# The scope of reciprocal degree operators and degree pluralities\*

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**Abstract** A degree sentence such as *John and Mary are equally tall* conveys both reciprocity and equivalence and hence are termed 'reciprocal equatives'. This paper investigates this degree construction; building on Schwarz's (2007) pioneer study, I suggest an account for this degree construction that covers a wider range of data. To the extent that the proposal is on the right track, it provides new support for building in plurality in the domain of degrees, an idea that has been put forward by Beck (2010, 2014) and Dotlačil & Nouwen (2016).

**Keywords:** reciprocal equative, degree plurality, vagueness, plural predication

## 1 Introduction

This paper aims to provide a proper analysis for the degree construction some examples of which are given in (1-3).

- (1) English
  John and Mary are equally heavy.
- (2) German
  Hans und Maria sind gleich schwer.
  Hans and Maria are equally heavy
- (3) Mandarin Yuēhàn hé Mălì yíyàng zhòng. John and Mary equally heavy

This degree construction has been dubbed 'reciprocal equatives' (henceforth, RE) by Schwarz (2007). As noted by him, the meaning of this construction may characterized as 'reciprocal' and 'equivalent': all these examples express that John's weight and Mary's are **equivalent** to **each other**, and these meaning components are carried out by the reciprocal equative morpheme *equally/gleich/yíyàng*.

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## 1.1 Types of Reciprocal Equatives

In addition to predicative REs, we may find adnominal ones (see the German examples (4), (6) and their Mandarin counterparts).

- (4) Hans hat gleich longe Ohren.Hans has equally long ears'Hans has equally long ear.'
- (5) Yuēhàn yŏu-zhe yíyàng cháng-de ĕrduo. John have-PROG equally long-MOD ear 'John has equally long ears.'
- (6) Hans und Maria tragen gleich schwere Rucksäcke. Hans and Maria carry equally heavy backpacks 'Hans and Maria carry equally heavy backpacks.'
- (7) Yuēhàn hé Mălì bēi-le yíyàng zhòng-de bēibāo. John and Mary carry-PERF equally heavy-MOD backpack 'John and Mary carry/carried equally heavy backpacks.'

Degree comparison in a RE may be along the dimension of quantity, as shown in the German examples (8), (10) and their Mandarin counterparts (9) and (11).

- (8) Hans und Maria haben gleich viele Katzen. Hans and Maria have equally many cats 'Hans and Maria have equally many cats.'
- (9) Yuēhàn hé Mălì yăng-le yíyàng dūo-de māo. John and Mary keep-PERF equally many-MOD cat 'John and Mary have equally many cats.'
- (10) Hans hat gleich viele Hunde und Katzen. Hans has equally many dogs and cats 'Hans has equally many dogs and cats.'
- (11) Yuēhàn yăng-le yíyàng dūo-de gŏu gēn māo. John keep-PERF equally many-MOD dog and cat 'John has equally many dogs and cats.

As indicated by the ungramaticality in (12), there is a need to distinguish an amount RE (e.g., (8-11) from those like (4-7), despite the fact that in all these cases the RE morpheme modifies a pre-nominal adjective: although the RE morpheme, in both cases, occur in pre-nominal position, a simple plural noun modified by the Q-adjective *viele* 'many' does not suffice to license it.

(12) \*Hans hat gleich viele Haustiere.
Hans has equally many pets

At least in Mandarin, objects in comparison in the meaning of a RE may be contributed by a universal quantifier, as shown in (13-14).

- (13) měi-ge xuéshēng dōu pǎo-de yíyàng kuài. every-CL student ALL run-PART equally fast 'Every student runs/ran equally fast.'
- (14) Zhāngsān gĕi-le mĕi-ge xuéshēng yī-tiáo yíyàng cháng-de Zhangsan give-PERF every-CLF student one-CLF equally long-MOD shéngzi.

  rope

'Zhangsan gave every student an equally long rope.'

Schwarz (2007) also notes that in German a predicative RE with a universal subject like (15) sounds significantly better than one with a singular nominal subject (16).

- (15) Jeder Junge war gleich schnell. every boy was equally fast
- (16) \* Maria ist gleich schwer.

  Maria is equally heavy

## 1.2 Vagueness and context dependency

Intuitions around an adnominal RE are not always as clear as we hope they are. Consider (6)/(7); these examples may be easily judged true in a scenario like (17), where John and Mary each carry just one backpack.

(17) John carries one backpack weighing 10kgs; Mary carries one weighing 10kgs.

The situation gets complicated when objects in comparison are in a relatively large group. Consider the scenario in (18), where John and Mary each carry more than

- i. Yuēhàn bēi-le yí-ge wŭshí gōngjīn zhòng-de bèibāo; Mălì \*/??(yĕi) bēi-le John carry-PERF one-CLF 50 kg heavy-MOD backpack; Mary also carry yí-ge yíyàng zhòng-de bèibāo.

  one-CLF equally heavy-MOD backpack
  - Intended: 'John carried a backpack that weighs 50kg; Mary carried an equally heavy backpack.'
  - ≅John and Mary each carry one 50kg backpack.

<sup>1</sup> The fact that English *Maria is equally heavy* is grammatical on a reciprocal, discourse anaphoric interpretation is not in the concern of this paper. As Schwarz (2007) notes, such an interpretation, in some dialects of German, is not possible for *gleich*. To my ear, Mandarin *yíyàng* carries an interpretation of this kind only if it is accompanied by the additive particle *yĕi* 'also'.

one backpack, and only one backpack John carries weighs the same as one Mary carries.

(18) John carries two backpacks a and b; a weighs 10kgs and b 15kgs; Mary carries two c and d; c weighs 10kgs and d 5kgs.

Judgment making in such a scenario seems to become not so easy. Schwarz (2007) reports that intuitively the German example (6) may be true or false in such a scenario. To the ears of mine and other speakers' I have consulted, the Mandarin example (7) is difficult to judge in this scenario and might hardly be true. Nevertheless, with extra contextual information added in, judgment making may become much easier: as shown in (19), with additional contextual information, (7) may be easily judged true against the scenario in (18).

(19) All the students randomly pick two backpacks to carry in the hiking trip. Before taking off, let's weigh the backpacks they choose and see whether there are any two students who get at least two backpacks that have the same weight. It then happens that ...

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Yuēhàn hé Mălì bēi-le yíyàng zhòng-de bēibāo.
John and Mary carry-PERF equally heavy-MOD backpack
'John and Mary carried/carry equally heavy backpacks.'
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A different choice of verb might make judgment making easier as well. In contrast to (7), (20a), where the verb is changed to  $ti\bar{a}o$  'pick', (20a) may be easily judged true in a scenario (e.g., (20b)) very similar to the one in (18).

- (20) a. Yuēhàn hé Mălì tiāo-le yíyàng zhòng-de bēibāo.

  John and Mary pick-PERF equally heavy-MOD backpack

  'John and Mary picked equally heavy backpacks.'
  - b. John picks two backpacks weighing 10kgs and 15kgs respectively; Mary picks two weighing 10kgs and 5kgs respectively.

All these observations suggest that intuitions around an adnominal RE may be vague about the contribution of each individual in comparison and may be sensitive to the context of utterance. This is reminiscent of the vagueness observed in plural predication, where the contribution of each individual is also vague and context-dependent (Schwarzschild 1996; a.o.).

## 1.3 Roadmap

An adequate analysis of REs should not only cover the data discussed in section 1.1 but also reflect the vagueness and contextual dependency illustrated in section 1.2;

this paper aims to achieve this goal. Below I first review Schwarz's (2007) pioneer analysis and discuss some of its problems. In Section 3 I review the theory of plural predication the proposal is couched on and the idea of 'degree plurality' suggested by Dotlačil & Nouwen (2016). My analysis of the semantics of the RE morpheme is laid out in Section 4. Amount REs are discussed in Section 5. Section 6 centers on the vagueness and context dependency observed in an adnominal reciprocal equative; the discussion reveals how delicately plurality in the domain of individuals interacts with that in the domain of degrees. Section 7 is the conclusion.

## 2 Schwarz's (2007) analysis

Building on the assumption that a gradable predicate such as *heavy* relates a degree d and an individual x in the way that x's weight at least reaches d (see (21a)), Schwarz suggests that a reciprocal equative morpheme such as German *gleich* relates a gradable predicate R and a plural individual X (see (21b)) and asserts that all the relevant subparts of X have the same degree with respect to R.

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(21) a. [\![\!]\!] schwer/heavy [\!]\!]=\lambda d_d. \lambda x_e. \mu_{weight}(x) \ge d (where \mu_{weight} is a measure function that maps x to x's weight )

b. [\![\!]\!] gleich [\![\!]\!]=\lambda R_{<d, <e, t>>}. \lambda X_e: \neg ATOM(X). \forall x,y \sqsubseteq X[x \ne y \text{ and } x,y \in C \rightarrow \{d: R(d)(x)\} = \{d: R(d)(y)\} \}
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In (21b), C is the contextual restriction on plural predication and may be taken to be a cover á la Schwarzschild (1996). Along with these assumptions, the truth conditions (22) may be derived for (2): with the natural assumption that C contains the individuals Hans and Maria, these truth conditions then say that the weight of Hans is equivalent to that of Maria.

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(22) [ [ Hans and Maria ] are [ gleich heavy ]]=1 iff \forall x,y \sqsubseteq (H \sqcup M)[x \neq y \text{ and } x,y \in C \rightarrow \{d: \mu_{weight}(x) \geq d\} = \{d: d: \mu_{weight}(y) \geq d\} ]
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The reciprocal equative morpheme need not be interpreted *in situ*. When combined with a relational gradable adjective like *angry* (see (23)), *gleich* moves out of its base-generation position (see (24a-24b)) to resolve type mismatch. In the LF in (24b), *d* is the degree variable left after the movement of *gliech*.

- (23) Hans und Maria sind mir gleich böse. Hans and Maria are me.DAT equally angry 'Hans and Maria are equally angry at me.'
- (24) a.  $[angry/b\ddot{o}se] = \lambda d_d$ .  $\lambda x_e$ .  $\lambda y_e$ .  $\mu_{anger-at-x}(y) \ge d$ b.  $[H\&M[gleich[1[[d_1 angry-at me]]]]] = 1$  iff  $\forall x,y \sqsubseteq (H \sqcup M)[x \ne y \text{ and } x,y \in C \rightarrow \{d: x \text{ is d-angry at me}\} = \{d: y \text{ is d-angry at me}\}$

Schwarz (2007) also points out that in an amount reciprocal equative like (8), *gleich* must move out of its base-generation position and gets interpreted outside its containing DP.<sup>2</sup> Assuming that in (25b) C contains the group of the pets Hans has and that of the pets Maria has, the derived truth conditions amount to saying that the number of the pets Hans has is the same as that of those Maria has. In (25b), the pluralization operators \* and \*\* are are used and understood in the way as in Link (1983), Sternefeld (1998), Beck (2000, 2001) and many others.

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(25) a. [viele/many] = \lambda d_d. \lambda P_{\langle e, t \rangle}. \lambda Q_{\langle e, t \rangle}. \exists Z[|Z| \geq d \text{ and } P(Z) \text{ and } Q(Z)]
b. [H&M[gleich] = \{d: \exists Z[*pet(Z) \text{ and } |Z| \geq d \text{ and } **have(Z)(x)]\} = \{d: \exists Z[*pet(Z) \text{ and } |Z| \geq d \text{ and } **have(Z)(y)]\}]
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An adnominal reciprocal equative like (6), in this analysis, may be parsed in two different ways. In one, *gleich* is interpreted *in situ* (see (26a)); in the other, *gleich* moves out of its containing DP at LF (see (27a)). As Schwarz (2007) notes, these two LF's, in a context in which Hans and Maria each carry just one backpack (see (17)), lead to the same prediction: assuming that C in (26a) contains each of the backpack Hans and Maria carry respectively and on the other hand that in (27a) contains the individuals Hans and Maria, these two sets of truth conditions both predict that (6) is true iff the backpacks they carry weigh the same.

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(26) a. LF 1 of (6): [ H\&M [ **carry [ \exists [ [ gleich\ heavy\ ] *backpacks ]]]] b. [[ (26a) ]]=1 iff \exists Z[*bp(Z)\ and\ **carry(Z)(H\&M)\ and\ \forall x,y \sqsubseteq Z[x,y \in C\ and\ x \neq y \rightarrow \{d:\ \mu_{weight}(x) \geq d\} = \{d:\ \mu_{weight}(y) \geq d\}]] (27) a. LF 2 of (6): [ H\&M [ gleich [ 1 [ **carry [ \exists [ [ d_1\ heavy\ ] *backpacks ]]]]]] b. [[ (27a) ]]=1 iff \forall x,y \sqsubseteq (H\sqcup M)[x,y \in C\ and\ x \neq y \rightarrow \{d:\ \exists Z[*bp(Z)\ and\ **carry(Z)(x)\ and\ \mu_{weight} \geq d]\} = \{d:\ \exists Z[*bp(Z)\ and\ **carry(Z)(y)\ and\ \mu_{weight} \geq d]\}]
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Nevertheless, in a scenario like (18), where Hans and Maria each carry two backpacks, these two LF's lead to different predictions: while (26b) predicts that (6) is true against this scenario, (27b) predicts that it is false. Given that as Schwarz (2007) reports, (6), intuitively, can be true or false in this scenario, he concludes that both analyses are consistent with intuitions.

<sup>2</sup> Having *gliech* interpreted *in situ* in an amount reciprocal equative, in Schwarz's analysis, leads to the truth conditions that further lead to the wrong prediction that *Hans and Maria have equally many cats* entails *Hans and Maria have equally many pets*. I refer the reader to Schwarz (2007) for detailed discussion.

Promising as it might initially seem to be, Schwarz's (2007) analysis suffers from several problems some of which are already noted by himself. One of them has to do with universal REs' like (13-15). As Schwarz notes himself, it is unclear how such cases may be addressed in his analysis. Another challenge Schwarz's faces comes from examples like (28) (from German) and its Mandarin counterpart (29). In these examples, the number of the dogs John has and that of the cats he has are being compared.

- (28) Hans hat gleich viele Hunde und Katzen. Hans has equally many dogs and cats 'Hans has equally many dogs and cats.'
- (29) Yuēhàn yăng-le yíyàng dūo-de gŏu gēn māo. John keep-PERF equally many-MOD dog and cat 'John has equally many dogs and cats.'

As noted above, in an amount reciprocal equative, a reciprocal equative morpheme, in Schwarz's setting, must move out of the containing DP. Nevertheless, having the reciprocal equative morpheme interpreted DP-externally in these cases wrongly predicts that (28-29) are unacceptable for the reason why \*John has equally many dogs is.

## 3 Plural predication and Degree Plurality

In this section, I review some assumptions the proposal relies on; these include i) a theory of plural predication that makes use of the pluralization operators \* and \*\* that are constrained by *covers* and ii) Dotlačil & Nouwen's (2016) idea of **degree plurality**.

### 3.1 Plural Predication, Distributivity and Cumulativity

Following Link (1983), Sternefeld (1998), Beck (2000, 2001) and many others, I assume that the pluralization operations \* and \*\* are introduced through operators present at LF. \* gives rise to the distributive reading of, e.g., *John and Mary left*, according to which John left and Mary, too, did; \*\* gives rise to the so called 'cumulative reading' of, e.g., *John and Mary love Bill and Sue*, according to which each of John and Mary loves one of Bill and Sue, and each of Bill and Sue is loved by one of John and Mary. Both operations are sensitive to *covers* C á la Schwarzschild (1996), a salient way in the context of utterance objects in the universe of discourse are divided into groups.

(30) a. 
$$[ * ](C)(P_{\langle e, t \rangle}) = \lambda X_e$$
.  $\forall x \sqsubseteq X[x \in C \rightarrow [*P](x)]$ 

#### b. **Distribution**:

\* is that function:  $D_{<e,\,t>} \rightarrow D_{<e,\,t>}$  such that for any  $f \in D_{<e,\,t>}$  and any x in  $D_e$ , [\*f(x)]=1 iff f(x)=1 or  $\exists u \exists v [x=u \sqcup v \text{ and } [*f](u) \text{ and } [*f](v)]$ 

(31) a. 
$$[\![ ** ]\!](C)(P_{>}) = \lambda X_e$$
.  $\lambda Y_e$ .  $\forall y \sqsubseteq Y[\ y \in C \to \exists X \sqsubseteq x[x \in C \text{ and } [**P](x)(y) \ ]]$  and  $\forall x \sqsubseteq X[\ x \in C \to \exists y \sqsubseteq Y[y \in C \text{ and } [**P](x)(y) \ ]]$ 

### b. Cumulation:

\*\* is that function:  $D_{<e, <e, t>>} \to D_{<e, <e, t>>}$  such that for any  $R \in D_{<e, <e, t>>}$  and any x, y such that  $x \in D_e$  and  $y \in D_e$ , [\*\*R](x)(y)=1 iff: R(x)(y) or  $\exists x_1 \exists x_2 \exists y_1 \exists y_2 [x=x_1 \sqcup x_2 \land y=y_1 \sqcup y_2 \land [**R](x_1)(y_1) \land [**R](x_2)(y_2)]$ 

## 3.2 Degree plurality

Much research (e.g., Fitzgibbons, Sharvit & Gajewski 2008; Beck 2010, 2013, 2014; Dotlačil & Nouwen 2016) suggests that the ontology and semantic mechanism designated for plurality of individuals should be extended to degrees. Among them, Dotlačil & Nouwen (2016) explicitly suggest that one may form a sum of degrees via the same summation operation according to which a sum of individuals is formed: for any two degrees d and d', d⊔d' is the sum of d and d'. As Dotlačil & Nouwen (2016) notes, it is not surprising that the semantic mechanisms governing plurality formation and plural predication may be exteded to degrees, given that degrees and entities behave very much alike. For instance, (32a) carries a cumulative interpretation (e.g., John is 20 years old, Peter is 22, and Mary 26) in the way that (32b) possibly could (e.g., John likes Bill, Peter likes Chris and Mary likes Sue). This suggests that the same cumulation relation may be involved in both (32a) and (32b).

- (32) a. John, Peter and Mary are 20, 22 and 26 years old.
  - b. John, Peter and Mary like Bill, Chris and Sue.

Building on this idea, Dotlačil & Nouwen further suggest that a gradable adjective such as *tall* relates a sum d of degrees and an individual x in the way that the height of x (i.e.,  $\mu_{height}(x)$ ) is part of d (see (33a)). An operator MIN is postulated to pick out the unique member d' from a set D of sums of degrees such that d' does not contain any other members in D as its subpart. Take John's height for instance; applying MIN to the set of sums d of degrees that contain John's height (i.e.,  $\mu_{height}(J) \sqsubseteq d$ ) gives John's height (i.e.,  $\mu_{height}(J)$ ) (see (34)).

(33) a. 
$$[tall] = \lambda d_d$$
.  $\lambda x_e$ .  $\mu_{height}(x) \sqsubseteq d$   
b. For any  $D' \in D_{< d, t>}$ ,  $MIN(D') = \iota d[D'(d)$  and  $\neg \exists d'[D'(d')$  and  $d' \sqsubseteq d]]$ ; otherwise, undefined.

(34) If 
$$\mu_{\text{height}}(J)=180\text{cm}$$
, {d:  $[tall](d)(J)$ }={d:  $\mu_{\text{height}}(J)\sqsubseteq d$ }={d:  $180\text{cm}\sqsubseteq d$ }; MIN( $\lambda d$ .  $\mu_{\text{height}}(J)\sqsubseteq d$ )= $\mu_{\text{height}}(J)$ 

Dotlačil & Nouwen's (2016) main goal is to account for comparatives with a universal quantifier inside the *than*-clause.<sup>3</sup> Intuitively, *John is taller than every girl is* is true iff John is taller than the tallest girl. Along with their idea, this intuition may be captured in the following way. Suppose that there are three girls, namely a, b and c, in the context of utterance; the *than*-clause then denotes the set of sums d of degrees such that d contains every girl's height as its subparts (see (35a); i.e.,  $(\mu_{\text{height}}(a) \sqcup \mu_{\text{height}}(b) \sqcup \mu_{\text{height}}(c)) \sqsubseteq d)$ ; MIN then picks out the unique sum from this set that contains all and only every girl's height (i.e.,  $\mu_{\text{height}}(a) \sqcup \mu_{\text{height}}(b) \sqcup \mu_{\text{height}}(c)$ ). With the application of the cumulation operation \*\*, the truth conditions (35b) are derived, which amounts to saying that  $\mu_{\text{height}}(J)$  is greater than all of  $\mu_{\text{height}}(a)$ ,  $\mu_{\text{height}}(b)$  and  $\mu_{\text{height}}(c)$ . This then correctly predicts that *John is taller than every girl is* is true only if John is taller than the tallest girl.

(35) a. [ than every girl is tall ] = 
$$\lambda d_d$$
.  $\forall x[x \text{ is a girl} \rightarrow \mu_{\text{height}}(x) \sqsubseteq d]$   
b.  $\mu_{\text{height}}(J)[**>]MIN(\lambda d. \forall x[x \text{ is a girl} \rightarrow \mu_{\text{height}}(x) \sqsubseteq d])$ 

## 4 Predicative REs

Along with the assumptions laid out above, I suggest that a reciprocal equative morpheme such as *y*(*y*\hat{a}ng/gleich/equally has the denotation in (36).

(36) 
$$\|yiyang/gleich/equally\|=\lambda D'_{< d. t>}$$
.  $\forall d', d''[d', d'' \sqsubseteq MIN(D') \rightarrow d'=d'']$ 

A reciprocal equative morpheme operates on a set of sums of degrees and asserts that the unique member picked out by MIN has subparts mutually equivalent. At LF, it moves out of its base-generation position and leaves a degree variable bound a  $\lambda$ -abstractor (c.f., Heim & Kratzer 1998).

(37) 
$$[AP \ y'iyang/gleich/equally [A' \ heavy]] \Rightarrow [y'iyang/gleich/equally [7 [...[AP \ d7 [A' \ heavy]]]]]$$

The predicative reciprocal equative such as (1-3) then may be analyzed as in (38): with the natural assumption that the cover C contains each of the individuals John and Mary, MIN picks out the unique sum d of degrees that contains all and only the weight of John and that of Mary; the derived truth conditions then say that all the subparts of d are mutually equivalent, which amounts to saying that John's weight is the same as Mary's.

<sup>3</sup> For detailed discussion on quantifiers in the *than-*clause, see Beck (2010, 2014), Alrenga & Kennedy (2014), Dotlačil & Nouwen (2016) and the references cited therein.

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(38) a. [ yiyang/gleich/equally [ 7 [ J\&M [ [ * C] [_{AP} d_7 heavy]]]] b. [ _{heavy} ]=\lambda d_d. \lambda x_e. \mu_{weight}(x) \sqsubseteq d c. Let C\supseteq \{J, M\}, [ _{yiyang/gleich/equally} ](\lambda d_d. \forall x \sqsubseteq (J \sqcup M)[x \in C \rightarrow \mu_{weight}(x) \sqsubseteq d ] )=1 iff: \forall d', d'' [d', d'' \sqsubseteq MIN(\lambda d_d) \forall x \sqsubseteq (J \sqcup M)[x \in C \rightarrow \mu_{weight}(x) \sqsubseteq d ]) \rightarrow d' = d'' ] 'The unique sum of degrees that contains only \mu_{weight}(J) and \mu_{weight}(M) has subparts that are mutually equivalent. '
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With the idea laid out above, a universal reciprocal equative like (39) may be accounted for in a very similar way a comparative with a universal quantifier in the *than*-clause is accounted for. In (39), the reciprocal degree morpheme takes as its argument the set of sums of degrees that contain the thickness of every steak (see (40b)); the operator MIN then picks out the unique element in this set that does not contain any other members in this set as its subpart.

- (39) měi-yī-kuài niúpái dōu yíyàng hòu. every-one-CL steak all equally thick 'Every steak is equally thick.'
- (40) a. [ yíyàng [ 7 [ every steak [  $d_7$  thick ] ] ] ]
  b. [ [ 7 [ every steak [  $d_7$  thick ] ] ] ] = $\lambda d_d$ .  $\forall x[x \text{ is a steak} \rightarrow \mu_{\text{thickness}}(x) \sqsubseteq d]$ [ (39/40a) ]=[ yíyàng ]( $\lambda d_d$ .  $\forall x[x \text{ is a steak} \rightarrow \mu_{\text{thickness}}(x) \sqsubseteq d]$ ) =1
  iff  $\forall d', d''[d', d'' \sqsubseteq \text{MIN}(\lambda d_d)$ .  $\forall x[x \text{ is a steak} \rightarrow \mu_{\text{thickness}}(x) \sqsubseteq d]$ )  $\rightarrow d' = d''$ ]

The derived truth conditions say that all the subparts of the unique sum of degrees picked out by MIN are mutually equivalent. Suppose that the steaks in comparison are a, b, and c; the set of sums of degrees yiyang operates on contains all and only those that have as their subpart  $\mu_{thickness}(a) \sqcup \mu_{thickness}(b) \sqcup \mu_{thickness}(c)$ ; MIN then picks out the sum  $\mu_{thickness}(a) \sqcup \mu_{thickness}(b) \sqcup \mu_{thickness}(c)$ . By saying that all the subparts of  $\mu_{thickness}(a) \sqcup \mu_{thickness}(b) \sqcup \mu_{thickness}(c)$  are mutually equivalent, the derived truth conditions amount to saying that  $\mu_{thickness}(a) = \mu_{thickness}(b) = \mu_{thickness}(c)$ .

### 5 Amount REs

A piece required to account for an amount reciprocal equative like (10)/(11) is the syntax and semantics of Q-adjectives. It has been suggested recently that although the meaning of Q-adjectives involves gradability, measurement of quantity is not introduced by these elements; instead, it is introduced via a functional head that co-occurs with the Q-adjectives (Rett 2008; Solt 2015; and others). Below I work with Solt's (2015) analysis, according to which Q-adjectives have quite a trivial semantics and do not encode a measure function in their lexical meaning (see (41a)). Measurement of quantity, instead, is introduced by the functional head Meas, whose

lexical meaning, along with Dotlačil & Nouwen's (2016) idea of degree plurality, is given in (41b). Following Solt (2015), I further assume the compositional rule **D**egree **A**rgument **I**ntroduction to resolve the type-mismatch between Meas and the NP it combines with.

- (41) a.  $\llbracket many/much/viele/d\bar{u}o \rrbracket = \lambda d_d$ .  $\lambda I_{< d, t>}$ . I(d) b.  $\llbracket Meas \rrbracket = \lambda x_e$ .  $\lambda d_d$ .  $\mu_{quantity}(x) \sqsubseteq d$ 
  - c. <u>Degree Argument Introduction</u>: (Solt 2015, with slight modification) For any branching node  $\alpha$ , whose daughters are  $\beta$  and  $\gamma$ , if  $[\![\beta]\!] \in D_{\langle e, t \rangle}$  and  $[\![\gamma]\!] \in D_{\langle e, \langle d, t \rangle \rangle}$ , then  $[\![\alpha]\!] = [\lambda d_d, \lambda x_e, [\![\beta]\!] (x)$  and  $[\![\gamma]\!] (x) (d) [\![\alpha]\!]$

Along with these assumptions and the LF in (42), the truth conditions of (10)/(11) are derived as in (43b).

- [42) [yiyang/gleich [@ 7 [[QP  $d_7$  many] [@ 5 [[ConjP [ $DP_1$ ]  $\exists$  [MeasP  $d_5$  [Meas' [\*-C] [Meas dogs]]]] and [ $DP_2$ ]  $\exists$  [MeasP  $d_5$  [Meas' [\*-C] [Meas cats]]]]] [1 J \*\*-C-have  $t_1$ ]]]]]]
- - c.  $[\![yiyang/gleich]\!]([\![\mathcal{Q}]\!])=1$  iff  $\forall d,d''[d,d''\sqsubseteq MIN([\![\mathcal{Q}]\!])\rightarrow d=d'']$  '(with  $C\supseteq \{J, \text{ the-cats-he-has, the-dogs-he-has}\}$ ) the unique sum d that contains only the number of the dogs John has and the number of the cats John has has mutually equivalent subparts. '

With the natural assumption that C contains J, the sum of the dogs J has, and the sum of the cats he has, MIN operates on the set of sums of degrees that contain  $\mu_{\text{quantity}}$ (the-dogs-J-has) $\sqcup \mu_{\text{quantity}}$ (the-cats-J-has) and picks out this sum of degrees. The truth conditions derived then assert that  $\mu_{\text{quantity}}$ (the-cats-J-has) $\sqcup \mu_{\text{quantity}}$ (the-cats-Mary-has) has mutually equivalent subparts, which amounts to saying that the number of the cats John has is exactly the same as the number of the dogs he has.

## 6 Adnominal REs and vagueness

As noted above, intuitions around an adnominal reciprocal equative like (6)/(7) may be vague; it can be true or false in a scenario like (2), where each of John and Mary carries more than one backpack, and only one of those John carries weighs the same as one of those Mary carries. Schwarz (2007) captures this vague intuition by assigning multiple LFs' to examples of this kind. In the alternative analysis I have suggested above, a reciprocal equative morpheme moves obligatorily at LF; therefore, the vagueness observed can no longer be accounted for by assigning (6)/(7) multiple LF's. Instead, I suggest that this should be captured via manipulation of covers, the contextual restriction on plural predication.

Along with the proposal and the LF (44a), the truth conditions (44b) are derived for (6)/(7).

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(44) a. [ yíyàng/gleich/equally [_{\bigcirc} 7 [ [_{DP} \exists [[[ * C ] [ d_7 heavy ]] backpacks ]] 1 [ J\&M **-C-carry t_1 ]]]]
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b. [\![ DP ]\!] = \lambda P_{<e, t>}. \exists X[*bp(X) \text{ and } \forall x \sqsubseteq X[x \in C \to \mu_{weight}(x) \sqsubseteq d] \text{ and } P(X)] [\![ \bigcirc ]\!] = \lambda d. \exists X[*bp(X) \text{ and } \forall x \sqsubseteq X[x \in C \to \mu_{weight}(x) \sqsubseteq d] \text{ and } \forall y \sqsubseteq (J \sqcup M)[y \in C \to \exists x \sqsubseteq X[x \in C \text{ and } **carry(x)(y)] \text{ and } \forall x \sqsubseteq X[x \in C \to \exists y \sqsubseteq (J \sqcup M)[y \in C \text{ and } **carry(x)(y)]] [\![ yiyàng/gleich/equally ]\!] ([\![ \bigcirc ]\!]) = 1 \text{ iff } \forall d', d''[d', d'' \sqsubseteq MIN([\![ \bigcirc ]\!]) \to d' = d''] 'The unique d that contains all and only the weight of some backpacks in C that John carries and the weight of some backpacks in C that Mary
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In the scenario in which John and Mary each carry only one backpack, these truth conditions, with the natural assumption that C contains John, Mary, the backpack John carries and that Mary carries, correctly predict that (6)/(7) is true iff the weight of John's backpack is the same as that of Mary's.

carries has subparts mutually equivalent.'

The situation gets complicated in a scenario like (18), where John and Mary each carry more than one backpack. With this scenario in mind, let's first consider the possibility according to which C contains John, Mary and each individual backpack carried by either of them (i.e.,  $\{J, M, a, b, c, d\}\subseteq C$ ). With this possibility, the reciprocal equative morpheme operates on the set of sums of degrees in (45); MIN then serves to pick out the unique sum from this set that does not contain any other members as its subpart.

(45) {d: d conatins as its subparts at least one of **15kg**⊔**5kg**, 15kg⊔10kg, 10kg⊔5kg, and **10kg**}

Applying MIN to this set however leads to undefinedness: in this set, the sum 10kg does not contain any other members as its subparts, and neither does the

sum 15kg $\sqcup 5$ kg; MIN hence fails to pick out the unique member from this set. Consequently, (6)/(7) cannot be true with this value for C.

It seems that the only possible value for C that may render (6)/(7) true in (18) is one according to which it is a so-called 'ill-fitting cover' for the backpacks in this scenario (Brisson 1998, 2003). Being such a cover, C may contain the individual backpacks a and c but group b and d in a 'junkpile'. For instance, the backpacks b and d are grouped together with e, where e is some random object in the universe of discourse (i.e.,  $\{J, M, a, c, (b \sqcup d) \sqcup e\} \subseteq C$ ). In this possibility, b and d escape quantification introduced via plural predication; the truth conditions derived in (44b) then may be satisfied in the scenario in (18) in the following way: the operator MIN picks out 10 kgs,  $\mu_{\text{weight}}(b) \sqcup \mu_{\text{weight}}(c)$ , which has subparts mutually equivalent.

The idea of using an 'ill-fitting cover' in plural predication has been suggested to account for the tolerance of exceptions of a statement with definite plurals, such as the students built a raft. As already observed in various research, this sentence can be true even if there is one student who did not participate in any raft building. Brisson (1998, 2003) suggests that this intuition may be captured if the cover C groups the exceptions with some random objects in the universe of discourse so that they could escape from quantification introduced in plural predication. Along these lines, we may approach the vague intuition Schwarz (2007) reports in the following way. In an out-of-the-blue context, the default value for C, according which it contains each individual backpack, leads to undefinedness; this explains why speakers might not consider (6)/(7) true in such a scenario. On the other hand, once an ill-fitting cover, such as the one discussed above, becomes a salient option available in the context of utterance, (6)/(7) then may be easily judged true in the same scenario. Compared to the possibility of C containing each individual backpack, that of C being an ill-fitting cover that groups the backpacks b and d in (18) in a 'junkpile' is far from salient in an out-of-the-blue context. Such a context dependency explains why enrichment of the contextual information and a different choice of verb may render (7)/(6) get judged true against (18) more easily. As already shown in (19), if more contextual information is added. (7)/(6) would be judged true more easily in the scenario (18). The change of the verb from *carry* to *pick*, as shown in (20a), may have the very same effect. All these are expected if the source of the vagueness observed in (6)/(7) is the context-sensitivity of C; after all, the saliency of a cover is sensitive to the contextual information as well as the nature of the property distributed (Schwarzschild 1996). In these examples, the additional contextual information or the change of verb 'highlights' the backpacks that weigh the same and consequently, in Brisson's (1998) term, render those that do not weigh the same salient enough to be ignored. An ill-fitting cover that may render (6)/(7) true is then easier to be drawn by the hearer in face of a scenario like (18).

Intuitions around statements with plurals generally are vague about the contri-

bution of each individual in question and are sensitive to the context of utterance when large groups are involved. The discussion above shows that such vagueness and context sensitivity are observed in an adnominal RE as well. Along with the cover-based theory of plural predication the proposal is couched on, this may be seen as the result from the context sensitivity of covers.

#### 7 Conclusion

It has been suggested repeatedly that plurality on degrees may have played a role in the semantic derivation of a degree construction, especially that of a comparative sentence with a quantifier in the *than*-clause (e.g., Heim 2006; Beck 2010, 2014; Dotlačil & Nouwen 2016). Building on the insight of these work, I have attempted to extend the idea of **degree plurality** to reciprocal equatives, a degree construction that conveys reciprocity and equivalence. Taking Schwarz's (2007) pioneer study as the starting point, I offer an account for this degree construction that covers a wider range of data. The discussion not only provides new support for the need of building in plurality in degree semantics but also reveals the intricate interaction between plurality in the domain of degrees and that in the domain of individuals.

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Reciprocal Degree operators and degree pluralities

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