Three sources of vagueness in degree constructions

Galit W. Sassoon, Ben Gurion University of the Negev

Since Russell (1905), semanticists often characterize gradable predicates as mapping entities to real numbers $r \in \Re$ (Kennedy 1999). The mapping is additive wrt a dimension (Klein 1991). For example, the degree function of *long*, f_{long}, is 'additive wrt length'. It represents ratios between quantities of length in entities – the fact that the length of the concatenation (placing end to end) of any two entities d_1 and d_2 (symbolized as $d_1 \oplus_{length} d_2$) equals the sum of lengths of the two separate entities ($f_{long}(d_1 \oplus_{length} d_2) = f_{long}(d_1) + f_{long}(d_2)$). This analysis provides straightforward semantic accounts of numerical degree predicates (NDPs; like *2 meters tall*) ratio predicates (like *twice as happy as Sam*), and difference predicates (*2 meters shorter*).

Yet, many predicates don't license NDPs (#*two meters short*; #*two degrees warm* /*beautiful* /*happy*), rendering the numerical analysis unintuitive. Moreover, there is much indeterminacy concerning the (presumed) mapping of entities to numbers. Given the real interval [0,1], why would one have a degree 0.25 rather than say 0.242 in *happy*? (Kamp and Partee 1995); which set of real numbers forms the degrees of *happy*? Moltmann (2006) concludes that only the few predicates that license NDPs map entities to numbers. Conversely, I propose that any gradable predicate (including *happy*) maps entities to numbers, but no mapping (including that of *tall*!) is fully specified, resulting in a limited distribution of NDPs, ratio-modifiers, and unit names. Let me explain these claims in more details.

Let the set W_c consist of worlds that given the knowledge in some *actual context* c (the common knowledge of some community of speakers out of the blue) may still be the actual world (Stalnaker 1975). We cannot count directly quantities of the 'stuff' denoted by mass nouns (*height*, *heat, happiness*). These quantities have no known values (like 1,2,3,..) Thus, objects d with a non-zero quantity of height (say, the meter) should be mapped to different numerals in different worlds ($\exists w_1, w_2 \in W_c$: $f_{tall,w1}(d) \neq f_{tall,w2}(d)$). Still, meter rulers tell us the ratios between entities' heights, and in any w, $f_{tall,w}$ represents these ratios (in every $w \in W_c$, entities with n times d's height are mapped to the numeral $n \times f_{tall,w}(d)$). All *tall*'s functions in W_c, then, yield the same ratios between entities' degrees (these ratios are known numbers). Let's call all objects, whose height equals that of the meter, '*meter unit objects*'. I propose that an entity d falls under NDPs like *2 meters tall* iff the ratio between d's degree in *tall* and the meter unit-objects' degree in *tall*, $r_{m,w}$, is 2 ($\forall w \in W_c$: $f_{tall,w}(d) = 2 \times r_{m,w}$). So it is not the case that Dan is 2 meters tall iff f_{tall} maps Dan to 2. The value to which f_{tall} maps Dan is unknown ($\neg \exists n$: $\forall w \in W_c$, $f_{tall,w}([[Dan]]_w) = n$). We feel that we have knowledge about entities' degrees in *tall* only because **the following two preconditions hold**:

(i) The ratios between entities' degrees are known numbers ($\forall d_1, d_2$, $\exists n \in \Re$: $\forall w \in W$, $f_{tall,w}(d_1) = n \times f_{tall,w}(d_2)$), and

(ii) There is an agreed-upon set of unit-objects s.t. any d is associated with a known number *representing the ratio between d's degree and the unit-objects' degree* in *tall*.

Violations of (ii) : Lack of agreed-upon unit-objects

Consider *happy* or *heavy* (understood as *feels heavy*). Even if one speaker treats certain internal states as unit-objects, no other speaker has access to these states. So no object d can be s.t. it would be *agreed-upon by all the community* that d is a unit-object. My proposal predicts that the lack of conventional unit-objects will prevent the possibility of determining numbers for entities.

This proposal is superior to non-numerical theories (cf. Moltmann 2006) because it accounts for the compatibility of *happy* with ratio and difference modifiers. For example, the felicity of *Dan is twice as happy as Sam* shows that the ratios between *happiness* degrees can be treated as meaningful (it is true iff $\forall w \in W_c$: $f_{happy,w}([[Dan]]_w) = 2 \times f_{happy,w}([[Sam]]_w)$). Generally, we don't need to know entities' degrees, only the ordering or ratios between their potential degrees.

Violations of (i) : Lack of knowledge about ratios between degrees

While we may feel acknowledged of the ratios between, say, our degrees of happiness in separate occasions, we can hardly ever feel acknowledged of the ratios between degrees of entities in predicates like *short*. This is illustrated by the fact that ratio modifiers are less acceptable with *short* than with *tall* or with *long* (as in *Dan is twice as tall as Sam* vs. *#Dan is twice as short as Sam*, and as Google search-results show). In accordance, the present analysis predicts that, in the lack of knowledge concerning ratios between degrees, numerical degree predicates will not be licensed (as in **two meters short*).

Still, numerical degree predicates *are* fine in the comparative (as in *two meters shorter*). In actual contexts, we can positively say that Dan's degree in *short* is n meters bigger than Sam's iff Sam's degree in *tall* is n meters bigger than Dan's. Elsewhere (Salt 18), I show that any function that linearly reverses and linearly transforms the degrees of f_{tall} can predict these facts. I.e., I propose that for any $w \in W_c$ there is a constant $Tran_{short,w} \in \Re$, s.t. $f_{short,w}$ assigns any d the degree $(Tran_{short,w} – f_{tall,w}(d))$ (so Dan is taller iff Sam is shorter); the transformation value, $Tran_{short}$, is unknown ($\neg\exists n \in \Re$: $\forall w \in W_c$, $Tran_{tall,w}$=n). Therefore, if in c *tall* maps some d to 2 meters ($\forall w \in W_c$, $f_{tall,w}(d)=2 \times r_{m,w}$), *short* maps d to $Tran_{short}$–2 meters ($f_{short,w}(d)= Tran_{short,w} – 2 \times r_{m,w}$). So in the lack of knowledge about $Tran_{short}$ (it varies across W_c), we can't say which entities are *2 meters short* in c ($\neg\exists$d: $\forall w \in W_c$, $f_{short,w}(d)=2 \times r_{m,w}$). However, in computing degree-differences, the transformation values cancel one another: $\forall w \in W_c$, d_2 is 2 meters taller than d_1 ($f_{tall,w}$ maps d_2 to some $n \in \Re$ and d_1 to $n–2 \times r_{m,w}$) iff $\forall w \in W_c$, d_1 is 2 meters shorter ($f_{short,w}$ maps d_2 to $Tran_{short,w}$–n and d_1 to $Tran_{short,w}–(n–2 \times r_{m,w})$; the degree difference is still $2 \times r_{m,w}$.) Thus, we can felicitously say that entity-pairs fall, or don't fall, under '*two meters shorter*'.

Last, but not least, my proposal is superior to other accounts of the licensing of numerical degree predicates (cf. von Stechow 1984; Kennedy 1999), because it can capture facts pertaining to positive predicates, like *warm*. Positive predicates may have transformation values, too, which (among other things) render, e.g., *#2 degrees warm*, but not *2 degrees warmer*, infelicitous. Cross linguistic variations with respect to the licensing of numerical degree predicates is expected, since languages may vary as to whether predicates like *heavy* or *warm* measure external or internal states (or both), and whether the measure is transformed or not.

A third (but different) source of vagueness

I proposed that despite the fact that, e.g., $f_{tall,w}$ differs across worlds in W_c, we have knowledge about the ratios and ordering between entities' degrees in predicates like *tall* (so there is no denotation-gap in predicates like *two meters tall* or *taller*). Similarly, in previous vagueness-based gradability theories (Kamp 1975; Fine 1975), the denotation of *taller* does not vary across valuations in a vagueness-model. Yet, sometimes we do not know the truth value of statements like *Dan is (two inches) taller than Sam*. I submit that this vagueness is due to a different source.

I propose that individuals are distinguished by their property values (the values that the degree functions assign to them). For instance, if the referent of *Dan* in w_1 is 1.87 meters tall, and the referent of *Dan* in w_2 is 1.86 meters tall, I say (following Lewis 1986) that the name *Dan* refers to two different individuals in these two worlds. However, if in w_1 and w_2 the referent of *Dan* is 1.87 meters tall, and identical in all the other property values, even if 1.87 counts as 'tall' in w_1 but not in w_2, I still say (unlike Lewis 1986) that the name *Dan* denotes the same individual in these two worlds (it is only our interpretation of the word *tall* that has changed). I do take individuals to be real entities, identified with their 'real' properties. So it is invariably determined for each two individuals in D what their heights are. However, when we use proper names, we do not know exactly which individuals in D they refer to (since we do not know all of their property values). When we do not know the heights of these individuals, we may easily not know how their heights compare. If Dan's height is not accessible to me (its referent is 1.87m tall in w_1, 1.86m tall in w_2, etc.), I may not know whether *Dan is taller than Sam* it true or not.