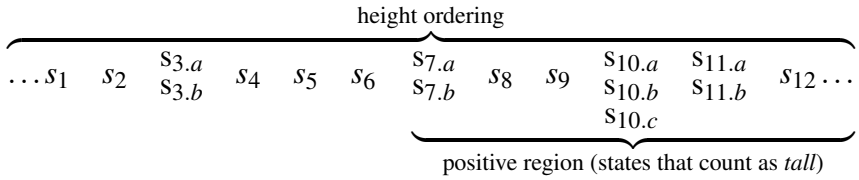

Figure 1 A pre-order on height states, some of which are states of tallness.

As a reminder, the central datum here is that a sentence like *Ann is tall* is true just in case Ann exceeds some standard for height in the context. We implement this context-sensitivity in the states-based framework via a contextual index on the gradable adjective. To delimit the positive region of the ordering, we explicitly define the positive region in terms of a function that we label `contrast`.

Concretely, we assume the lexical entry for *tall* in (28a), with **tallness** indexed by C. In (28b), we state schematic truth conditions for any gradable property **g-ness**, its associated background ordering $\succsim_{\textbf{g-ness}}$, and state s. The function `contrast` maps the gradable property to a salient *threshold state* s'. (Evidently, `contrast` is implicit parametrized to a context, but we will stop short of marking this explicitly.) In the case of (22), we now have the logical form in (29), which says that (22) is true just in case Mary is in a height state s ordered at least as high as the threshold state s' in that ordering.[21]

(28) a. $[\![\text{tall}]\!]^g = \lambda s_v\colon\ s \in Dom(\langle D_{\textbf{height}}, \succsim \rangle).\textbf{tallness}_C(s)$

b. $\textbf{g-ness}_C(s)$ is true iff $s \succsim_{\textbf{g-ness}} \texttt{contrast}(\textbf{g-ness})$

(29) $\exists s_v[\textbf{holder}(s) = m \ \wedge\ \textbf{tallness}_C(s)]$
$\equiv\ \exists s_v[\textbf{holder}(s) = m \ \wedge\ s \succsim_{\textbf{height}} \texttt{contrast}(\textbf{tallness})]$

For some applications, one might entertain a more complex function than `contrast`. We will not pursue this here.

This proposal is interesting for a number of reasons. First, our account of the positive form doesn't invoke measures, unlike those that utilize POS. Furthermore, we can already see how relativizing the `contrast` function to the gradable property can be useful: it allows different cut-off points for different adjectives, even if they plausibly share the same background ordering. Thus, we have in place a natural framework for modeling the relationships among clusters of gradable adjectives, like *cool* $\sim$ *warm* $\sim$ *hot*, or *doubtful* $\sim$ *unsure* $\sim$ *sure*. The further right in these lists, the higher the cut-off point required for a heat or credence state to count as an instance of the property.

21 The argument of `contrast` needs to be **tallness**, rather than **height**. The reason is that there might be other properties that exploit the same background ordering but select different regions within that ordering.

3.4 Revisiting the comparative form

Our analysis avoids POS by building extra information into the relevant lexical items: their entries distinguish a background ordering and a 'positive region' within that ordering. Comparative morphology uses part of this information, and discards the rest. In particular, comparative morphology discards the information encoded in the `contrast` function used to delimit the positive region. This blocks any inference to the positive form, and allows that even entities with very little height can be compared using *taller than*.

By way of illustration, we add a useful piece of notation. We assume a function $\texttt{background}(\cdot)$ that maps denotations of gradable adjectives — i.e., the partial function representing the property associated with an adjective G — to the background ordering on which states having that property are located. For example, $\texttt{background}(\cdot)$ maps the denotation of *tall* to a background ordering on states of height. Formally, this background ordering is characterized as a pair consisting of a set of sets and an ordering relation on that set.[22]

One might worry that this approach has a problem. How can we define a function from $[\![\text{tall}]\!]^g$ to such an ordering if *tall*, in effect, denotes a mere set of height states? Given what we've said so far, both *tall* and *short* should simply denote sets of height states. But somehow the comparative forms of these adjectives, *taller* and *shorter*, exploit different ordering relations on these sets. So we need to ensure that `background` delivers, in each case, the right ordering.

To address this problem, we simply assume that, for any dimension of comparison, there is a fundamental direction of the ordering on the relevant set of states. Accordingly, gradable adjectives that denote sets of states along that dimension exploit that fundamental direction. The fundamental direction for height, for example, is increasing. So `background` is able to return a set of states with the right ordering. The view that our cognitive system associates a privileged direction with dimensions actually enjoys empirical support.[23]

22 These assumptions flow from the set of proposals we build on (especially Wellwood 2019 and her precedents): degree morphology requires that the state/individual/event targeted for comparison lies on such an ordering, and admissible assignments of measure functions to μ are determined by conditions evaluated with respect to that ordering (e.g., what Solt (2018) calls the "Monotonicity Constraint" of Schwarzschild 2006). Presupposition-satisfaction via `background` effectively formalizes Wellwood's cross-categorial distinction between 'measurable' and 'non-measurable' predicates: plural count nouns (*more toys*), mass nouns (*more coffee*), and gradable adjectives (*more intelligent*) have non-trivially ordered domains, while singular count nouns (?*more toy*), once-only telic verbs (?*die more*), and non-gradable adjectives (?*be more pregnant*) do not.

23 Recent semantic analyses suggest, for example, that negative antonyms like *short* are represented as including their positive counterpart alongside an element that, in effect, inverts its associated ordering (cf. Heim 2006, Büring 2007). These analyses accurately predict a reaction time hit for *shorter than* as opposed to *taller than* comparatives (Tucker et al. 2018), in accord with long-standing expectations

Specifically, then, we say that *tall* has a uniquely associated ordering relation — this is its background structure, (30a). And, we say that *tall* is defined, for any given s, only if s is in the domain of that ordering, (30b).

(30) a. For any C, there is a unique $\langle D_{\textbf{height}}, \succcurlyeq_{\textbf{height}} \rangle$ associated with $[\![\text{tall}]\!]^g$ such that $\texttt{background}([\![\text{tall}]\!]^g) = \langle D_{\textbf{height}}, \succcurlyeq_{\textbf{height}} \rangle$.

b. For any s, if $[\![\text{tall}]\!](s)$ is defined, then $s \in Dom(\langle D_{\textbf{height}}, \succcurlyeq_{\textbf{height}} \rangle)$.

More generally, (31) states the relevant principles.

(31) a. For any gradable property G and context C, there exists a unique ordering relation R associated with G in C such that $\texttt{background}(G) = R$.

b. For any s, gradable property G, and ordering relation R, if G is defined for s and $\texttt{background}(G) = R$, then $s \in Dom(R)$.

These formulations pair naturally with our definedness conditions for *tall*: in any given context, states of tallness must be states of height. Those states are ordered. For `background` to be a function, of course, this height ordering must be the unique background structure plausibly associated with states of tallness.

The `background` function allows us, then, to use the denotations of adjectives like *tall* directly as the argument of $\texttt{background}(\cdot)$. In the entry for *more* in (32), `background` is invoked in a presupposition on the state argument: the relevant state is presupposed to be part of the background ordering of the predicate G.

(32) $[\![\text{more}_\mu]\!]^g = \lambda d_d \lambda G_{vt} \lambda s_v :\ s \in \texttt{background}(G).g(\mu)(s) > d$
type $\langle d, \langle \langle v,t \rangle, \langle v,t \rangle \rangle \rangle$

For illustration, the compositional process underlying (33) is sketched in (34). Abbreviating the contribution of the *than*-clause using δ, the property expressed by the degree phrase, *taller than Sue*, is a property of states in the background ordering of $\textbf{tallness}_C$ whose $g(\mu)$-measure is greater than δ, (34c). Combining the rest, (33) is interpreted as in (35), which says that Mary is in a height state (i.e., a state in the domain of the background ordering for $\textbf{tallness}_C$), the $g(\mu)$ measure of which is greater than Sue's corresponding state.[24]

(33) Mary is taller than Sue is.

from cognitive psychology about the processing of 'marked' expressions (e.g. Clark & Chase 1972). Further analysis of the antonymic case is beyond the scope of this paper, and is left for future work.

24 (35) records the presupposition on the state argument as a condition on the domain of the existential quantifier. Here, the asserted part is enclosed in square brackets, whereas in a lambda term it follows the dot. We will mostly suppress indications of the presupposed material for quantified statements in what follows, and more compositional details will be given in §4.

(34) a. $[\![\text{than Sue}]\!]^g = \delta$

b. $[\![\text{er [than Sue]}]\!]^g = \lambda G_{\langle vt \rangle}.\lambda s_v :\ s \in \texttt{background}(G).g(\mu)(s) > \delta$

c. $[\![\text{[tall [er than Sue]}]\!]^g = \lambda s_v :\ s \in \texttt{background}([\![\text{tall}]\!]^g).\ g(\mu)(s) > \delta$

(35) $[\![(33)]\!]^g = \exists s_v :\ s \in \texttt{background}([\![\text{tall}]\!]^g)\ [\textbf{holder}(s) = m\ \wedge\ g(\mu)(s) > \delta]$

3.5 States and attitudes

Let us take stock. We initially focused on the case of abstract mass nouns. We took notice of the standard approach in terms of states. Next, we presented Wellwood's proposal to the effect that it is possible to give a unified, states-based treatment of abstract mass nouns and gradable adjectives. Finally, we presented a new account of the relation between the positive and comparative forms within Wellwood's framework.

There is one last bridge to cross before we can provide an account of confidence reports. A key difference between *swagger* and *confidence* is that states of confidence are propositional attitudes. The last module of our account of confidence reports, then, aims to capture how the contents of confidence states figure in their truth conditions.

4 The semantics of confidence reports

4.1 States of confidence

Our semantics makes appeal to states of confidence. Let us make explicit our assumptions about these states and how they relate to each other.

Suppose that Mary is confident that it's raining, that Regina is in Saskatchewan, and that Brazil will win the World Cup. Then we say that there are three states of confidence such that Mary is the holder of all three. These states have as themes, respectively, the propositions that it's snowing, that Regina is in Saskatchewan, and that Brazil will win the World Cup. Hence, on this view, every ordinary person is the holder of a large number of confidence states.[25]

We assume that, like states of height, the confidence states of a holder are ordered. We again model this ordering via a pair $\langle D, \succsim \rangle$ of a set of states and (at least) a total pre-order on those states. Intuitively, the order ranks states by how confident the holder is in the truth of the state's theme. Thus, the background ordering includes both states of high and low confidence. Both *confident* and *confidence* single out a

25 A different construal of confidence states may be available: one could think that each individual is in exactly one confidence state, which has as its theme the strongest proposition they are confident of. This is similar to how, in a Hintikka-style semantics, every individual is in exactly one belief state. This is not the picture we adopt.

positive region of this ordering in a context. An ordering of confidence states, then, may be represented as in Figure 4.1.

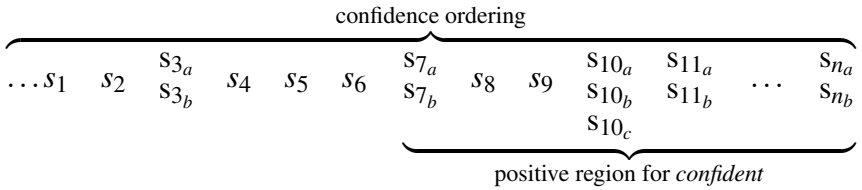

Figure 2 An ordering for *confident*.

As the diagram suggests, we assume that, at least for ordinary individuals, the ordering of confidence states includes the upper bound; that is, we assume that there are 'maximal' confidence states. Intuitively, these are states such that the holder cannot be more confident than the level of confidence that they have in the relevant proposition. As we point out in §5, this is especially plausible once we assume that the states picked out by *certain* also sit in the confidence ordering.

Finally, as given, background orderings vary from holder to holder. They represent how confident an individual is in the truth of different propositions. The orderings do not vary from theme to theme; we understand propositions to be the objects of confidence states, not parameters in fixing their ranking.

4.2 Comparative confidence reports

Having introduced states of confidence, let us introduce our semantics, starting from the comparative form.

Assume that the schematic comparative sentences in (36) have the same interpretation, i.e. (37), here and below abbreviating **holder** as **ho** and `background` as `bg`. Both express an existential statement about confidence states whose holder is Ann, whose theme is the proposition p and whose measure μ is greater than δ (the value provided by the *than*-clause, implicit in (36)). This analysis assumes that *confident* and *confidence* apply to the same subset of the same background ordering. We revisit this assumption shortly.

(36) a. Ann is more confident that p.
b. Ann has more confidence that p.

(37) $\exists s_v : s \in \mathsf{bg}(\llbracket \text{confident} \rrbracket^g)\ [\mathbf{ho}(s) = a \wedge \theta(s) = p \wedge g(\mu)(s) > \delta]$

The ordering of confidence states is tracked, as for *tall*, via presupposition, as shown in (38). Here and below, the subscript **conf** indicates that the ordering concerns states of confidence.[26]

(38) $[\![\text{confident}]\!]^g = [\![\text{confidence}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D_{\mathbf{conf}}^{\mathbf{ho}(s)}, \succsim \rangle).\mathbf{confidence}_C(s)$

In the end, logical forms like (37) say just that Ann's confidence with respect to p is greater than δ. This is a roundabout way of saying what the standard scalar analysis can say much more directly. However, taking the detour through states makes it explicit that it is confidence (and not the proposition that the confidence relates to) that is measured. It also allows us to capture the intuitive equivalence between the nominal and adjectival comparative forms as a matter of (propositional) identity, all the while maintaining a univocal analysis of *more*.

4.3 Positive confidence reports

The machinery that we established for interpreting the positive form with, e.g., **tallness** extends straightforwardly to the case of *confident* and *confidence* as well. Assume, as before, that the schematic positive sentences in (39) have the same interpretation — i.e., (40). Both express an existential statement about confidence states s whose holder is Ann, whose theme is the proposition p, and which is ordered higher than the contrast state s' according to the background ordering on confidence states.

(39) a. A is confident that p.
b. A has confidence that p.

(40) $\exists s_v[\mathbf{ho}(s) = a \wedge \mathbf{confidence}_C(s) \wedge \theta(s) = p]$
$\equiv \exists s_v[\mathbf{ho}(s) = a \wedge s \succsim_{\mathbf{conf}}^{\mathbf{ho}(s)} \texttt{contrast}(\mathbf{confidence}) \wedge \theta(s) = p]$

The fact that this analysis predicts that (39a) and (39b) have equivalent truth-conditions might look surprising. Suppose for instance that the weatherman is 20% confident that it will rain. In such a context, there is little temptation to accept *the weatherman is confident that it will rain*. Some judge, however, *the weatherman has confidence that it will rain* to be acceptable.[27] Indeed, the latter sentence seems

26 Relativizing the confidence structure to a holder is one of the main differences between the interpretations we assign to *confident* (/*confidence*) and *likely*, as we show below.

27 This judgment was brought to our attention in the Q&A session of a talk in which we presented some of this material. Several audience members, though not necessarily a majority, seemed to agree. We find it somewhat surprising, but must acknowledge that some speakers find the sentence acceptable.

to suggest that the weatherman has *some* confidence that it will rain. Taken at face value, such judgments are in tension with our prediction that sentences with *confident* and *confidence* are equivalent.

Nonetheless, we think there are good reasons not to take these judgments at face value. For one thing, if *having confidence* means the same as *having some confidence*, then negating a sentence of the form *A has confidence that p* should require that A has no confidence whatsoever in p. But this doesn't seem right. For example, (41) doesn't require that the weatherman assign zero confidence to the possibility of rain in order to be judged true.

(41) The weatherman does not have confidence that it will rain.

Another reason to reject any identification between *having confidence* and *having some confidence* is that it predicts *Ann has more confidence that it's raining than that it's snowing* to entail *Ann has confidence that it's raining*. This seems wrong, too: merely having more confidence in p than in q doesn't seem sufficient for having confidence in p.

Perhaps, however, one might reject the equivalence between (39a) and (39b) while denying that *A has confidence that p* is equivalent to *A has some confidence that p*. Nominal confidence reports might demand a lower (but non-zero) threshold than adjectival reports. Officially, we are agnostic on this point, but it is worth noting that our framework allows us to model it as a possibility. For instance, we might treat *confident* and *confidence* on the model of *hot* and *warm* — i.e., that there are two different properties of states, **confident** and **confidence**. They are based on the same background confidence ordering, just the `contrast` function maps them to different benchmarks on that ordering in the positive form.

4.4 Compositional details

Here is how our analysis derives the interpretations of the sentences in (1).

(1) a. Ann is confident that it's raining.
b. Ann is more confident that it's raining than that it's snowing.

Recall our interpretation for the gradable adjective, as in (38). Its syntactic complement, like the subject *Ann* (see §3.1) is theta-marked, and so interpreted as a predicate of eventualities, (42). Here and following, we indicate the interpretation of expressions like *that it's raining* as the proposition **rain**, etc; e.g., (42).

(38) $[\![\text{confident}]\!]^g = [\![\text{confidence}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D^{\mathbf{ho}(s)}_{\mathbf{conf}}, \succsim\rangle).\mathbf{confidence}_C(s)$

(42) $[\![\text{that it's raining}_{[Th]}]\!]^g = [\lambda s_v.\theta(s) = \textbf{rain}]$

Deriving the interpretation of the positive form in (1a) is then straightforward: *confident* first combines conjunctively with *that it's raining*$_{[Th]}$ and then with *Ann*$_{[Ho]}$. As is clear in (43), we assume that if one of the two conjoined functions has a specific domain condition, this condition is inherited by their conjunction; the same goes for the eventual existential closure of the relevant predicate in (44).

(43) a. $[\![\text{confident [that it's raining]}_{[Th]}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle).\textbf{confidence}_C(s)\ \wedge\ \theta(s) = \textbf{rain}$

b. $[\![+\ \text{Ann}_{[Ho]}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle).\textbf{ho}(s) = a\ \wedge\ \textbf{confidence}_C(s)\ \wedge\ \theta(s) = \textbf{rain}$

(44) $[\![(1a)]\!]^g =$
$\exists s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle)[\textbf{ho}(s) = a\ \wedge\ \textbf{confidence}_C(s)\ \wedge\ \theta(s) = \textbf{rain}]$

Second, for the comparative in (1b). We begin with the matrix clause, abbreviating the *than*-clause meaning as δ. Recall our interpretation for *more* in (32).

(32) $[\![\text{more}_\mu]\!]^g = \lambda d_d \lambda G_{vt} \lambda s_v\colon\ s \in \text{bg}(G).g(\mu)(s) > d$

Since, on our proposal, *more* simply uses the XP it combines with to fix the background structure and effectively discards the rest, if XP = *confident that it's raining*, the information that the relevant state is about **rain** will be lost. So, we revise the structural assumption of §2 so that *more*+thanP combines with *confident* before *that it's raining*. The matrix clause interpretation of (1b), then, is as in (45).

(45) a. $[\![\text{more}_\mu\ \text{thanP}]\!]^g =$
$\lambda G_{vt} \lambda s_v\colon\ s \in \text{bg}(G).g(\mu)(s) > \delta$

b. $[\![+\ \text{confident}]\!]^g =$
$[\lambda s_v\colon\ s \in \text{bg}([\![\text{confident}]\!]^g).g(\mu)(s) > \delta] =$
$[\lambda s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle).g(\mu)(s) > \delta]$

c. $[\![+\ \text{that it's raining}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle).g(\mu)(s) > \delta\ \wedge\ \theta(s) = \textbf{rain}$

d. $[\![+\ \text{Ann}_{[Ho]}]\!]^g =$
$\lambda s_v\colon\ s \in Dom(\langle D_{\textbf{conf}}^{\textbf{ho}(s)}, \succsim\rangle).\textbf{ho}(s) = a\ \wedge\ g(\mu)(s) > \delta\ \wedge\ \theta(s) = \textbf{rain}$

For the *than*-clause, we make the same structural assumptions as in §3.1, just with the requisite adjustments to the interpretation of *as (much)* to align it with (32), with $\geq$ rather than $>$. This expression, too, combines directly with the gradable adjective prior to combination with the propositional object. The composition, then, proceeds in parallel with the matrix clause; the result is as in (46).

(46) $[\![\text{thanP}]\!]^g =$
$[\![\text{than } [\text{OP}_d \text{ Ann}_{[Ho]} \text{ is } [[[d \text{ as}_\mu] \text{ confident}] \text{ [that it's snowing]}_{Th}]]]\!]^g =$
$max(\lambda d.\exists s_v\colon\ s \in Dom(\langle D^{\mathbf{ho}(s)}_{\mathbf{conf}}, \succsim\rangle)[\mathbf{ho}(s) = a \ \wedge\ g(\mu)(s) \geq d \ \wedge\ \theta(s) = \mathbf{snow}])$

Putting these pieces together, and existentially binding the state argument, delivers (47).

(47) $[\![(1b)]\!]^g =$
$\exists s_v\colon\ s \in Dom(\langle D^{\mathbf{ho}(s)}_{\mathbf{conf}}, \succsim\rangle)[\mathbf{ho}(s) = a \ \wedge\ \theta(s) = \mathbf{rain} \ \wedge\ g(\mu)(s) >$
$max(\lambda d.\exists s_v\colon\ s \in Dom(\langle D^{\mathbf{ho}(s)}_{\mathbf{conf}}, \succsim\rangle)[\mathbf{ho}(s) = a \ \wedge\ \theta(s) = \mathbf{snow} \ \wedge\ g(\mu)(s) \geq d])]$

4.5 Varieties of confidence reports

Semanticists often puzzle over variant uses of *confident*/*confidence* when considering confidence reports that appear, at least on the surface, to require a different treatment. In this section, we briefly show how our analysis would approach this broader distribution. We will not provide anything like a complete account of these varieties, but we think the states-based analysis in particular highlights promising avenues for analysis.

First, it is often observed that, in addition to its occurrences with clausal complements, *confident* (like *confidence*) can surface with prepositional complements, (48), and without any apparent complement whatsoever, (49).

(48) Marie is confident in Bill.

(49) Marie is confident.

The *in*-phrase in (48) doesn't obviously stand in for any propositional content. (49), in contrast, can be read just like (48), or as proposition-involving like our target cases, depending on what is salient in the context. For that matter, (49) can also be read as saying that Marie is a confident person, simpliciter, or that she is confident as an athlete, etc.

Our focus here has been on the proposition-involving uses, however we think it is plausible to see such data as reflective of the kind of flexibility afforded by our Neodavidsonian analysis. Conceiving of *confident*/*confidence* as introducing a set of states allows us to suppose that such a set may be restricted in various ways; such restrictions are the function of elaboration by thematic predicates like *in Bill* or modifiers like *as an athlete*. Consider, for an analogy, that *Al ran to the park* is telic and supports different inferences than atelic *Al ran in the park* (cf. Rothstein 2016). Elaborating the ways in which the relevant sets can be restricted is a matter for semantic typology. Regardless, we might expect that any such possible

refinements can be inferred in the absence of any thematic expression, as we are plausibly observing with uses like that in (49).[28]

It is inviting to think about the contrast between *be confident* and *feel confident*, as well, but this will require a semantics for *feel* which is clearly beyond the scope of this paper. As preliminary remarks, we may say that it appears that the assertibility conditions for *feel confident* line up with those for *be confident*. It strikes us (and an anonymous reviewer) as bad to assert the one but deny the other, (50a)-(50b).

(50) a. ? Marie is confident that it's raining but she doesn't feel confident that it is.

b. ? Marie isn't confident that it's raining but she feels confident that it is.

The reason for the badness of (50), however, cannot be the logic of *feel X*, because sentences like those in (51) don't strike us as bad in the same way.

(51) a. Marie is tired but she doesn't feel tired.

b. Marie isn't tired but she feels tired.

Plausibly, people bring to bear some kind of default assumptions to the effect that, typically, as something that we know to be generally true of the world, experiencing a feeling of confidence comes close to being confident and vice versa, but this is not true of what we know about being tired.

4.6 The logic of confidence reports

The analysis we propose has interesting consequences for the logic of reports with *confident* and *confidence*.

On the one hand, we impose virtually no constraints on what a subject's confidence ordering looks like. This allows us to regard as true any confidence report that describes states that cannot be represented via a probability function. Here is one example: by the way probability functions are defined, the probability of a conjunction is a lower bound on the probability of a conjunct. Yet it is well-known[29] that, under determinate circumstances, subjects appear to routinely violate this constraint. As a result, it appears that, under the right circumstances, the sentences in (52) can be true together.

(52) a. John is not confident that Linda is a bankteller.

b. John is confident that Linda is a feminist bankteller.

28 The same likely goes for thinking about Individual-level vs Stage-level attributions of confidence. Compare *She's a confident person* and *She's a confident swimmer*.

29 The *locus classicus* for this claim is Tversky & Kahneman 1983.

Our semantics is equipped to vindicate this. Similarly, nothing in our proposal dictates that a subject should be fully confident of tautologies, while probability functions assign tautologies full probability by design.

On the other hand, other predictions are hardwired into our semantics. These predictions don't track logical relations between the *contents* of confidence states. Rather, they track logical relations between *confidence states* themselves. For example, the inference from (53a) to (53b) is validated by our semantics. Let us introduce σ as a metalinguistic variable ranging over individuals, and continue to use p and q as metalinguistic variables for propositions.

(53) a. σ is confident that p, σ is more confident of q than of p
b. σ is confident that q

Below are three logical properties that are validated by our semantics for *confident* and *confidence*.

Transitivity. (54a) and (54b) entail (54c).

(54) a. σ is more confident (/has more confidence) that p than that q.
b. σ is more confident (/has more confidence) that q than that r.
c. σ is more confident (/has more confidence) that p than that r.

Antisymmetry. (55a) and (55b) entail (55c).

(55) a. σ is at least as confident of p as of q.
b. σ is at least as confident of q as of p.
c. σ is equally confident of p and q.

Connectedness. (56) is a logical truth.

(56) Either σ is at least as confident of p as of q, or σ is at least as confident of q as of p.

Transitivity and Antisymmetry seem to be encoded in the grammar of the relevant expressions, as empirical evidence shows. For example, the discourse in (57) appears to be contradictory.

(57) Aidan is more confident that it will rain than that it will snow, and more confident that it will be windy than that it will rain. # But he's not more confident that it will be windy than that it will snow.

There is a clear contrast between the discourse in (57) and the sentences in (52). The latter are perfectly consistent, though of course they describe a subject whose cognitive state is not fully rational.

The case for Connectedness is less straightforward.[30] If *confident* violates Connectedness, the following should be heard as consistent:

(58) Gina is not more confident that it will rain than that it will snow, not equally confident that it will rain than that it will snow, and not less confident that it will rain than that it will snow

Arguably, (58) is a very odd discourse. But it's unclear that it should be treated as incoherent, on a par with (57). It might just be that some propositions are simply not comparable by the lights of a subject's confidence states, and that this is reflected in grammar.

We remain agnostic about whether Connectedness actually holds for *confident* and *confidence*. Let us just point out that modifying our semantics in a way that Connectedness fails would be straightforward. Currently, states of confidence are arranged in a total order. We drop Connectedness by swapping this for a partial order, thereby admitting some incomparabilities.

Consider now the pattern of entailment in (59). This requires more controversial assumptions. Suppose that the `contrast` function invoked by the positive form of the adjective always maps a proposition to its negation (a corollary being that one cannot be both confident that p and confident that $\neg p$). Then we predict the entailment in (59): (59a) requires that confidence-that-p states be ranked higher than confidence-that-not-p states, and *more* will always map higher-ranked states to higher degrees, in line with its monotonicity condition.

(59) a. σ is confident (/has confidence) that p.
b. σ is more confident (/has more confidence) that p than that $\neg p$.

These seem welcome consequences of assuming that the contrast of a proposition is always its negation. Nevertheless, we prefer to remain agnostic about this assumption, since there are substantial reasons to doubt it. Here are two.

First, the assumption might overgenerate. We did not assume that an attitude holder's confidence states are probabilistic, hence it may happen that Carlo has extremely low confidence in p and even lower confidence in $\neg p$. In this case, if we hold on to the assumption that the contrast of a proposition is always its negation, Carlo will still count as confident in p. But this seems wrong.[31]

30 Thanks to an anonymous referee for feedback on this point.

31 We might try to fix this by letting the contrast proposition be some benchmark proposition (e.g., the proposition that the agent feels fifty-fifty about p and q). That would fix the current problem while making the same predictions as the original proposal when the attitude holder's confidence structure is probabilistic. But it loses the entailment (59) and its corollary, as there might be some non-probabilistic attitude holders according to which both p and $\neg p$ exceed the benchmark. Ultimately, we should expect some unintuitive predictions from any theory that attempts to model less than

Second, there seem to be intuitive cases where an agent is confident in a proposition, even though they are more confident of its negation.[32] Suppose that Clara, who is probabilistically coherent, believes that the Warriors have a 49% chance of winning the NBA finals this year, and that each of the other teams has at most a 3% chance of winning. Now suppose that we are having a discussion about which teams have the best shot at winning the finals. (60) seems true in this context, despite the mass of Clara's confidence favoring some team other than the Warriors.

(60) Clara is confident that the Warriors will win the NBA finals.

5 Beyond *confidence*

Having presented our analysis of confidence reports, we quickly touch on some possible extensions. Some of these extensions are immediate, and can be resolved entirely within the scope of our discussion. Others will require separate development.

5.1 Conditional confidence

Confidence reports interact with conditional antecedents in ways that are not entirely predicted by the system we have set up. Two specific kinds of facts stand out: it is possible for one to self-ascribe conditional confidence in p even if one is not confident of p, as in (61a). Such conditional ascriptions sound roughly equivalent to self-ascriptions of confidence in the conditional, as in (61b).

(61) a. If Lisa is in town, I am confident that she is at the lab.
b. I am confident that if Lisa is in town she is at the lab.

This is plausibly an instance of a more general phenomenon: doxastic attitudes, as well as other kinds of attitudes, may be restricted by conditional antecedents (Blumberg & Holguín 2019, Jerzak 2019). There are plausible off-the-shelf modifications one might make to the semantics to capture this sensitivity. One option would be to endow confidence reports with a modal base and allow conditional antecedents to restrict it. Another option would be to make the background ordering sensitive to an information state i which can be operated on by conditional antecedents. Specifically, revise (38) to (62) — indexing the ordering $\succsim$ with i. Then, assume a semantics for conditionals (broadly in the style of Kratzer 1991, Yalcin 2007, Kolodny & MacFarlane 2010) in which conditional antecedents restrict i. Since (62) makes the ordering $\succsim$ dependent on i, this predicts that one can assert (61a) even if

perfectly coherent agents. It is hard to say what exactly the semantics should predict when an agent's confidence structure is incoherent in the way Carlo's is.

32 For a similar point about *likely*, cf. Yalcin 2010 and discussion in Hawthorne et al. 2016, p. 1400.

one isn't unconditionally confident that Lisa is at the lab. Choosing between these options is, of course, beyond the scope of the present investigation.

(62) $[\![\text{confident}]\!]^{g,i} = [\![\text{confidence}]\!]^{g,i} =$
$\lambda s_v\colon\ s \in Dom(\langle D^{\mathbf{ho}(s)}_{\mathbf{conf}}, \succsim_i \rangle).\mathbf{confidence}_C(s)$

5.2 *certain* and *certainty*

The kind of analysis for *confident*/*confidence* that we propose can be extended to a variety of other adjectives which report gradable attitudes and have nominal counterparts. This is not surprising. Confidence reports are embedded in a network of inferential and semantic connections with reports of certainty, doubt, and subjective plausibility. For instance, (63a) asymmetrically entails (63b), which in turn appears inconsistent with (63c).

(63) a. Ann is certain that the dress is blue.
b. Ann is confident / has confidence that the dress is blue.
c. Ann doubts that the dress is blue.

Our approach can be generalized smoothly to these other gradable attitudinal adjectives. Here we focus on the adjective *certain* and the noun *certainty*.

Let's start by observing that *certain* leads a double life. On the one hand, like *confident*, it is a gradable attitudinal adjective, i.e. it is used to describe the mental state of a subject. The mark of this usage of *certain* is the presence of a non-expletive subject, as in (63a) above. On the other hand, *certain* may be used with an expletive subject to produce an 'impersonal' reading that is more akin to an epistemically modalized claim, an example of which is in (5.2).

(64) It is certain that the dress is blue.

We set this impersonal reading aside and focus on the attitudinal use.

As noted above, it appears that *certain* asymmetrically entails *confident*. This is confirmed by the observation that (65a) is perfectly felicitous, while (65b) is defective.

(65) a. Ann is confident that the dress is blue, but she isn't certain that it's blue.
b. ?? Ann is certain that the dress is blue, but she isn't confident that it's blue.

Certainty behaves in a fully analogous way. Having certainty that p asymmetrically entails having confidence that p, as shown in (66).

(66) a. Bob has confidence, but not certainty, that the dress is blue.
b. ? Bob has certainty, but not confidence, that the dress is blue.

To account for this asymmetric entailment, we suggest that *certain* and *certainty* exploit the same background ordering of states as *confident* and *confidence*. The difference between the two adjective/noun pairs is just that they are assigned different positive regions within that ordering, such that *certain* picks out a smaller segment of the background ordering than *confident*.

Hence there is an obvious analogy between the pair *confident*/*certain* and the pair *warm*/*hot*, which we discussed briefly in §3. In both cases, the adjectives exploit the same background ordering of states, but they single out different positive regions. There are also disanalogies.[33] Consider (67) and (68):

(67) The pot is hot, but the pan is even warmer/hotter.

(68) Ann is certain the dress is blue. ??But she's even more confident/certain that the shirt is blue.

Even if something is hot, it is possible for something else to be hotter than it is. But if you're certain of a proposition, it would be odd to say that you're nonetheless more certain of anything else.[34] This means that the states singled out by *certain* form an upper bound on the confidence ordering. This is also confirmed by data involving modifiers: the sentences in (69a) and (69b) appear to be fully equivalent.

(69) a. Ann is fully/completely/100% confident the dress is blue.
b. Ann is certain the dress is blue.

Given these facts, we assume that confidence orderings have maximal elements, and that *certain* denotes the set of those maximal elements. This situation is captured in Figure 5.2.

The truth conditions for a bare ascription of certainty, then, are as in (70).

(70) a. A is certain that p.
b. A has certainty that p.

(71) $\exists s_v[\mathbf{ho}(s) = a \wedge \mathbf{certainty}_C(s) \wedge \theta(s) = p]$
$\equiv \exists s_v[\mathbf{ho}(s) = a \wedge s \succsim^{\mathbf{ho}(s)}_{\mathbf{conf}} \texttt{contrast}(\mathbf{certainty}) \wedge \theta(s) = p]$

33 Thanks to an anonymous referee for pressing us to consider this point, and for suggesting to us the relevant data.

34 Some sentences of the form *I'm certain that p, but I'm even more certain that q* sounds consistent. Apparent counter-examples to the claim that 'maximum standard' adjectives pick out the endpoint of the scale have been known for some time. Kennedy & McNally (2005) suggest that while such expressions (including *full*, *empty*, and, for us, *certain*) indeed encode reference to maxima, they can be used more loosely to talk about things ordered slightly lower. Such uses can be modeled, for example, using pragmatic halos (Lasersohn 1999). (Thanks to our S&P editor for discussion here.)

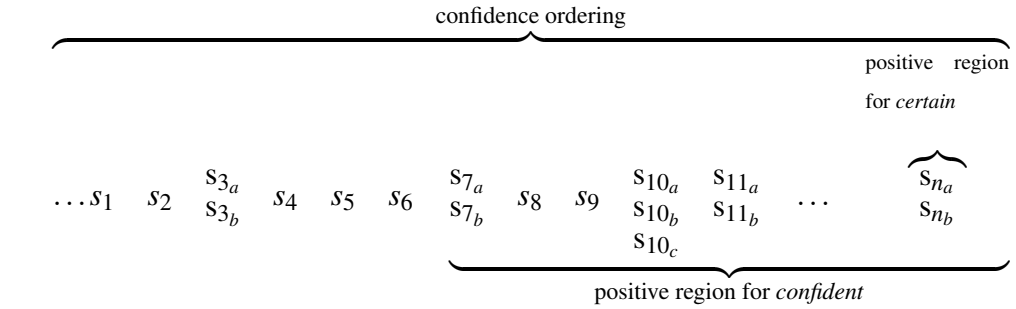

Figure 3 The ordering for *confident* and *certain*.

These assumptions immediately predict the pattern of asymmetric entailment we have observed, i.e., that one can ascribe confidence without certainty, as in (65a) and (66a), but not certainty without confidence, as in (65b) and (66b).

One nice feature of this approach is that it readily explains why the comparative forms of these attitude-reporting adjectives are so close in truth-condition. That is, we can explain why the sentences in (72) sound approximately equivalent to each other. Because the `contrast` function (and thus sensitivity to the positive region) is disabled in the comparative form, the sentences express the same comparison.

(72) a. A is more confident that p than that q.
b. A is more certain that p than that q.

5.3 From *confident* to *likely*

Confidence and certainty reports can be roughly characterized as gradable attitude reports. We can think of such gradable attitude reports as claims about some attitude holder's being in a certain credal state. This naturally raises the question of how the work we carried out in the case of gradable attitude reports relates to the recent explosion of work on gradable epistemic modals. For instance, much recent work has tackled the semantic analysis of claims such as those in (73).[35]

(73) a. It is likely to rain.
b. It is more likely to rain than to snow.

The first thing to observe here is that there are important asymmetries between the semantics of gradable attitude reports and the semantics of probabilistic modals

35 For a non-exhaustive list, see Yalcin 2010, Swanson 2007, Lassiter 2011, 2015, 2016, Holliday & Icard 2013, Klecha 2014, Moss 2015, 2018, Santorio & Romoli 2017. For an approach to gradable modality that may have implications for gradable epistemic modals (even though it was not initially developed in that context), see Portner & Rubinstein 2016.

like *likely*. These asymmetries have already been used to draw a contrast between *believe*, on the one hand, and *might*/*must*, on the other. They can be easily replicated for *confident* and *likely*; they show up with the pairs in (74) and (75) involving our target expressions.

(74) a. Suppose it's raining but I am confident it is not raining.
b. ? Suppose it's raining but it is probably not raining.

(75) a. Suppose it's raining but I am more confident that it's snowing than that it's raining.
b. ? Suppose it's raining but it's more likely that it's snowing than that it's raining.

While these examples show that probability operators are importantly different from attitude verbs, there are also reasons to explore a states-based analysis of probabilistic language. For one thing, there appears to be a near equivalence between gradable confidence reports and qualitative belief ascriptions involving certain probabilistic contents. For instance, there is a reading of *confident* that makes the sentences in (76) sound roughly equivalent, and similarly for the sentences in (77).[36]

(76) a. I am confident (/have confidence) that it will rain.
b. I think/believe it is likely that it will rain.

(77) a. I am more confident that Masaya will teach syntax than that he will teach semantics.
b. I think/believe that it is more likely Masaya will teach syntax than that he will teach semantics.

We emphasize that this observation is merely one of 'rough equivalence', since we have encountered a variety of judgments on the matter. While some people judge them to be equivalent, others hear (76a) as somewhat stronger than (76b). This intuition is supported by the observation that (78) can be heard as consistent.

(78) I think it's likely that it will rain, though I'm not confident that it will rain.

While we do not deny these complications, we also note that the intuitions in favor of equivalence are much stronger for the comparative sentences in (77). If those intuitions were taken at face value, they would support the need to forge an inferential link between gradable attitude expressions and probability operators.

Indeed, as a reviewer points out, there are deep analogies between *think*/*believe likely* on the one hand and *confident* on the other when it comes to their evidentiality

36 We do not, of course, deny that there is another reading of (76a) on which this equivalence fails. Given this other reading, *I am confident that p* means roughly that I have faith that *p* will happen.

requirements. Thus both (79b) and (79c) require that Susanna has not tried the pasta, while (79a) is used — and in fact *preferably* used — in contexts in which she has tried the pasta.

(79) a. Susanna thinks the pasta is delicious.
b. Susanna thinks the pasta is likely to be delicious.
c. Susanna is confident that the pasta is delicious.

There are also more direct considerations for extending our approach to probability operators. The main one is that, as for confidence reports, related probability claims can be expressed using nominal forms, for example (80).

(80) a. There is a chance I will drink tea today.
b. There is more chance/likelihood that it will rain than that it will snow.
c. There is a good chance/probability of snow above 5000 ft.

The distributional facts that inspired the states-based approach to *confidence* replicate in this case too. Nouns like *chance*, *probability* and *likelihood* combine comfortably with *much*, but not with cardinal number words (?*two chances*, ?*two likelihoods*), or distributive quantifiers (?*each chance*, ?*each likelihood*), etc.

Moreover, the array of data that suggest the presence of an eventuality argument in confidence reports (see fn.18) can be replicated for likelihood claims. For example, these nominal forms can introduce causes (81) and effects (82). This suggests that, as for confidence reports, the sentences in (81) and (82) involve concrete entities linked to likelihood that can enter into causal relations.

(81) a. The likelihood of snow led me to wear boots.
b. The probability of snow led me to wear boots.
c. Rain's being likely caused me to bring an umbrella.

(82) a. God banging his drum increased the likelihood of snow.
b. Warm air currents lessened the probability of snow.
c. God's banging his drum made snow likely.

Threading together the similarities and differences between confidence reports and probability operators with regards to their semantic profiles is a complex project. Our hope here has just been to provide some initial direction and focus for such a project, building on our analysis of confidence reports.

6 Conclusion

This paper has considered the semantics of confidence reports across their nominal and adjectival uses. We posited that *confident* and *confidence* express (Neodavidsonian) properties of states, type $\langle v,t\rangle$. In the bare, or positive form, an attitude-holder's

confidence state with respect to a given proposition p is contrasted with their confidence with respect to (at least in some cases) the proposition $\neg p$. In the comparative form, *more* compositionally introduces a mapping from confidence states to degrees. The central insight of the approach encodes a division of labor with regards to degree semantics. Expressions like *confident* carry along information about the sorts of state structures they are relative to. We exploit these background orderings in our formulation of a (degree-less) positive form, exploiting scales (i.e., ordered sets of degrees) only when dealing with the comparative form.

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