

Amount semantics *

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Abstract This paper presents a case study of the English noun *amount*, a word that ostensibly relies on measurement in its semantics, yet stands apart from other quantizing nouns on the basis of its EXISTENTIAL interpretation. *John ate the amount of apples that Bill ate* does not mean John and Bill ate the same apples, but rather that they each ate apples in the same quantity. *Amount* makes reference to abstract representations of measurement, that is, to degrees. Its EXISTENTIAL interpretation evidences the fact that degrees contain information about the objects that instantiate them. Outside the domain of nominal measurement, the noun *kind* exhibits behavior strikingly similar to that of *amount*; both yield an EXISTENTIAL interpretation (Carlson 1977b). This observation motivates re-conceiving of degrees as nominalized quantity-uniform properties—the same sort of entity as kinds. Thus, the semantic machinery handling kinds also handles degrees (e.g., *Derived Kind Predication*; Chierchia 1998): As nominalized properties, degrees are instantiated by objects that hold the corresponding property; when instantiated by real-world objects, degrees (and kinds) deliver the EXISTENTIAL interpretation.

Keywords: measurement, degrees, kinds

1 Introduction

English possesses a class of nouns, call them ‘quantizing’ nouns, that perform or facilitate measurement. Among this broad class of quantizing nouns, subclasses emerge on the basis of interpretation and function. There are container nouns like *glass* or *bowl*, measure terms like *kilo* or *liter*, and atomizers like *grain* or *pile*. There are also nouns that make direct reference to abstract representations of measurement (i.e., degrees), for example *size* or *width*.¹ Most versatile of these degree nouns is the word *amount*, whose semantics is the current object of investigation.

The word *amount* admits both DEFINITE and EXISTENTIAL interpretations. In (1), suppose the addressee bought three apples; under the DEFINITE interpretation,

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¹ For discussion of the full typology of quantizing nouns, see Scontras 2014 and references therein.

the sentence asserts that John ate those three apples that the addressee bought. In (2), suppose the addressee ate three apples. Rather than making the implausible (and grotesque) claim that John ate the same apples that the addressee ate, (2) asserts that John ate three apples, a plurality equal in amount to the apples eaten by the addressee. Here is the EXISTENTIAL interpretation of *amount*.

- (1) John ate the amount of apples that you bought.
 ↔ John ate the apples that the addressee bought (DEFINITE)
- (2) John ate the amount of apples that you ate.
 ↔ there were some apples that John ate equal in amount to the apples that the addressee ate (EXISTENTIAL)

In both (1) and (2), definite *amount* composes with a bare plural substance noun (i.e., *apples*) and gets modified by a relative clause. Despite their superficial similarities, these two uses of *amount* yield drastically different interpretations. In the first, DEFINITE use, *amount* makes direct reference to a concrete plurality of apples; *amount* merely establishes a partition on the denotation of *apples*. In the second, *amount* references an abstract amount—a degree—determined on the basis of a measure; this abstract amount gets instantiated by different objects (i.e., by pluralities of apples), which are acted on accordingly. Under the second interpretation of *amount*, apples are referenced only indirectly, through their ability to instantiate an abstract representation of measurement (i.e., to number three).² This paper develops a semantics that delivers this EXISTENTIAL interpretation for *amount*.

1.1 A puzzle: The EXISTENTIAL interpretation of *amount*

The sentence in (3) provides another example of the EXISTENTIAL interpretation. In (3), it is highly unlikely that the speaker eats the same apples every day. Instead, the sentence appeals to an abstract amount determined on the basis of a measure, and makes claims about objects that instantiate those amounts. For example, suppose a dietary regimen mandates the eating of two kilos of apples each day; *that amount of apples* in (3) could refer to that abstract amount, two kilos, which was differently instantiated by apples each day. In other words, the speaker ate different apples each day, but each day the apples that the speaker ate measured two kilos.

- (3) I ate that amount of apples every day for a year.

The abstract representations of measurement to which *amount* refers are degrees; within the class of quantizing nouns, *amount* inhabits the subclass of degree nouns.

² See Cartwright 1970 for a similar observation, which she attributes to Russell 1938.

Amount is not alone in its status as a degree noun; other nouns that fall within this class include *size* and *length* and *weight* (a subset of what Partee (1987) calls “attribute” nouns). Compare (3) with the sentences in (4); they all share the ability to reference objects indirectly via an abstract measurement. Under the EXISTENTIAL reading of (4a), the speaker does not sell and buy back the same piece of rope each day, but rather sells different pieces of rope that measure the same length.

- (4) a. I sold that length of rope every day for a year.
 b. I bought that size (of) shirt for my entire life.³

Degree nouns stand out among the typology of quantizing nouns. While *amount* in (3) admits an EXISTENTIAL interpretation, the quantizing nouns in (5) only allow for a DEFINITE construal. For example, (5a) makes the odd assertion that John spent at least a year drinking a single glass of wine, taking minuscule sips each day.

- (5) *No EXISTENTIAL interpretation for other quantizing nouns:*
 a. ✗ John drank that **glass** of wine every day for a year. (container)
 b. ✗ John bought that **kilo** of potatoes every day for a year. (measure)
 c. ✗ John dropped that **grain** of rice every day for a year. (atomizer)

However, outside the domain of quantizing nouns, the behavior of the noun *kind* and other kind-denoting nominals parallels that of *amount*: kind-denoting nominals also yield EXISTENTIAL interpretations. For example, (6) asserts not that John spent a year drinking some salient quantity of wine (cf. (5a)), but rather that he drank many instances of some salient *kind* of wine (say, a specific vintage).

- (6) John drank that **kind** of wine every day for a year.

Compare *that amount of apples* with *that kind of wine*. In the case of *amount*, we reference abstract representations of measurement that get instantiated by real-world objects (e.g., by pluralities of apples). With *kind*, we name a sortal concept—a nominalized property—that gets instantiated by real-world objects (e.g., by quantities of wine). It would seem, then, that the degrees to which *amount* refers are aligned with kinds in the semantics: both behave as properties—the property of being a type of wine, or of being three kilos of apples—which can be instantiated.

The task is to derive the EXISTENTIAL interpretation for *amount* in a way that tracks these similarities with *kind*. Doing so will force a reevaluation of our understanding of degrees. But first, a review of the semantics of kinds.

³ *Size* may compose directly with the substance noun, without an intervening *of*, supporting the claim made below that degree nouns take the substance noun as an argument. Why the other degree nouns preserve the particle *of* remains an open question. See Zamparelli 1998 for further discussion.

1.2 Some background: The EXISTENTIAL interpretation of kinds

Nouns lead dual lives. Under one guise, they are function-like properties that serve as predicates, which delimit a class of objects that hold the relevant property. For example, in (7), the noun *bears* names the set of bears and the existential construction is used to assert that John likes some members of that set.

(7) There are bears in the zoo that John likes.

Under another guise, nouns are argumental: they name individuals directly. In (8), the sentence ascribes the property of being widespread not to individual bears, or even to collections thereof, but to the bear kind—intuitively, to the species itself.

(8) Bears are widespread.

Since the groundbreaking study of Carlson (1977b), we have come to understand the complex behavior of kinds. Take the DOG kind. It corresponds to the property of being a dog. Dogs instantiate the dog property. Formally, kinds are built from properties via a process of nominalization via the ‘down’ operator \cap , defined as in (9) (see Chierchia 1998 for discussion).⁴ The DOG kind is the individual correlate of the property of being a dog—the totality of dogs in a given world. Kinds behave as individuals because they are individuals; the domain of kinds, D_k , is a subset of the domain of individuals, D_e . As individuals, kinds get referenced and serve as arguments to predicates.

(9) For any property P and world/situation s,

$$\cap P = \begin{cases} \lambda s. \iota P_s, & \text{if } \lambda s. \iota P_s \text{ is in } K \text{ (the set of kinds)} \\ \text{undefined,} & \text{otherwise} \end{cases}$$
 where P_s is the extension of P in s.

Just as kinds may be constructed from properties via nominalization, properties may be retrieved from kinds via predicativization. The ‘up’ operator \cup applies to a kind and returns the property that characterizes the kind. Applied to the DOG kind, \cup returns the property of being a dog. Chierchia (1998: 349) schematizes the

⁴ The term ‘kind’ is used here rather liberally: any nominalized, sortal property formed on the basis of a semantically plural predicate (closed under sum formation via the *-operator) will count as a generalized kind, or ‘kind’ for short. Collapsing over the distinction between what are at times called ‘law-like’, ‘conventional’, or ‘established’ kinds and sortal concepts should not be taken as a dismissal of this distinction. Established kinds like BEAR stand apart from sortal concepts like BEARS JOHN LIKES on the basis of two phenomena: 1) established kinds but not sortal concepts may serve as arguments to kind-level predicates, and 2) established kinds but not sortal concepts exhibit scopelessness in episodic sentences. For fuller discussion of this distinction, see Carlson 1977b; Dayal 1992; Chierchia 1998.

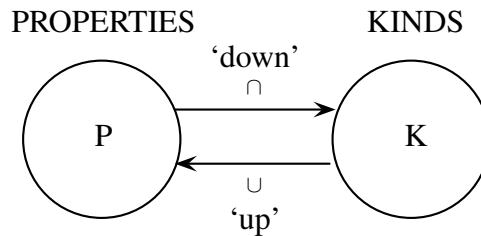


Figure 1 Diagram of property–kind correspondence from Chierchia 1998

relationship between properties and kinds in Fig. 1.

It bears repeating that the set of kinds is a subset of the domain of individuals. Fido is a dog; he is also an individual. The DOG kind is the individual correlate of the property of being a dog; it, too, is an (intensionalized) individual. When the DOG kind serves as the argument to kind-level predicates, as in (8) and (10), we reference the kind and attribute properties directly to it.

- (10) Dogs are extinct.
 $\hookrightarrow \text{extinct}(\text{DOG})$ (where DOG corresponds to $\cap \lambda x. *dog(x)$, the kind)

To compose a kind with a non-kind-selecting predicate—that is, a predicate that applies to real-world objects—the construction must undergo a type adjustment similar to noun-incorporation (see van Geenhoven 1998). What results is the EXISTENTIAL interpretation: the predicate quantifies existentially over instances of the kind. Chierchia (1998) terms this process *Derived Kind Predication* (DKP):

- (11) *Derived Kind Predication:*
 If P applies to objects and k denotes a kind, then $P(k) = \exists x[\cup k(x) \wedge P(x)]$

Instead of ascribing a property to the entire DOG kind, the sentence in (12) asserts that there is an instance of the DOG kind (i.e., dogs) that is barking. The sentence asserts that there *exists* an instance of the kind that holds the property of barking.

- (12) $[[\text{Dogs are barking outside my window}]]$
 $= \text{barking-outside-my-window}(\text{DOG})$
via DKP
 $= \exists x[\cup \text{DOG}(x) \wedge \text{barking-outside-my-window}(x)]$

DKP applies at the level of the predicate *barking outside my window*, an object-level predicate (dogs, not species, bark). The result is existential quantification over members of the DOG kind. Here is the EXISTENTIAL interpretation. Moreover, DKP applying at the level of the predicate delivers the scopelessness (i.e., obligatory

narrow scope) of kinds in episodic sentences (Carlson 1977b; Chierchia 1998).

Next, consider the behavior of the noun *kind*, as in *that kind of dog*. In the general case, *kind* composes with a kind-denoting nominal and returns its subkinds (Zamparelli 1998). Composing with *dog*, *kind* returns a set of dog kinds, for example dog breeds. These subkinds are individual correlates of the properties of being a certain kind of dog. A candidate denotation for *kind of dog* appears in (13).⁵

- (13) a. $\llbracket \text{kind} \rrbracket = \lambda g \lambda k. \text{SUBKIND}_f(g)(k)$
 b. $\llbracket \text{kind of dog} \rrbracket = \lambda k. \text{subkind}(\text{DOG})(k)$
 c. $\llbracket \text{kind of dog} \rrbracket = \left\{ \begin{array}{l} \cap \lambda x. * \text{bulldog}(x) \\ \cap \lambda x. * \text{collie}(x) \\ \cap \lambda x. * \text{poodle}(x) \\ \vdots \end{array} \right\}$
 d. $\llbracket \text{that kind of dog} \rrbracket = \cap \lambda x. * \text{bulldog}(x) = \text{BULLDOG}$

Just like *dogs* refers to the DOG kind in (12), *that kind of dog* refers to a kind (i.e., the BULLDOG kind) in (13). In (14), composition proceeds in the same fashion: DKP applies at the level of the predicate to allow *that kind of dog* to serve as an argument to the object-level predicate *barking*. What results is the EXISTENTIAL interpretation, which asserts that instances of the relevant kind hold the named property.

- (14) $\llbracket \text{That kind of dog is barking...} \rrbracket$
 = $\text{barking}(\text{BULLDOG})$
via DKP
 = $\exists x[\cup \text{BULLDOG}(x) \wedge \text{barking}(x)]$

To repeat: the EXISTENTIAL interpretation arises when a kind—a nominalized property—attempts to compose with an object-level predicate. For this composition to proceed, the predicate quantifies existentially over instances of the kind. Next, we turn to the EXISTENTIAL interpretation for *amount* and degrees.

2 A new kind of degree

In uttering (15), the speaker references an abstract amount and asserts that the amount was instantiated each day by apples, which got eaten. But what are amounts, and, crucially, how are they instantiated by real-world objects?

⁵ The SUBKIND_f function returns a set of subkinds along a given dimension of evaluation. For example, it could return a set of dog breeds, or a set of dog sizes, ages, etc. See Carlson 1977b for discussion.

- (15) I ate that amount of apples every day for a year.
 \leftrightarrow every day for a year I ate apples that measured the relevant amount

Amounts are extents along a scale; they are degrees, for example, three kilos or four feet. Minimally, degrees contain information that determines points on a scale: a measure function μ and a value n in its range. Degrees get instantiated by the objects that hold them: apples weighing three kilos, trees reaching four feet in height, etc. In other words, the degree indicated by *that amount of apples* instantiates as any set of apples that evaluates to the appropriate value with respect to the relevant measure, that is, that reaches the specified extent along the given scale.

The language used to describe the referents of *amount* and their behavior in the sentences that embed it reveals the strategy for formalizing *amount*'s semantics: *amount* references abstract representations of measurement which may be instantiated by objects in the world. Note the striking parallel with the semantics of kinds: abstract entities corresponding to properties, which are defined in terms of the objects that instantiate them. Moreover, the paradigmatic names for these sorts of entities exhibit similar behavior: both *amount* and *kind* admit EXISTENTIAL interpretations whereby real-world objects that instantiate salient properties are indicated by the use of these terms. Here is the explanation for this overlap in behavior: *amount* refers to a set of degrees; *kind* to a set of kinds. Degrees, like kinds, are the individual correlates of properties of individuals; kinds and degrees are the same sort of entity. Put simply, degrees are kinds.

Using a different set of data, Anderson & Morzycki (2012) arrive at a similar conclusion, namely that degrees are kinds. Focusing on modification as it relates to degrees, manners, and kinds, they show a broad range of functional elements that appear to apply to all three sorts of entities, for example English *how*, *as*, and *such*. They also note the behavior of the Polish anaphoric expression *tak*, which refers to kinds, manners, and degrees. The authors' conclusion is couched in a Neo-Davidsonian framework: degrees are kinds of states. While the proposal developed here is in principle compatible with Anderson & Morzycki's approach, the current analysis makes do without appeal to events or states; our degrees are of a different sort.

Degrees are abstract representations of measurement. These representations behave as individuals: speakers may reference degrees and provide them as arguments to predicates (e.g., *That amount of apples is too much*). Furthermore, degrees correspond to properties: sets of individuals holding the relevant degree. When a predicate applies to objects and composes with a degree, speakers make claims about objects that instantiate the relevant degrees via an EXISTENTIAL reading. *Amount* behaves like *kind* because both terms denotes entities of the same sort: nominalized properties. The same semantic machinery handles both kinds and degrees: an EX-

EXISTENTIAL reading results when a nominalized property serves as the argument to an object-level predicate and a type-shift like DKP mediates their composition.

But what sort of property begets a degree? Because they are abstract representations of measurement, degrees must be built from properties whose semantics appeals to a measure. In its simplest form, a degree is the nominalization of a property defined on the basis of a measure, as in (16).⁶

$$(16) \quad \text{DEGREE} := \cap \lambda x. \mu_f(x) = n$$

Setting μ_f to the kilogram measure, μ_{kg} , and its value n to 3 yields the *three kilo* degree in (17). This degree is the individual correlate of the property of weighing three kilos; predicativising (17) via \cup returns the set of things that weigh three kilos.

$$(17) \quad \cap \lambda x. \mu_{kg}(x) = 3$$

Note that the property from which a degree is built is quantity-uniform with respect to the measure μ_f specified in the property's semantics: everything holding this property evaluates to the same n with respect to μ_f . In (17), every object holding the de-nominalized property weighs the same: three kilos.

Degrees are the nominalizations of quantity-uniform properties. *Three kilos* qua degree is the individual correlate of the property something holds when it weighs three kilos. Similarly, *that amount* is the individual correlate of the property something holds when it measures the appropriate amount. As individuals, degrees enter into semantic computation as arguments. Composing with a predicate that may apply directly to degrees, *that amount* yields a DIRECT interpretation in parallel to the interpretation resulting from a kind composing with kind-level predicates—compare (18) with (10).

$$(18) \quad (\textit{pointing to a signboard at a farm stand}) \text{ That amount is the largest.}$$

By predicativizing them via \cup (as in DKP), degrees grant access to the individuals that instantiate them. Hence, degrees also admit an EXISTENTIAL interpretation.

Finally, the denotation of *amount*: the noun denotes a set of degrees, nominalized quantity-uniform properties formed on the basis of a contextually-specified measure. As with *kind*, *amount* behaves like a transitive noun, relating a kind with amounts thereof. Echoing Zamparelli (1998), an amount is always an amount of *something*. Rarely does one find bare *amount*, that is, an instance of the degree noun without a substance noun like *apples* specifying what the amounts are of.

⁶ Building on the analysis of *amount* presented below, this degree template should contain two additional pieces of information: a kind k delimiting the class of things to which the degree may apply (e.g., apples), and a contextually-supported instantiation of this kind, π . Without the space to fully motivate these elements of the analysis, they are omitted. See Scontras 2014 for discussion.

When *amount* appears bare, a substance noun gets assumed. The substance noun, a bare plural or mass term (e.g., *apples*), serves as an argument of *amount*. The degrees referenced by *amount* are tied to the kind supplied by the substance noun. This move ensures that the degrees to which *amount* refers are both quantity- and quality-uniform. To make available salient concrete portions of the substance for measurement, the partitioning instantiation operator π returns maximal instances of a kind supported by context. For present purposes, translate π as the predicativization operator \cup (but see Scontras 2014 for fuller discussion). (19) exemplifies a quantity- and quality-uniform degree: every member of the denominalized property is an instance of the APPLE kind evaluating to the same n with respect to μ_f .

$$(19) \quad \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLE})(x)$$

$$(20) \quad \llbracket \text{amount} \rrbracket = \lambda k \lambda d. \exists n [d = \cap \lambda x. \mu_f(x) = n \wedge \pi(k)(x)]$$

where μ_f is a contextually-specified measure,
 n is some number in the range of the measure μ_f ,
and π is a contextually-supplied partitioning instantiation of k

In (20), transitive *amount* first takes the kind-denoting substance noun, retrieves the kind's maximal instances, then relates this partitioned set of instances to a set of quantity- and quality-uniform degrees. Amounts are thus always *of something*.

As with *kind*, *amount* receives a relational semantics under which it takes a kind-denoting substance noun as an argument and relates the kind with a set of nominalized properties, that is, with a set of degrees. Building degrees from properties permits access to the holders of those properties like with the instantiations of a kind. Thus, (15) references an amount (i.e., a degree) and asserts that this degree was variously instantiated by apples, which were eaten each day over the course of a year. This instantiation process proceeds with degrees just as it did with kinds: via existential quantification over the members of denominalized degrees. The mechanism remains DKP, generalized in (21) to apply to both kinds and degrees.

$$(21) \quad \textit{Generalized DKP:}$$

If P applies to objects and y denotes a nominalized property, then

$$P(y) = \exists x [\cup y(x) \wedge P(x)]$$

A simplified derivation for the sentence in (15) appears in (22). Two features are crucial: first, *that amount of apples* denotes a degree; second, this degree composes with the object-level predicate *eat* via Generalized DKP. The result is an EXISTENTIAL interpretation; the speaker asserts that there was an instantiation of the *amount-of-apples* degree that he ate. The specific apples are irrelevant.

- (22) $\llbracket \text{I ate that amount of apples} \dots \rrbracket$
 = $\text{ate}(\text{that-amount-of-apples})(\text{I})$
via Generalized DKP
 = $\exists x[\cup \text{that-amount-of-apples}(x) \wedge \text{ate}(x)(\text{I})]$

Taking seriously the similarities in behavior between *amount* and *kind* suggests a kind semantics for degrees. Degrees, like kinds, are the individual correlates of properties, for example the property of attaining a certain degree (e.g., weighing 3 kilos) or belonging to a specific kind (e.g., being a poodle). Associating degrees with properties permits access to the objects that instantiate them, just as associating kinds with properties grants access to their members; the EXISTENTIAL interpretation results. Taking degrees as semantic primitives that merely indicate points on a scale (e.g., Kennedy 1999), there is no hope of deriving the EXISTENTIAL interpretation that characterizes *amount*. A point-on-scale analysis of degrees also misses the generalization that captures the striking similarity in behavior between *amount* and *kind*: both nouns reference nominalized properties. The next step is to specify how the internal composition of, say, *that amount of apples* proceeds such that the result is a degree.

3 Degrees in the compositional semantics

To review: *amount* relates a kind-denoting substance noun with a set of amounts of that substance. This set is a set of degrees; degrees are conceived of as nominalized quantity-uniform properties formed on the basis of a measure. *Amount* is highly context-sensitive, such that this measure μ_f and its value n are contextually determined. Additionally, the partitioning function π that returns maximal instances of the substance noun receives its specification from context. The resulting denotation for the phrase *amount of apples* appears in (23).

- (23) a. $\llbracket \text{amount} \rrbracket = \lambda k \lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(k)(x)]$
 b. $\llbracket \text{amount of apples} \rrbracket = \lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLE})(x)]$

Amount inhabits the subclass of degree nouns, which stand apart from other quantizing nouns in their ability to yield an EXISTENTIAL interpretation. *Kind* and other kind-denoting nominals pattern with *amount* and deliver the EXISTENTIAL interpretation in episodic contexts. Both kinds and degrees track the objects that instantiate them. Hence the conception of degrees, like kinds, as nominalized properties.

3.1 Referencing degrees

Having settled on a semantics for *amount*, the task now is to determine how this semantics interacts with the structures that embed *amount* to yield reference to specific degrees. Consider *amount of apples*. The substance noun is an argument of *amount*, which projects a transitive structure. The particle *of* makes no semantic contribution (recall its optionality with other degree nouns). By composing with its substance noun argument and contextually determining the measure in its semantics, *amount* returns a set of nominalized quantity- and quality-uniform properties. This set is a set of degrees, ordered on the basis of a measure. In (24), suppose context sets this measure to μ_{kg} . The result is a set of kilograms-of-apples degrees.

$$(24) \quad \llbracket \text{amount of apples} \rrbracket = \lambda d. \exists n [d = \bigcap \lambda x. \mu_{kg}(x) = n \wedge \pi(\text{APPLE})(x)] \\ = \left\{ \begin{array}{l} \bigcap \lambda x. \mu_{kg}(x) = 1 \wedge \pi(\text{APPLE})(x) \\ \bigcap \lambda x. \mu_{kg}(x) = 2 \wedge \pi(\text{APPLE})(x) \\ \bigcap \lambda x. \mu_{kg}(x) = 3 \wedge \pi(\text{APPLE})(x) \\ \vdots \end{array} \right\}$$

How does one get from a set of degrees the relevant degree? That is, how does one arrive at a single degree from the NP denotation in (24)? Consider the behavior of *amount of apples* when it serves as the argument of the demonstrative *that*.

(25) John bought that amount of apples.

Here is a situation in which the sentence in (25) may be uttered felicitously: some apples sit on a table; the speaker points to these apples, and intends an EXISTENTIAL interpretation. The speaker conveys that John bought some apples equal in amount to the apples to which the speaker points. Suppose *amount of apples* denotes a set of kilograms-of-apples degrees as in (24), and there are three kilograms of apples on the table. The demonstrative *that* takes the set of degrees in (24) and returns the maximal degree that applies to those apples on the table. The degree is accessed through the objects that instantiate it. This process obtains for *that* when it composes with nominalized properties elsewhere (see Partee 1987): through the indicated object that instantiates it, we access the (nominalized) property.

- (26) a. I love that color of shirt!
 b. That style of art never took off.
 c. I wish that kind of animal would stay out of my garden.

Inherent to the semantics of demonstrative *that* is the individual ‘that’, the salient object that is indicated. To access the kind/degree-level entity the indicated object instantiates, demonstrative *that* receives the semantics in (27).

- (27) $[[\text{that}]] = \lambda A. \iota y[A(y) \wedge \cup y(\text{that})]$
 where A is a set of individuals, either nominalized properties or objects,
 and that is the salient object indicated in the use of the demonstrative

The \cup -operator in the semantics of *that* predicativizes the individuals its argument denotes, which allows them to apply to the specified object *that*. When *that* composes with a set of nominalized properties, kinds or degrees, it returns the nominalized property instantiated by the indicated object.

In (25), the appropriate degree is accessed by first identifying the relevant apples (i.e., by establishing a pointer to them with *that*) and then picking out *the* degree that applies to these apples. Suppose the relevant apples comprise the object $a+b+c$, and that the weight of $a+b+c$ is n_{a+b+c} (i.e., $\mu_{kg}(a+b+c) = n_{a+b+c}$):

- (28) $[[\text{that}]](\llbracket\text{amount of apples}\rrbracket)$
 $= [[\text{that}]](\lambda d. \exists n[d = \cap \lambda x. \mu_{kg}(x) = n \wedge \pi(\text{APPLE})(x)])$
 $= \iota y[\lambda d. \exists n[d = \cap \lambda x. \mu_{kg}(x) = n \wedge \pi(\text{APPLE})(x)](y) \wedge \cup y(\text{that})]$
 $= \iota y[\lambda d. \exists n[d = \cap \lambda x. \mu_{kg}(x) = n \wedge \pi(\text{APPLE})(x)](y) \wedge \cup y(a+b+c)]$
 $= \cap \lambda x. \mu_{kg}(x) = n_{a+b+c} \wedge \pi(\text{APPLE})(x)$

The result references a degree: a nominalized quantity-uniform set of apples; everything in that set evaluates to n_{a+b+c} with respect to the kilogram measure; all of the quantities of apples have the same weight. For this degree to compose with the structure that embeds it, Generalized DKP type-shifts the nominalized property for object-level argument slots, quantifying over objects that instantiate the degree.

- (29) $\llbracket\text{John bought that amount of apples}\rrbracket$
 $= \text{bought}(\cap \lambda x. \mu_{kg}(x) = n_{a+b+c} \wedge \pi(\text{APPLE})(x))(\text{John})$
via Generalized DKP
 $= \exists y[\cup(\cap \lambda x. \mu_{kg}(x) = n_{a+b+c} \wedge \pi(\text{APPLE})(x))(y) \wedge \text{bought}(y)(\text{John})]$
 $= \exists y[\mu_{kg}(y) = n_{a+b+c} \wedge \cup \text{APPLE}(y) \wedge \text{bought}(y)(\text{John})]$

Here is the EXISTENTIAL interpretation: (29) asserts that John bought some apples equal in weight to the salient apples indicated by *that*.

To see that this semantics for demonstrative *that* applies in the same fashion for kinds, consider the derivation in (30). Assume that the indicated dog, b , is a beagle.

- (30) John bought that kind of dog.
 a. $[[\text{that kind of dog}]]$
 $= [[\text{that}]](\lambda k. \text{SUBKIND}_f(\text{DOG})(k))$
 $= \iota y[(\lambda k. \text{SUBKIND}_f(\text{DOG})(k))(y) \wedge \cup y(b)]$
 $= \cap \lambda x. *beagle(x) \quad (= \text{BEAGLE})$

- b. $\llbracket \text{John bought that kind of dog} \rrbracket$
 $= \text{bought}(\cap \lambda x. *beagle(x))(\text{John})$
via Generalized DKP
 $= \exists y[\cup(\cap \lambda x. *beagle(x))(y) \wedge \text{bought}(y)(\text{John})]$

The sentence in (30) asserts that John bought some dog that belongs to the BEAGLE kind, that is, that John bought a beagle. The semantics for demonstrative *that* in (27) thus delivers the EXISTENTIAL interpretation for both degrees and kinds.

Verifying that nothing is lost in this new semantics for *that*, consider its more basic uses. When *that* takes a simple predicate as an argument, as in *that boy*, it returns the individual in the denotation of the predicate that is identical to the specified object *that*. In other words, when *that* takes a set of objects as an argument, it returns the unique, salient object from this set. Key to this result is the way the \cup -operator predicativizes an object-level individual.

Applied an object a , \cup shifts that object into a property. Using the IDENT operator from Partee 1987, the result is the property of being identical to a :

- (31) *Object predicativization:*
 $\cup_a := \text{IDENT}(a) = \lambda x. x = a$

Suppose we have the boy a (i.e., Alan). Predicativizing a , \cup_a , yields the property of being identical to Alan. Thus, when *that* composes with a simple predicate as in (32), it returns the unique individual identical to the specified object *that*. Simply put, it returns the indicated object. This generalized semantics for *that* permits the specification of individuals, both nominalized properties and real-world objects.

- (32) a. $\llbracket \text{boy} \rrbracket = \{a, b, c\}$
 b. $\text{that} = a$
 c. $\llbracket \text{that boy} \rrbracket = \iota y[\text{boy}(y) \wedge \cup_y(a)] = \iota y[\text{boy}(y) \wedge \text{IDENT}(y)(a)] = a$

3.2 Modifying degrees

Next, consider what happens with sets of degrees when they serve as arguments to the definite determiner *the*. *The* denotes the maximality operator ι , composing with a set and returning its maximal element (Sharvy 1980; Chierchia 1998; Zamparelli 1998). Chierchia (1998: 346, ex. (11a)) defines the ι -operator as in (33).

- (33) $\iota A =$ the largest member of A if there is one (else, undefined)

This semantics allows *the* to compose with a set of degrees. These degrees are ordered on the basis of a measure, and *the* returns the largest degree. The derivation in (34) illustrates this process; *max* stands for the largest possible value in the domain

of the measure. The result has *the amount of apples* denote the maximal degree.

- (34) a. $\llbracket \text{amount of apples} \rrbracket = \lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLE})(x)]$
 b. $\llbracket \text{the(amount-of-apples)} \rrbracket = \iota \lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLE})(x)]$
 $= \cap \lambda x. \mu_f(x) = \max \wedge \pi(\text{APPLE})(x)$

Unmodified, definite *amount* is often infelicitous. Awkwardness arises because definite *amount* references a maximal degree, which in most circumstances will be impossible to instantiate. For example, (35a) asserts that John bought some apples that measure the maximal degree, that is, that he bought the totality of apples. To be used felicitously, definite *amount* must be modified. Modification restricts the set of degrees to just the relevant subset. In (35b), the degrees are restricted to those that apply to the apples on the table; maximality selects the largest such degree.

- (35) a. #John bought the amount of apples.
 b. John bought the amount of apples on the table.

Under the EXISTENTIAL reading, (35b) asserts that John bought some apples equal in amount to the apples on the table. If there are three kilograms of apples on the table, then (35b) asserts that John bought three kilograms of apples. But how does the PP *on the table* restrict *amount of apples* to just those apple-degrees that apply to the objects on the table? Consider the ingredients of this modification.

Take the NP *amount of apples*, a set of degrees as in (36a). To this NP adjoins the PP *on the table*, a set of objects as in (36b). The structure in (36c) results.

- (36) a. $\llbracket \text{amount of apples} \rrbracket = \lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLE})(x)]$
 b. $\llbracket \text{on the table} \rrbracket = \lambda x. \text{on-table}(x)$
 c. $[_{DP} \text{the} [_{NP} [_{NP} \text{amount of apples}] [_{PP} \text{on the table}]]]$

To derive the EXISTENTIAL reading of (35b), the maximal NP in (36c) must denote a set of apple degrees restricted to just those degrees that apply to objects on the table. As was the case when nominalized properties served as arguments to object-level predicates, here this restriction involves existential quantification over instances of the de-nominalized properties. In other words, a set of degrees composes with a set of individuals via point-wise application of Generalized DKP. This restrictive, existential modification is defined as in (37); the derivation for (35b) appears in (38). Note that composing the modified set of degrees with maximal *the* adds the restriction as a presupposition on this degree set.

- (37) *Existential Modification (version 1):*
 $A_{\langle d,t \rangle} \cap P_{\langle e,t \rangle} = \lambda d. A(d) \wedge \exists y[P(y) \wedge \cup d(y)]$

- (38) John bought the amount of apples on the table.
- a. [[the amount of apples on the table]]
 = the $[\lambda d. \exists n[d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLES})(x)]] \cap [\lambda x. \text{on-table}(x)]$
via Existential Modification
 = the $[\lambda d. \exists n[(d = \cap \lambda x. \mu_f(x) = n \wedge \pi(\text{APPLES})(x)) \wedge \exists y[\text{on-table}(y) \wedge \cup d(y)]]]$
 = $\cap \lambda x: \exists y[\mu_f(y) = \max \wedge \pi(\text{APPLES})(y) \wedge \text{on-table}(y)].$
 $\mu_f(x) = \max \wedge \pi(\text{APPLES})(x)$
- b. [[John bought the amount of apples on the table]]
 = bought(the-amount-of-apples-on-the-table)(John)
via Generalized DKP
 = $\exists y[\cup(\text{the-amount-of-apples-on-the-table})(y) \wedge \text{bought}(y)(\text{John})]$

By making use of maximality in the semantics of *the* and type adjustment via Generalized DKP, the sentence in (38) asserts that John bought some apples equal in amount to the apples that are on the table. These tools, all of them independently justified, thus deliver the EXISTENTIAL interpretation for modified *amount*. By restricting the degrees denoted by *amount*, its use suddenly describes a much more plausible state of affairs: In (38), John buys a subset of the totality of apples.

Another common means to modify *amount* (and degrees) is relativization. First, a word of caution: The name ‘amount relative’ (sometimes ‘degree relative’) often indicates a peculiar class of *there*-existentials that ostensibly flout the Definiteness Restriction (Milsark 1974; Carlson 1977a; Heim 1987; Grosu & Landman 1998). These constructions are analyzed presently. For now, the aim is true *amount* relatives: relative clauses headed overtly by *amount*, as in (39).

- (39) John ate the amount of apples that you ate.

Under the EXISTENTIAL reading, (39) asserts that John ate some apples equal in amount to the apples the addressee ate. At the level of the relative CP, suppose there is degree abstraction. What precipitates this abstraction will depend on the analysis of relative clause syntax. For example, under a head-external approach (Montague 1974; Partee 1975; Chomsky 1977), an operator will move to the specifier of the relative CP, binding a degree trace in object position. Under a raising approach (Åfarli 1994; Kayne 1994), the relative head *amount of apples* will originate as the object in the relative CP, and then move to a CP-external position, binding its trace. For present purposes, suppose merely that (39) receives the simplified LF in (40).

- (40) *John ate* [_{DP} *the* [_{NP} [_{NP} *amount of apples*] [_{CP} λd (*that*) *you ate d*]]]
- a. $\lambda d. \text{ate}(d)(\text{you}) \Rightarrow \text{via DKP} \Rightarrow \lambda d. \exists x[\text{ate}(x)(\text{you}) \wedge \cup d(x)]$
- b. $\lambda d. \text{amount-of-apples}(d) \wedge \exists x[\text{ate}(x)(\text{you}) \wedge \cup d(x)]$

The denotation of the relative CP appears in (40a). Note that the object-level predicate *ate* composes with the degree variable via DKP, such that the CP denotes the set of degrees true of things eaten by the addressee. The relative head, *amount of apples*, also denotes a set of degrees (as in (36a)). Simple intersective modification composes these two sets of degrees, such that the result, (40b), denotes a set of apple degrees true of things eaten by the addressee. Maximality selects the largest such degree—the maximum apple degree eaten by the addressee—and DKP allows this degree to compose with the matrix predicate. The EXISTENTIAL interpretation results: John ate an instance of the maximal apple degree true of something the addressee ate. Therefore, he ate the same amount of apples the addressee ate.

Now for so-called ‘amount’ or ‘degree’ relatives, as in (41).

- (41) John bought the apples that / \emptyset / *which there were __ on the table.

First, a description: degree relatives are relative clauses introduced by *that* or the null relativizer \emptyset ; they participate in existential constructions, ostensibly flouting the Definiteness Restriction (Milsark 1974; Heim 1987), which would otherwise prohibit individual variables from the gapped position in (41). Next, a claim: degree relatives involve degree abstraction over the gapped position of the relative CP. Note that both degrees and kinds avoid the Definiteness Restriction, as demonstrated in (42) (Heim 1987). Supporting this claim, *wh*-form relativizers do not permit degree or kind abstraction, which is why they cannot participate in degree relatives. In (43), an EXISTENTIAL interpretation fails with *which*, resulting in anomaly.

- (42) a. *Which food truck is there __ in Austin?
 b. How many food trucks are there __ in Austin?
 c. What kind of food trucks are there __ in Austin?
- (43) a. John ate the amount of apples that / #which you ate.
 b. John ate the kind of apples that / #which you ate.

And now, a correction: Heim (1987) uses the preferred EXISTENTIAL interpretation of the sentence in (44) to motivate an analysis of degree relatives under which the resulting DP denotes a degree.⁷ This analysis has been adopted in the literature, with Grosu & Landman (1998) providing a compositional account of the phenomenon.

⁷ For now, simply note that based on the description above, (44) does not feature a degree relative—it lacks an existential construction. Heim’s parse likely results from an implied *amount*, aligning the relative clause in (44) with true *amount* relatives.

- (44) It will take us the rest of our lives to drink the champagne that they spilled that evening.

However, as Grosu & Landman themselves note, a degree relative does not reference a degree: *the apples that there were on the table* refers to the apples that were on the table, not an abstract amount (i.e., a degree that applies to them). For (41) to be true, John must have bought the apples on the table, not any apples measuring the same as the apple on the table. An EXISTENTIAL interpretation fails for (41) because a degree relative does not denote a degree. Rather than retrieving objects from the degree referenced by a degree relative (the approach pursued by Grosu & Landman), a degree relative should reference objects directly.

Independently-motivated tools deliver this result. Two factors are crucial: degree abstraction in the relative CP, and Generalized DKP. With the simplified LF in (46), the head *apples* composes with the relative CP, a set of degrees true of things on the table. This composition, between a set of objects and a set of degrees, proceeds via Existential Modification. The modification is head driven as in (45) (cf. (37)), such that the result in (46) is a set of apples restricted by the set of degrees. A set of degrees modified by a set of objects begets a restricted set of degrees, while a set of objects modified by a set of degrees begets a restricted set of objects.

- (45) *Existential Modification (final version):*
 $A_{\langle d,t \rangle} \cap P_{\langle e,t \rangle} := \lambda d. A(d) \wedge \exists x[P(x) \wedge \cup d(x)]$
 $P_{\langle e,t \rangle} \cap A_{\langle d,t \rangle} := \lambda x. P(x) \wedge \exists d[A(d) \wedge \cup d(x)]$
- (46) $[[\text{apples } \lambda d \text{ (that) there were } d \text{ on the table}]]$
 $= \lambda x. \text{apples}(x) \cap \lambda d: \cup d(x) \wedge \text{on-table}(x)$
via Existential Modification
 $= \lambda x. \text{apples}(x) \wedge \exists d'[(\lambda d. \exists y[\cup d_{\text{on-table}}(y)])(d') \wedge \cup d'(x)]$

By tracking the objects that instantiate them, degrees-as-kinds yield degree relatives without added machinery: the head (e.g., *apples*) is a set of individuals, the relative CP a set of degrees; point-wise DKP via Existential Modification allows these two sets to compose, and the result has a degree relative reference objects directly.

4 Discussion

Degree nouns like *amount* yield EXISTENTIAL interpretations; so do *kind* and *kinds*:

- (47) a. John drank that amount of wine every day for a year.
 \hookrightarrow every day for a year there was some wine measuring the same amount (e.g., 1 liter) that John drank

- b. John drank that kind of wine every day for a year.
 \hookrightarrow every day for a year there was some wine of the same kind (e.g., Burgundy) that John drank

Kinds are the nominalizations, or individual correlates of properties. In episodic sentences, predicates acquire existential force via a type shift that allows them to compose with kind-denoting arguments. Conceived of as kinds, degrees are handled by the same semantic machinery: Generalized DKP quantifies over the objects instantiating nominalized properties, delivering the EXISTENTIAL interpretation.

The properties that beget degrees are quantity-uniform, formed on the basis of a measure. Not only does this re-conception of degrees as kinds deliver the EXISTENTIAL interpretation with independently motivated tools, it also predicts the striking similarity in behavior between degrees and kinds (e.g., degree relatives and quantificational adverbs, [Zamparelli 1998](#); questions, [Heim 1987](#); and other cross-categorical parallels, [Anderson & Morzycki 2012](#)). They behave alike because degrees are kinds. More precisely, both are nominalized properties.

A final note is in order: most degree-based approaches to gradability assume simple degrees-as-points (e.g., [Kennedy 1999](#)). Degrees enter into the ontology as abstract entities; they are points (or intervals) ordered along some dimension. In other words, degrees are numbers tagged with information about the dimension to which they pertain (e.g., height, width, cost, beauty, etc.). Along a given dimension, the set of ordered degrees constitutes a scale. Scales provide the structure for comparison: by establishing a correspondence between individuals and degrees, individuals get mapped onto scales; the relative position of these individuals on the scale determines the outcome of comparison. The current notion of degrees-as-kinds merely enriches traditional conceptions. Nothing is lost by this move, and this paper spells out just a portion of what is gained.

To see that degrees-as-kinds translate straightforwardly into standard theories of gradability, consider the two denotations for the gradable predicate in (48). The first, (48a), treats degrees as simple points and has lexical predicates establish the correspondence between individuals and degrees directly ([Kennedy 1999](#); see also [Seuren 1973](#); [Cresswell 1976](#); [von Stechow 1984](#); [Heim 1985](#)). Put differently, the predicate in (48a) itself performs measurement. The second, (48b), adopts the degrees-as-kinds approach. Both denotations deliver the same result: a person is, say, five feet tall just in case her height measures at least five feet. However, with degrees-as-kinds, measurement becomes the job of degrees, not of gradable predicates (a state of affairs [Wellwood \(2014\)](#) counts as a desirable result).

- (48) a. $[[\text{tall}]] = \lambda d \lambda x. \mu_{\text{tall}}(x) \geq d$
 b. $[[\text{tall}]] = \lambda d \lambda x: d \text{ is appropriate for height. } \exists d' [d' \geq d \wedge \cup d'(x)]$

A host of additional issues arise within the domain of degree semantics, but for now it suffices to hint at the way that degrees-as-kinds behave within this framework. In addition to losing nothing with respect to standard theories of gradability, degrees-as-kinds capture the parallels in behavior between degrees and kinds, and the at first surprising EXISTENTIAL interpretation now falls out as a prediction of the theory. All that was required was a recognition of the seemingly exceptional behavior of *amount* and its striking similarity with *kind*.

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