A Crack at a Hard Nut: Attributive-Adjective Modality and Infinitival Relatives

The English DP construction known since Berman (1974) as the "hard nut," after the poster example *a hard nut to crack*, has a peculiar interpretation that has long gone without a satisfactory explanation. The main difficulty is to explain how the attributive adjective comes to modify not the immediately following noun, but the infinitival relative clause adjoined to NP; this interpretive property of hard nuts is most clearly demonstrated in examples like *a good neighborhood to avoid*. Here I propose a simple modal semantics for the relevant adjectives that explains the interpretive properties of hard nuts, while at the same time explaining why all hard-nut adjectives also occur in impersonal constructions with clausal subjects (e.g., *To crack that nut is hard*). The analysis makes explicit the semantic connection between syntactically disparate uses of these adjectives.

The key to understanding hard nuts, I propose, is recognizing that the head noun of the construction (i.e., *neighborhood* in our second example above) and the infinitival relative clause (*to avoid*) are evaluated in different possible worlds. This reflects a basic semantic intuition about hard nuts: in the DP *a good neighborhood to avoid*, the referent must be understood to be a *neighborhood* in the base world of evaluation (e.g., the actual world), but the DP does not require that the neighborhood be *avoided* in that world. Rather, the DP states that the neighborhood is avoided in those worlds that correspond to what is right or desirable. The infinitival clause thus has a modal interpretation; indeed, this is an independently attested property of infinitival relatives (Bhatt 1999; Hackl and Nissenbaum 2003). At the same time, we must be sure that the noun *neighborhood* is not interpreted modally, as the referent is a neighborhood in the base world, not merely in those worlds that correspond to what is right or desirable. The semantic representations in (1) capture these properties, with the noun and infinitival relative meanings combining by predicate modification, as is usual for adjuncts (Heim and Kratzer 1998). As shown in (1c), the noun meaning is evaluated in world w, the infinitival relative meaning in world w'.

This world-of-evaluation disparity is the basis for the peculiar behavior of the attributive adjective in hard nuts. I propose that the reason why such adjectives fail to modify their immediately following noun is that they provide information about w', the infinitival relative's world of evaluation. In this sense, these adjectives are modals. The adjective *good* in our example is a bouletic modal (Kratzer 1981), specifying an accessibility relation based on what is right or desirable, and quantifying over the accessible worlds. It has the lexical entry and truth conditions shown in (2).

As it stands in (2), *good* quantifies vacuously. In order for it to be used felicitously, one of its arguments must introduce an appropriate variable into its scope. This, I propose, is precisely what the infinitival relative does in hard nuts. When *good* combines with *neighborhood to avoid* by functional application, the free world variable w' from (1c) is introduced into *good*'s scope and bound by it. *Good* likewise specifies the accessibility relation for the infinitival relative, with bouletic BOUL binding the variable ACC. The composition is shown in (3); I follow Abney (1987) in assuming that A^0 takes NP as its complement. *Good*'s quantification applies vacuously to world w, in which *neighborhood* is evaluated: this is why we understand the attributive adjective not to modify the noun in hard nuts. The only semantic connection between the two is that the noun is evaluated in the base world from which the modal accessibility relation introduced by the adjective is determined.

This analysis accounts for the semantic intuition about hard nuts noted above. It likewise accounts for the fact that hard-nut adjectives may take full clausal subjects, as also noted earlier. This is because hard-nut adjectives are sentential modifiers, as the lexical entry and truth conditions in (2) make plain. The only difference between the two uses of hard-nut adjectives is the syntactic composition of the sentential argument: in attributive position, it is built up piecemeal, as represented by $P(x)$ in (2); with a clausal subject, it is introduced all at once, as shown in (4). The truth conditions are the same in either case, a semantic connection despite the syntactic disparity.

(1)   a. Noun meaning (*neighborhood*):
        $\lambda x \lambda w[\mathbf{neighborhood}'(x)(w)]$

   b. Infinitival relative meaning (*to avoid*):
        $\lambda x \lambda w[w' \in \mathrm{Acc}_w : \mathbf{avoid}'(x)(z)(w')]$

   c. Conjoined meaning (via predicate modification):
        $\lambda x \lambda w[\mathbf{neighborhood}'(x)(w) \wedge w' \in \mathrm{Acc}_w : \mathbf{avoid}'(x)(z)(w')]$

   d. Notes:

      i. Acc_w = the modal accessibility relation from world w

      ii. z = the PRO subject of the infinitival relative; a free variable of type e

(2)   a. Lexical entry for *good*:
        $\lambda P \lambda x \lambda w[\exists w' \in \mathrm{Boul}_w : P(x)(w)]$

   b. $[\![\exists w' \in \mathrm{Boul}_w : P(x)(w)]\!] = 1$ iff there exists a world w', bouletically accessible from world w, such that $P(x)$ is true in w.

(3)   a. Functional application, $[\![\mathbf{good}']\!]([\![\mathbf{neighborhood\ to\ avoid}']\!])$—i.e., $[\![(2a)]\!]([\![(1c)]\!])$:
        This yields, after the first lambda reduction:
        $\lambda x \lambda w[\exists w' \in \mathrm{Boul}_w : \lambda y \lambda w''[\mathbf{neighborhood}'(y)(w'') \wedge w' \in \mathrm{Acc}_{w''} : \mathbf{avoid}'(y)(z)(w')](x)(w)]$
        $= \lambda x \lambda w[\exists w' \in \mathrm{Boul}_w : \mathbf{neighborhood}'(x)(w) \wedge w' \in \mathrm{Acc}_w : \mathbf{avoid}'(x)(z)(w')]$
        $= \lambda x \lambda w[\exists w' \in \mathrm{Boul}_w : \mathbf{neighborhood}'(x)(w) \wedge \mathbf{avoid}'(x)(z)(w')]$

   b. $[\![\exists w' \in \mathrm{Boul}_w : \mathbf{neighborhood}'(x)(w) \wedge \mathbf{avoid}'(x)(z)(w')]\!] = 1$ iff there exists a world w', bouletically accessible from w, such that x is a neighborhood in w and z avoids x in w'.

(4)   a. Lexical entry for *good* with clausal subject:
        $\lambda \phi \lambda w[\exists w' \in \mathrm{Boul}_w : \phi(w)]$

   b. $[\![\exists w' \in \mathrm{Boul}_w : \phi(w)]\!] = 1$ iff there exists a world w', bouletically accessible from world w, such that ϕ is true in w.

References

ABNEY, STEVEN PAUL. 1987. *The English Noun Phrase in Its Sentential Aspect*. Cambridge, Mass.: MIT dissertation.

BERMAN, ARLENE. 1974. *Adjectives and Adjective Complement Constructions in English*. Cambridge, Mass.: Harvard University dissertation. [Report no. NSF-29].

BHATT, RAJESH. 1999. *Covert Modality in Non-Finite Contexts*. Philadelphia: University of Pennsylvania dissertation.

HACKL, MARTIN, and JON NISSENBAUM. 2003. A modal ambiguity in *for*-infinitival relative clauses. Ms., Pomona College and McGill University.

HEIM, IRENE, and ANGELIKA KRATZER. 1998. *Semantics in Generative Grammar*. Malden, Mass.: Blackwell.

KRATZER, ANGELIKA. 1981. The notional category of modality. In *Words, Worlds, and Contexts: New Approaches in Word Semantics*, ed. by H.-J. Eikmeyer and H. Rieser, 38–74. Berlin: Walter de Gruyter.