CHAPTER 2

Resolving form-meaning discrepancies in Construction Grammar

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1. Introduction

A central idea in Construction Grammar is that there is no strict division between the lexicon and syntax (Fillmore et al. 1988; Jurafsky 1992; Goldberg 1995). It has been argued that although grammatical constructions differ in their complexity, they are basically the same type of declaratively represented data structures that pair form with meaning (Goldberg 1995: 7). However, there has been relatively little work detailing the exact nature of the relationship between form and meaning in Construction Grammar. This is important when an analysis aims to posit different abstract argument structure constructions for licensing a single syntactic structure that may be interpreted in different ways. For example, Goldberg (1995) claims that the caused-motion and resultative interpretations of the sentences in (1) and (2) are ultimately due to the fact that independently existing meaningful constructions are capable of contributing additional arguments to the basic senses of verbs.

(1) He sneezed the napkin off the table. (Goldberg 1995: 9)

(2) She drank him under the table. (Goldberg 1995: 157)

According to Goldberg, the caused-motion and resultative semantics associated with the constructions are encoded syntactically by a [NP V NP PP/AP] frame that typically does not occur with verbs such as those in (1) and (2). That is, in (2) the final interpretation of the combined verbal and constructional semantics is 'X CAUSES Y TO MOVE Z by drinking'. This meaning is paired with a three-argument syntactic frame [NP V NP PP] that expresses the combined semantics of the verb and the construction. One advantage of this approach lies in the fact that it is not necessary to posit implausible verb senses based on intransitive verbs in order

to account for the distribution of postverbal arguments in the examples above.[1] Furthermore, because of the close relationship between form and meaning it becomes possible to infer the meaning of a sentence based on its form (syntactic bootstrapping (Landau & Gleitman 1985; Fisher et al. 1991; Gleitman 1992).

While Goldberg's constructional approach is quite successful at explaining the distribution of a large number of caused-motion and resultative constructions, it is not entirely clear how her abstract constructions would account for the distribution of postverbal arguments occurring in a syntactic pattern similar to that in (1) and (2).

(3) You pushed a hole through the crazing. (BNC)

(4) The army blew a hole in the barrier round the Americans' fine embassy, … (BNC)

(5) He suggests we knock a hole through the wall. (BNC)

The sentences in (3)–(5) display the same syntactic structure as the sentences in (1) and (2), that is, they exhibit a [NP V NP PP] frame. If one had never heard the verbs in (3)–(5) used in that syntactic pattern before, one might expect the meanings of (3)–(5) to be parallel to the meanings of (1) and (2). However, this is not the case. A comparison of the two example sets illustrates that it is not always possible to arrive at an unambiguous interpretation of sentences based on the meaning of a basic sense of a verb in combination with a syntactic frame that is not intransitive. Our examples show that there exist fundamental discrepancies between the relationship of a single syntactic frame [NP V NP PP] in combination with a basic sense of a verb and the range of different types of possible interpretations that are attributed to abstract constructions in Goldberg's framework.

The goal of this paper is to determine how such form-meaning discrepancies can be accounted for in Construction Grammar. Taking as a test case the 'A hole through Y' constructional pattern exemplified by sentences such as in (3)–(5), I will discuss in detail the role played by abstract Goldberg-style constructions in contributing different types of meanings to verbs belonging to different semantic classes. The insight emerging from this investigation is that form-meaning discrepancies can be accounted for when one pays closer attention to constructions that are much narrower in semantic scope. On this view, constructions exist at different levels of semantic specificity with respect to both the types of situations they may denote and how much lexical material they may contain.

1. For a critical discussion of Goldberg's approach to Construction Grammar, see Kay (1996, 2002), Nemoto (1998), and Boas (2002b, 2003a).

Any analysis of form-meaning discrepancies in Construction Grammar necessitates an understanding of Frame Semantics, which proposes that a "word's meaning can be understood only with reference to a structured background of experience, beliefs, or practices, constituting a kind of conceptual prerequisite for understanding the meaning" (Fillmore & Atkins 1992: 76). An example is the Theft Frame, which represents a scenario with different Frame Elements that can be regarded as instances of broader semantic roles such as AGENT, UNDERGOER, INSTRUMENT, etc. (cf. Boas 2005a). This frame represents a scenario with different core Frame Elements such as GOODS (anything that can be taken away), PERPETRATOR (the person or other agent that takes the goods away), SOURCE (the initial location of the goods before they change location), and VICTIM (the person that owns the goods before they are taken away). The frame description defines the relationships between Frame Elements of the same frame. For the Theft frame, the frame description states that a PERPETRATOR takes GOODS that belong to a VICTIM. To exemplify, the verb *steal* evokes the theft frame in sentences such as *Ben stole the book from Nancy*. The needed background to interpret the sentence requires an understanding of illegal activities, property ownership, taking things, and a great deal more. (Boas 2005a: 139) For a detailed overview of Frame Semantics, see Petruck (1996).

Before I begin with my analysis it is necessary to briefly explain the nature of my data. One major source of data used in this paper comes from electronic corpora. The data source is indicated in parentheses following example sentences, e.g., the British National Corpus (BNC), an electronic corpus containing ca. 100 million words of contemporary spoken (10%) and written (90%) English (see Kennedy (1998: 50–53) and http://www.hcu.ox.ac.uk/). Another provider of data were Usenet group archives and websites on the Internet. These archives contain texts from e-mails and web pages written by people who are relatively free and creative in their use of language. The messages of different Usenet groups can now be accessed at http://www.google.com/groups. The web-page address or the Message-ID number follows Internet citations. Searching the web for specific morpho-syntactic patterns and novel uses of verbs is by now an established method for data collection. See, for example, the special issue of *Computational Linguistics* 29(3) on "The Web as Corpus" (in particular Kilgarriff and Grefenstette 2003).

Finally, I collected acceptability judgments to determine whether sentences with novel uses of words sounded acceptable to native speakers of English. These data supplemented my corpus data. To this end, I followed a loose sampling technique (see Johnstone 2000: 92). Judgments about the acceptability of examples come from twenty undergraduate students at the University of Texas. The students filled out a two-page questionnaire containing two types of sentences: those discussed in this paper, and control sentences that did not contain the types of

argument structure constructions discussed in this paper. Students were asked to indicate whether sentences sounded acceptable or not. When the great majority of informants found a sentence to be unacceptable, a sentence is marked by an asterisk ('*'). The use of the asterisk does not necessarily indicate that the sentence is ungrammatical (see Chomsky's (1965: 10–21) discussion of grammaticalness vs. acceptability), but that it sounds unacceptable to the majority of my student informants. The use of question marks ('?') indicates that informants differ with respect to their acceptability judgments. The use of double question marks ('??') indicates that a large number of speakers find the sentence unacceptable.

The paper is structured as follows. Section two gives a more complete overview of the types of verbs that occur with what we will call for now the "A hole through Y" constructional pattern (henceforth AHTY). Section three takes a closer look at why Goldberg's independently existing meaningful constructions are problematic when it comes to determining the distribution of verbs occurring with AHTY. Section four offers an alternative analysis that looks in more detail at the lexical semantic properties of verbs capable of occurring with AHTY, suggesting that AHTY is an idiomatic construction in its own right. Section five discusses the relationship between AHTY and other grammatical constructions. Finally, section six proposes how to go about resolving form-meaning discrepancies in Construction Grammar, summarizes our findings, and suggests directions for further research.

2. Syntactic properties of verbs

Before going into a detailed analysis of the status of AHTY it is necessary to provide a more comprehensive overview of its distribution among different types of verbs. As pointed out in our discussion of examples (3)–(5), AHTY can only occur as a whole unit with certain types of verbs. Consider the following examples.

(6) a. *You pushed a hole.
b. ??You pushed through the crazing.
c. You pushed a hole through the crazing. (BNC)

(7) a. *He suggests we knock a hole.
b. ??He suggests we knock through the wall.
c. He suggests we knock a hole through the wall. (BNC)

(8) a. *The food won't burn a hole.
b. ?The food won't burn through you either.
c. The food won't burn a hole through you either. (www.gothicchicago.com/hunger.html)

(9) a. *The fowl projectile has blown a hole.
b. ?The fowl projectile has blown through your chest.
c. The fowl projectile has blown a hole through your chest. (www.amerinfoserv.com/maverick/doom.html)

(6)–(9) illustrate that verbs such as *push*, *knock*, *burn*, and *blow* may occur only with the whole phrase *a hole through Y* and not with parts of it. Verbs requiring the presence of *a hole through X* as a coherent unit in postverbal position will be called Class I verbs. One semantic property Class I verbs share with what will be called Class II verbs is the fact that they denote activities in which an entity that can be construed as an agent exerts energy. This is illustrated by the following examples with Class II verbs.[2]

(10) a. Using a hammer drill and carbide bit, drill a hole.
b. Using a hammer drill and carbide bit, drill through the sill plate.
c. Using a hammer drill and carbide bit, drill a hole through the sill plate. (www.ci.campell.ca.us/strctprep.html)

(11) a. The fluid is drained out from under the retina by creating a hole.
b. *The fluid is drained out from under the retina by creating through the whole part of the eye.
c. The fluid is drained out from under the retina by creating a hole through the whole part of the eye. (www.eyecaresite.com/retina_s.html)

(12) a. Once I can make a hole.
b. *Once I can make through them.
c. Once I can make a hole through them. (BNC)

(13) a. Meanwhile, Amy successfully digs a hole.
b. Meanwhile, Amy successfully digs through the oubliette, and escapes.
c. Meanwhile, Amy successfully digs a hole through the oubliette, and escapes. (www.thex-files.com/epi308.html)

Another property shared by Class I and Class II verbs concerns the interpretation of sentences including AHTY, i.e. the activity denoted by the main verb results in the creation of a hole in some surface. Class I verbs differ crucially from Class II verbs in that the former require the presence of the entire phrase *a hole through*

2. Dowty (1991) points out that often there are no clear semantic boundaries between thematic roles such as agent, patient, theme, and instrument. Based on a review of different thematic role hierarchies, Dowty proposes that most predicates exhibit a clustering of so-called proto-agent and proto-patient properties (Dowty 1991: 572). As such, entities that do usually not exhibit agent-like properties (e.g. *food* in (8), or *projectile* in (9)) may be construed as agent-like participants in the proper contexts. (cf. Boas 2003a: 243)

NP whereas the latter do not. Another interesting property of Class II verbs is that they differ from each other with respect to whether they allow omission of the patient argument. In examples (12) and (13) *them* and *the oubliette* represent surfaces that can be construed as patient arguments: in each case the surface is affected by the activity described by the main verb. In other words, whereas Class II verbs may occur only with *a hole* in postverbal position without *through NP* (cf. (10a)–(13a)), this option is disallowed by Class I verbs (cf. (6a)–(9a)). With this overview of the distribution of different verb classes occurring with AHTY, we now return to the question of how to account for their licensing.

3. Form-meaning relations among abstract constructions

As briefly mentioned in the introduction, Goldberg's approach to Construction Grammar (henceforth CxG) maintains that there are independently existing meaningful constructions capable of contributing arguments to a verb's semantics. Following the notion of the linguistic sign (Saussure 1916), a construction is taken to be a pairing of a particular form with a specific meaning. Goldberg's definition of a construction is as below. For alternative definitions of constructions, see Croft (2001: 17–21), Fried and Östman (2004: 18–23), and Goldberg (2006: 5–9).

> C is a CONSTRUCTION iff$_{def}$ C is a form-meaning pair <F_i, S_i> such that some aspect of F_i or some aspect of S_i is not strictly predictable from C's component parts or from other previously established constructions. (Goldberg 1995: 4)

For example, Goldberg argues for an independently existing caused-motion construction, which is a pairing of the meaning 'X CAUSES Y TO MOVE Z by V-ing' with the corresponding syntactic frame [NP V NP PP]. When the caused-motion construction fuses with the meaning of the intransitive verb *sneeze* in (1) above, it contributes additional constructional roles to the meaning of the verb, thereby arriving at the final interpretation 'X CAUSES Y TO MOVE Z by sneezing'. This meaning is expressed syntactically by the [NP V NP PP] frame that typically does not occur with the intransitive *sneeze*. Similarly in (2) above, the final interpretation of the combined verbal and constructional semantics is 'X CAUSES Y TO MOVE Z by drinking'. Again, this meaning is paired with a three-argument syntactic frame [NP V NP PP].

Based on Goldberg's assumption about the interconnection between form and meaning, one might want to assign the sentences in (3)–(5) a caused-motion interpretation 'X CAUSES Y to MOVE Z by V-ing' since this particular type

of meaning is paired with the [NP V NP PP] syntactic frame.[3] This view is supported by the fact that just as in (1) and (2) above, (3)–(5) contain activity verbs, which co-occur with three arguments, namely an agent, a patient, and a location. Further, just as in (1) and (2), the postverbal arguments in (3)–(5) are not prototypical object arguments of the verbs *push*, *blow*, and *knock* (cf. **You pushed a hole*, **The army blew a hole*, and **We knock a hole*). However, comparing the interpretations of the sentences in (3)–(5) with the meaning of the caused-motion construction clearly shows that they do not share an 'X CAUSES Y TO MOVE Z by V-ing' meaning. This illustrates that there is no one-to-one mapping between form and meaning and that Goldberg's caused-motion construction does not account for the distribution of AHTY in (3)–(13).

An alternative explanation of the data in (3)–(13) could involve another independently existing construction postulated by Goldberg, namely the resultative construction, which – according to Goldberg – is a metaphorical extension of the caused-motion construction. This construction pairs a resultative semantics 'X CAUSES Y TO BECOME Z by V-ing' with a specific syntactic frame [NP V NP PP/AP] in order to license postverbal arguments in sentences such as *Miriam ran herself to exhaustion* or *Michael talked himself blue in the face*. This means that the resultative construction contributes constructional arguments to the intransitive senses of *run* and *talk*, resulting in a 'X CAUSES Y TO BECOME Z by running/talking' interpretation that is represented at the syntactic level by the corresponding [NP V NP PP/AP] frame. But note that an explanation of the distribution of AHTY in (3)–(13) in terms of the resultative construction runs into similar problems as that observed for the caused-motion construction. That is, although the relevant sentences in (3)–(13) exhibit an [NP V NP PP] syntactic frame, their interpretations do not coincide with the 'X CAUSES Y TO BECOME Z by V-ing' semantics of the resultative construction.

Our discussion of the data suggests two things. First, the current Goldberg-style inventory of abstract grammatical constructions is not specific enough to deal with the types of data exemplified by (3)–(13). Second, the same syntactic form does not always entail the same interpretations. In other words, the main problem here lies in the fact that although our examples exhibit the same syntactic form [NP V NP PP] and a great deal of semantic overlap, their final interpretations seem to be radically different from the semantics associated with the

3. Clearly, a caused-motion interpretation would not be assigned to just any [NP V NP PP] syntactic frame as in sentences such as *I saw a beautiful woman by the pool*. (Thanks to Jaakko Leino who pointed this out to me.) Instead, one would only try to attempt such an interpretation with sentences in which a main verb occurs with a particular preposition (*through*, *in*, *into*, *out of*, etc.) that could be interpreted as implying caused-motion.

caused-motion and resultative constructions. This problem calls for a solution that involves pairing the same syntactic form as that exhibited by these two constructions with a more specific type of meaning, a point to which we now turn.

4. AHTY as an idiomatic construction

Based on Goldberg's (1995: 4) definition of a construction (see above), it is necessary to attribute the licensing of postverbal arguments in (3)–(13) to a construction different from the caused-motion and resultative constructions. There are two reasons for this: First, the semantics of the two constructions do not apply to (3)–(13). Second, there does neither seem to be any form or meaning component in our grammar (i.e., F_i or some aspect of S_i) nor any other construction that would make it possible to predict the distribution of postverbal arguments in (3)–(13) on a principled basis. The fact that the distribution of arguments in (3)–(13) cannot be attributed to other independently existing constructions in the language strongly suggests the existence of an specialized idiomatic construction. In what follows, I discuss in detail the lexical semantic properties of Class I and II verbs which in turn leads me to propose an independently existing AHTY construction capable of integrating the semantics of different verbs.

4.1 The relevance of verb classes

Recall that there are in principle two different classes of verbs that occur with AHTY. Class I verbs require the presence of the entire phrase *a hole through NP* whereas Class II verbs may only occur with *a hole* while omitting the locative PP. Looking at the distribution of Class II verbs first, the question arises as to why these verbs do not require the presence of a locative PP. The solution involves looking at the implicit meaning of Class II verbs. That is, transitive verbs such as *make*, *create*, *drill*, and *dig* are not only all transitive verbs, but also contain a meaning component that expresses the making of an object. This meaning component is very similar to the meaning of a class of verbs described by Levin (1993). She observes that most of the verbs belonging to a class she calls "verbs of creation and transformation" take "as one argument an agent that creates or transforms an entity" (1993: 172). Furthermore, Levin notes, "these verbs take what are called 'effected objects' – objects brought into existence as a result of the action named by the verb." (1993: 173)

Of the seven sub-classes postulated by Levin for the verbs of creation and transformation, members of the sub-class of "*Create* Verbs" (1993: 175–176) ex-

hibit properties very similar to our Class II verbs. This similarity becomes obvious when we compare their syntactic and semantic properties. For example, Levin demonstrates that the syntactic properties of *Create* Verbs do not occur in the Material/Product Alternation (Dixon 1991), as (14) illustrates.

(14) a. David constructed a house (out of/from bricks).
b. *David constructed the bricks into a house. (Levin 1993: 176)

(15) a. Miriam drilled a hole (through the table).
b. *Miriam drilled the table into/from the hole.

(16) a. Joe made a hole (through the wall).
b. *Joe made a wall into/from the hole.

Class II verbs such as *drill* and *make* in (15) and (16) are syntactically similar to Levin's *Create* Verbs in three ways: they are transitive, allow omission of the prepositional phrase, and do not occur in the Material/Product Alternation. However, note that members of the two classes are semantically different. That is, whereas the prepositional phrase occurring with *Create* Verbs in (14a) denotes the material (i.e., *bricks*) used to create the end product (i.e., *a house*), there is no such equivalent with Class II verbs. This difference has to do with the fact that the entity created by the activity denoted by Class II verbs – the "effected" object in Levin's (1993: 173) terms – is not being created by putting together materials such as bricks, for example. Instead, the activity denoted by Class II verbs results in the creation of an opening (i.e., *a hole*) in the patient object that the agent manipulates. This semantic difference also manifests itself syntactically by the fact that not all of Levin's *Create* Verbs are capable of appearing with AHTY (cf. **Collin coined a hole through the window*, **Lila derived a hole through the door*, and **Michael synthesized a hole through the paper*).

Besides discussing the Material/Product Alternation, Levin points out that *Create* Verbs are found neither in the Benefactive Alternation (Green 1974; Cattell 1984; Goldberg 1995) (cf. (17)) nor in the Causative Alternation (Jackendoff 1990; Croft 1998) (cf. (19)). The following examples illustrate that some Class II verbs (cf. (18) and (20)) share these syntactic properties with Levin's *Create* Verbs.

(17) a. David constructed a house for me.
b. *David constructed me a house. (Levin 1993: 176)

(18) a. Chris drilled a hole for me.
b. Chris drilled me a hole.

(19) a. David constructed the house.
b. *The house constructed. (Levin 1993: 176)

(20) a. Chris drilled a hole.
b. *The hole drilled.

Our comparison of Levin's *Create* Verbs with Class II verbs shows two important things. First, due to the similar semantics they employ to denote the creation of an "effected object", the two verb classes share the same type of syntactic distribution in a number of alternations. Second, the two verb classes are semantically different with respect to the types of effected objects that are the outcome of the activity denoted by the verb (physical object put together (e.g., *a house*) vs. creation of an opening in a surface (i.e., *a hole*)). This semantic difference has syntactic ramifications with respect to the types of verbs that may occur with AHTY. Whereas some of Levin's *Create* Verbs such as *form*, *produce*, and *construct*, among others, may occur with AHTY, others such as *coin*, *derive*, and *synthesize* do typically not share this property. It is this semantic and syntactic difference that sets Class II verbs apart from Levin's *Create* Verbs.[4] With this overview we now turn to the question of how to account for the distribution of AHTY with Class II verbs.

4.2 AHTY with Class II verbs

Since the semantic difference between the two verb classes is mirrored by a difference in syntactic distribution, I propose that Class II verbs form their own specific sub-class of what Levin (1993: 172) calls "Verbs of Creation and Transformation." The postulation of a separate verb class is based on the distribution of a number of verbs with respect to a very specific syntactic phenomenon, i.e., their distribution with AHTY, and the type of meaning these verbs encode. This classification does not preclude members of this verb class to be classified differently when it comes to other types of constructions.[5] As such, they have the same types of semantic and syntactic properties as *Create* Verbs discussed above, but differ crucially with respect to the nature of the effected object. As the distribution of postverbal arguments with Class II verbs is not attributable to more abstract constructions (see section three), I suggest that most Class II verbs are conventionally associated with

4. Ultimately, this difference is one of classification. That is, since only some of Levin's *Create* Verbs occur with AHTY, there exists a sub-class within Levin's *Create* Verbs. Thanks to Jaakko Leino for pointing this out.

5. For example, Levin (1993) postulates different verb classes based on the distribution of verbs in more than thirty different syntactic alternations. For an alternative classification of verbs on a frame semantic basis, see Baker & Ruppenhofer (2003) on how Levin's verb classes match up with verb classes in FrameNet (see http://www.icsi.berkeley.edu/~framenet). See also Croft (2001).

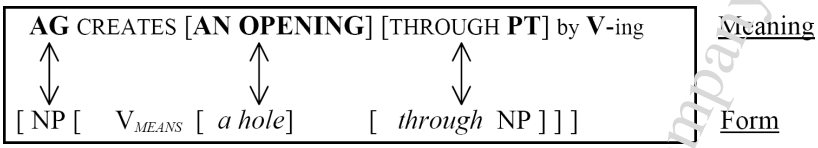

Figure 1. The 'A hole through Y' Construction (AHTY)

AHTY semantics. That is, they are associated with a conventionalized instantiation of a specific meaning 'X CREATES AN OPENING IN Y BY V-ing' in combination with a specific form 'a hole through NP'.[6] This conventionalized form-meaning pairing, the 'A hole through Y' Construction is illustrated in Figure 1.

As the meaning of the 'A hole through Y' Construction is paired with a specific form, it becomes possible to automatically interpret any sentence containing the 'A hole through Y' Construction provided one knows the meanings of the matrix verb as well as the relevant event participants (i.e., agent (AG) and patient (PT)). However, when it comes to *producing* sentences including AHTY, matters become more complicated as we have seen in the previous sections. The fact that Class II verbs closely related in meaning do not all occur with the AHTY Construction has led us to assume that they exhibit different idiosyncratic subcategorization patters that can not be predicted on general grounds.

I propose to encode the conventionalized meanings of Class II verbs in terms of mini-constructions that inherit the meaning and form from a generalized higher-level schema, namely the AHTY Construction. As such, the AHTY is a schema with a high level of abstraction (in the sense of Langacker (2000)) over a large number of low-level sub-schemas (individual mini-constructions representing the senses of Class II verbs) that all instantiate it. A mini-construction is a form-meaning pairing representing an individual sense of a verb (see Boas 2002a, 2003a). Mini-constructions are extremely specific with respect to the types of form-meaning pairings they represent.[7] Compared with more abstract constructions, mini-constructions differ in their complexity but are in principle the same type of declaratively represented data structure as other types of construc-

6. Note that the meaning part of AHTY contains 'AN OPENING' as a description of the type of effected object created by verbs occurring with AHTY. This general formulation is meant to also license examples including *a gap* or *an opening* instead of *a hole* in postverbal position.

7. Following a bottom-up methodology to semantic description that includes the influence of different types of context on the interpretation of a verb's meaning (see Cruse 2000; Fillmore & Atkins 2000; and Boas 2003a/2003b), I follow a splitting approach to describing word meanings rather than a lumping approach. A splitting approach has the advantage that it is more fine-grained when it comes to the distribution of arguments belonging to different senses of verbs (see Boas 2003a: 160–192).

tions, exemplifying the notion that there is no strict division between the lexicon and syntax (cf. Fillmore et al. 1988; Jurafsky 1992; Goldberg 1995). Mini-constructions contain detailed semantic, pragmatic, and syntactic information about the types of event participants (semantic arguments) that may occur with a specific sense of a verb. Adapting the main ideas of Fillmore's (1982, 1985) theory of Frame Semantics, we can capture the distribution of Class II verbs with simplified lexical entries such as the following:

(21) a. **make**$_{\text{CREATE-SUB}}$:SEM: [AG ___ OPENING (*through* PT)]
b. **drill**$_{\text{CREATE-SUB}}$: SEM: [AG ___ (OPENING) (*through* PT)]

(22) **RESTR**: AG: construable as exerting energy which directly affects PT
OPENING: opening construable as part of PT which goes through the PT
PT: construable as an object with a surface that is affected by energy emitted by AG

The mini-constructions representing the special creation sub-senses of *make* and *drill* in (21a) and (21b) contain semantic and syntactic information about the types of event participants they license. For example, the special sub-sense of *drill* in (21b) is capable of licensing three event participants. The semantic and pragmatic restrictions in (22) (which apply to both (21a) and (21b)) tell us that the agent licensed by this mini-construction has to be construable as exerting energy that directly affects a patient. The mini-construction also licenses postverbal event participants which denote openings construable as part of patient arguments. The third event participant is a patient, which has to be construable as an object with a surface that is affected by the energy emitted by the agent. As pointed out above, both *drill* and *make* allow omission of the patient argument that is embedded in an optional prepositional phrase headed by *through* (cf. *They {made/dug} a hole*). The fact that both *make* and *drill* allow omission of the patient suggests that the patient contained in the prepositional phrase headed by *through* is implicitly understood. That is, it is conventionalized world knowledge that whenever a hole is created, there is a surface (the patient) involved that undergoes the activity denoted by the main verb. As a result of the activity, a part of the patient (i.e. the surface) is removed, thereby creating a new entity (i.e. the hole). The use of parentheses indicates that the prepositional phrase headed by *through* containing the patient event participant is optional.[8] Note that the full constructional semantics of the AHTY Construction 'X CREATES AN OPENING IN Y by V-ing' is only evoked in cases in which all three event participants are overtly realized.

8. Due to space limitations, interactions of mini-constructions such as those in (21) with abstract tense/aspect constructions resulting in examples such as **We made for five hours* vs. *We dug for five hours* are not discussed here.

The reasons for stating an independently existing AHTY construction might not be clear by looking at Class II verbs alone. That is, for Class II verbs, no independently existing AHTY construction is necessary in order to license all of its three event participants (as each conventionalized mini-constructions is already specified for the form-meaning pairing). Due to the high token frequency of Class II verbs, this conventionalized form-meaning pairing affects lexical storage. For example, out of 1112 verbs occurring in the BNC with a frequency of 10 or more, *make* ranks 9th on the verb frequency list of the BNC (see http://www.comp.lancs.ac.uk/ucrel/bncfreq/ flists.html), *create* ranks 104th, and *dig* ranks 592th. Bybee (1988) shows that token frequency has an effect on the way words are stored and processed, as words have varying lexical strengths according to their frequency of use. The fact that high-frequency words have stronger representations in memory makes them easier to access. As such, the AHTY Construction is a generalization arising from the high frequency of mini-constructions that are conventionalized with the AHTY's form-meaning pairing. This suggests that conventionalized mini-constructions instantiating the AHTY Construction as well as the AHTY Construction itself form a network of constructional schemas, that is, a higher-level generalization as well as its specific instantiations (for a first step towards a formalization of such networks, see Langacker 2000). For this reason, speakers of English will typically not have problems interpreting non-conventional instances of AHTY. However, the fact that speakers are capable of producing novel AHTY patterns with verbs that are not conventionalized with its form-meaning pairings necessitates the postulation of an independently existing AHTY construction capable of contributing additional arguments to a verb's semantics (see Section 4.3 for more details).

While there seems to be a large degree of conformity between the mini-constructions representing the special senses of *make* and *drill*, note that there is a crucial difference between the two mini-constructions in (21a) and (21b). That is, the former allows optional realization of only one event participant whereas the latter allows us to leave out two event participants. Compare the following examples.

(23) a. *Lila made through the wall.
b. Lila made a hole through the wall.

(24) a. Abbey drilled through the wall.
b. Abbey drilled a hole through the wall.

This difference in distribution shows that the two mini-constructions representing the two individual verb senses differ crucially as to the number of event participants they license when not instantiating the full AHTY Construction. Dif-

ferences such as these necessitate the postulation of different mini-constructions such as in (21) representing the individual conventionalized senses of verbs and their specific semantic, pragmatic, and syntactic requirements. Our analysis has the advantage of licensing the full range of sentences occurring with specific subsenses of verbs by employing mini-constructions licensing different combinations of postverbal arguments (including AHTY). At the same time, we have seen that such a detailed lexico-semantic analysis is capable of ruling out unattested sentences. Having accounted for the licensing of AHTY and other combinations of postverbal arguments with Class II verbs, we now turn to the question of how AHTY is licensed with Class I verbs.

4.3 AHTY with Class I verbs

Recall that Class I verbs differ crucially from Class II verbs in that the former typically do not occur with *a hole* as their direct object argument alone (cf. *Brian pushed a car*/**Brian pushed a hole*, *Brigid wore a blouse*/**Brigid wore a hole*), whereas the latter do. This syntactic difference is mirrored by the semantics of the two verb classes. Class II verbs such as *drill*, *make*, *pierce*, *create*, and *dig* all have a specific sub-type of a conventionalized creation sense referring to an effected object being created. This is not the case with Class I verbs such as *push*, *knock*, *wear*, and *blow*.

I propose that the distribution of AHTY with Class I Verbs is licensed by unifying an existing conventionalized sense of a Class I Verb with the AHTY Construction. On this view, mini-constructions representing senses of Class I Verbs acquire new meanings because they are capable of being unified with the AHTY Construction. This means that a speaker utilizes her existing grammatical resources in order to create novel sentences. Figure 2 illustrates how the semantics of a Class I Verb is integrated into the AHTY Constructions in order to license sentences such as *Joe knocked a hole through the wall*. The semantic restrictions for the agent and patient of *knock* look as follows: AG: construable as exerting energy by striking with a sharp blow; PT: construable as exhibiting a surface.

On the left side in Figure 2 we see the AHTY Construction. The mini-construction representing *knock* is found on the right in Figure 2. It specifies that the agent of this sense of *knock* must be construable as exerting energy by striking with a sharp blow. The dotted arrow leading from the verb *knock* to the verb slot of the AHTY Construction means that the semantics of the verb *knock* (which in this case only contains information about the nature of the agent and patient) is unified with the semantics of the AHTY Construction. Note that the unification of the mini-construction's semantics only takes place when it is compatible with

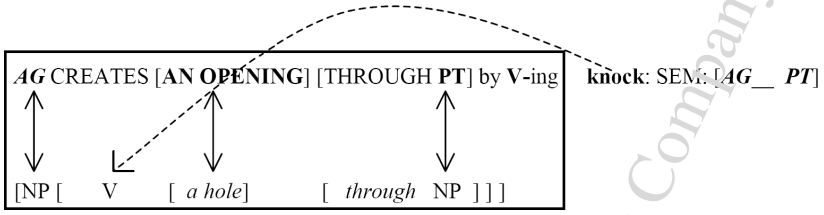

Figure 2. Integration of Class I Verbs into AHTY Construction

the semantic specifications regarding the interpretation of the agent and patient of the AHTY Construction. This integration leads to *knock* taking on the 'X CREATES A HOLE THROUGH Y by V-ing' semantics of the AHTY Construction, which in turn is mirrored at the syntactic level by the [NP [V *a hole through* NP]] frame, resulting in sentences such as *Joe knocked a hole through the wall*.

If nothing else were said about the conditions under which mini-constructions can fuse with the AHTY Construction, our account would vastly over-generate, resulting in sentences such as **Lila sneezed a hole through the peace*, **Collin pierced a hole through the ocean*, or **The blanket blew a hole through the atmosphere*. In order to avoid our account from generating unattested sentences, we need a set of constraints that restricts the integration of Class I Verbs into the AHTY Construction.

4.4 Partial productivity of AHTY

The first constraint concerns the nature of the activity denoted by the mini-construction to be integrated into the AHTY Construction. It requires the agent of the activity-denoting verb to be construable as emitting energy (i.e., physical force).[9] This constraint allows for examples such as (25a)–(25c) to be licensed while ruling out examples such as (26a)–(26c).[10]

9. Most of the constraints discussed in this section assume a "normal" world knowledge and are thus subject to override by contextual background information. For example, in a science fiction story in which blankets have the capability to emit energy that allows them to slice up surfaces, sentences such as (26a) are acceptable. For a detailed discussion of the influence of world knowledge and contextual background information on the licensing of non-conventionalized sentences see Boas (2003a: 270–277) and Boas (submitted).

10. Note that the current account does not address figurative usages of AHTY as in *Claire {glared/stared} a hole through Natasha*. It appears that figurative usages such as these pair the same syntactic form with a meaning different from that of the AHTY Construction. The fact that the productivity of figurative usages is extremely limited (cf. **Claire {looked/saw/watched}*

(25) a. Then Googol sprawled wretchedly on a couch, whispering of how a power axe had sliced a hole through the door … (BNC)
b. The bullet blew a hole through the right ear. (www.ipsn.org/cicero1.html)
c. He would draw the line over and over until he wore a hole through the paper. (www.schizophrenia-help.com/april.htm)

(26) a. *The blanket sliced a hole through the door.
b. *The book blew a hole through my desk.
c. *The peace wore a hole through her wall.

The second constraint restricting integration of Class I verbs with the AHTY Construction requires the energy emitted by the agent to physically affect the patient in such a way that it can be construed as being able to affect the physical integrity of the patient object.[11] Examples such as (27a)–(27c) are permitted by this constraint whereas examples such as (28a)–(28c) are typically ruled out.

(27) a. You pushed a hole through the crazing. (BNC)
b. Benefits being (a) the acid doesn't eat a hole through the can wall, and (b) tin salts aren't particularly toxic. (www.intercorr.com/desire.htm)
c. Kim burned a hole through the blanket. (BNC)

(28) a. *Dawn sneezed a hole through the universe.
b. *The water ate a hole through my glass.
c. *Christian talked a hole through the chair.

The third constraint on the application of AHTY concerns the nature of the construction's patient argument. It requires the physical properties of the patient to be construable as exhibiting a surface. This constraint rules out sentences (30a)–(30c) while allowing sentences such as (29a)–(29b).[12]

(29) a. I've burned a hole through Mars's moon and singed fannies on Pluto. (www.toyraygun.com/books.html)

a hole through Natasha) suggests that they are frozen idioms that do not form a basis for productive one-shot extensions based on integration with the AHTY Construction.

11. Note that the force-dynamic relations holding between the event participants need to be construable according to world knowledge. This means that in sentences such as (26) more fragile surface patients such as *a window* or *the steam* are acceptable patient arguments because they can be construed as being affected by the agent in such a way that the impact of the agent leads to the creation of a hole.

12. As with previous examples, unacceptable sentences may be rendered acceptable given proper contextual background information that may override the constraints restricting the integration of Class I verbs into the AHTY Construction (see Boas (submitted)).

b. But when these same snails chew a hole through the leaf or stem of the plant to lay their eggs … (www.pondscapes.com/page147.html)

(30) a. *Jen burned a hole through the air.
b. *Julio blew a hole through the metal plate.

The final constraint restricting integration of Class I verbs into the AHTY Construction requires that the result of the activity denoted by the verb be construable as causing the creation of an opening through the entire patient. This constraint permits sentences such as those in (31), but not those in (32). The examples in (31) differ from those in (32) in that the verbs in the latter do not encode a creation sense because they lack the proper force dynamics. More specifically, when the verbs co-occur with *a hole*, they are typically not construable as encoding the AHTY semantics.

(31) a. Woolley took out his revolver and blew a hole through Hawthorn's dispatch case. (BNC)
b. Using a grapefruit knife push and twist a hole through each potato working crosswise. (BNC)
c. Imagine their foot wearing a hole through the carpet. (offtheboss.com/nofear.htm)

(32) a. A site must be running an NT-based firewall or must provide a hole through the firewall. (www.avolio.com/fw+vpns.html)
b. Thermo-Pond is a unique patent pending pond heater that keeps a hole the ice in backyard ponds for just pennies a day. (www.bestfish.com/thermopnd.html)

Having discussed the constraints limiting the fusion of Class I Verbs with the AHTY Construction, the question remains as to how productive this construction really is. As we have seen, AHTY is not quite as productive as Goldberg's abstract ditransitive construction (1995: 141–150) and way construction (1995: 199–218). This is because AHTY denotes a semantic space (i.e., the range of semantic possibilities (see Croft 2001)) that is much narrower in scope, pairing the 'X CREATES A HOLE THROUGH Y by V-ing' semantics with the [NP [V *a hole through* NP]] frame. However, within this limited semantic space, AHTY is quite productive as the following examples attest.

(33) a. But Oswald doesn't stop by this idea, he says there's a shorter way than following the 2-dimensional tour and he eats a hole through the apple. (users.pandora.be/vannoppen/science4.htm)

b. They found that the bee uses its spiky, toothed mouth parts to chew a hole through the side of the corolla. (sci.agriculture.beekeeping, Message ID 20000304210457.03536.00000320@ng-cs1.aol.com)
c. Perhaps they would've sizzled a hole through the gas ball, but would they have hit anything? (rec.music.christian, Message ID 7kfd0plue1@nntp.ucs.ubc.ca)
d. Dribbling a hole through the metal isn't much different from ramming a war hammer spike through it. (rec.games.frp.dnd, Message ID I8a47.4817$JS2.552614@newsread1.prod.itd.earthlink.net)
e. I've also put grease fittings in the ball ends, by EDMing a hole through the outer race. (rec.motorcycles.dirt, Message ID FA738o.Fw0@arraycomm.com)
f. I think Tomken was worried about rubbing a hole through it. (rec.autos.makers.jeep+willys, Message ID 85cud8$v9a$1@ tabloid.unh.edu)
g. With patience and persistence, you can piss a hole through a rock. (www.vamp.org/comments-02-97.html)

Typically, the conventionalized senses of verbs like *eat*, *chew*, *sizzle*, *dribble*, *EDM*, and *piss* do not occur with the types of postverbal arguments as in (33a)–(33g). On the account proposed here, these verbs fuse with the AHTY Construction, which provides additional semantic arguments, thereby licensing the [NP [V *a hole through* NP]] frame. Note that all four constraints on the fusion of verbal and constructional semantics mentioned above are observed. This analysis has the advantage of not having to postulate separate verb senses requiring the realization of both postverbal arguments at the same time. Having accounted for the distribution of AHTY with both Class I and Class II verbs, we now turn to the following question: How does the AHTY Construction fit into the overall architecture of grammar?

5. The architecture of (Construction) Grammar

One of the main tenets of Construction Grammar is that there exists no strict separation of the lexicon and syntax. This constructional view of language is summarized by Goldberg & Jackendoff (2004) as follows:

(34) The Constructional View
a. There is a cline of grammatical phenomena from the totally general to the totally idiosyncratic.

b. Everything on this cline is to be stated in a common format, from the most particular, such as individual words, to the most general, such as principles for verb position, with many subregularities in between. That is, there is no principled divide between 'lexicon' and 'rules'.
c. At the level of phrasal syntax, pieces of syntax connected to meaning in a conventionalized and partially idiosyncratic way are captured by constructions. (Goldberg & Jackendoff 2004: 532–533)

Given these assumptions regarding the separation between the lexicon and syntax the question arises as to how the AHTY Construction differs from other types of constructions and whether these differences can be accounted for systematically. Closely related to this issue is the question of how to represent constructional productivity and how to integrate it into an overall constructional model of language.

Traditionally, productivity has been at the center of much research in morphology. Drawing on work by Aronoff (1976, 1983), Lieber (1981), Bybee (1995), and many others, Bauer (2001: 211) defines morphological productivity as follows: "The interaction between the potential of a morphological process to generate repetitive non-creative forms and the degree to which it is utilized in language use to yield new lexical items." Although specific accounts differ in how they prefer to measure the productivity of morphological processes, most analyses agree that a process is productive if the conditions of its applicability do not require the listing of exceptions.[13] In other words, the more constraints a construction exhibits on its applicability, the less productive it is.[14] For example, within inflectional morphology the third person singular *-s* in English is said to be completely productive because it is suffixed without exception to the stem of a verb whenever a third person singular subject is present.

Within Construction Grammar, Fillmore, Kay & O'Connor (1988) adopt the notion of productivity and extend it to describe and explain the distribution of linguistic units that consist of more than just one word. One example they discuss is the pattern [*the X-er the Y-er*]: "In spite of the fact that it is host to a large number of fixed expressions, the form has to be recognized as fully productive. Its member expressions are in principle not listable: unlimitedly many new ex-

13. Aronoff (1976: 36) measures productivity as follows: "The proportion between actual items and potential items generated by a morphological process." Lieber (1981: 114–115) defines it as: "The number of words a morphological process may apply to." For an in-depth overview of morphological productivity, see Bauer (2001).

14. This correlation is the same for any grammatical process, pattern, or rule in other frameworks, and is not specific to constructions within Construction Grammar. Compare, e.g., Chomsky's (1995) *Last Resort* or *Minimal Link Condition* that constrain the application of certain checking relations of features.

pressions can be constructed within its pattern, their meanings constructed by means of semantic principles specifically tied to this construction." (1988: 507) Another pattern analyzed by Fillmore et al. (1988) is the *let alone* construction as in *I didn't get up in time to eat my lunch, let alone cook my breakfast*. (Fillmore et al. 1988: 531) The *let alone* construction differs from the [*the X-er the Y-er*] construction in that it is associated with a number of syntactic, semantic and pragmatic conventions that restrict its applicability. For example, a sentence like #*He wasn't even a commissioned officer, let alone a second lieutenant* is typically judged odd because the rank of second lieutenant is the lowest commissioned rank, as Fillmore et al. (1988: 626) point out. As such, the sentence violates an entailment about scales that is implied in the use of the *let alone* construction. The comparison shows that inn contrast to the [*the X-er the Y-er*] construction, the *let alone* construction exhibits more restrictions on its applicability. This means that it is less productive. Fillmore et al. (1988) use these examples, among many others, to demonstrate that "those linguistic processes that are thought of as irregular cannot be accounted for by constructing lists of exceptions: the realm of idiomaticity in a language includes a great deal that is productive, highly structured, and worth of serious grammatical investigation" (1988: 534).

Goldberg (1995) limits the productivity of argument structure constructions by positing detailed semantic constraints. The number and granularity of her semantic constraints differ depending on the construction. For example, to limit the ditransitive construction (*He baked me a cake*) from generating unattested sentences, Goldberg proposes the following constraints: (1) The subject must intend the transfer (1995: 145); (2) The second object has to be understood as a beneficiary, or a willing recipient (1995: 146).[15] While these two constraints limit the ditransitive construction from unifying with certain verbs, they are fewer in number and far less specific than the types of constraints posited for resultative constructions (*He wiped the table clean*, *He talked himself blue in the face* (1995: 189)):

(35) a. The two-argument resultative construction must have an (animate) instigator argument.
b. The action denoted by the verb must be interpreted as directly causing the change of state: no intermediary time intervals are possible.
c. The resultative adjective must denote the endpoint of a scale.
d. Resultative phrases cannot be headed by deverbal adjectives.

(Goldberg 1995: 193)

15. These constraints rule out sentences such as **Joe threw the right fielder the ball he had intended the first baseman to catch* (Goldberg 1995: 143) or **Sally burned Joe some rice* (1995: 146).

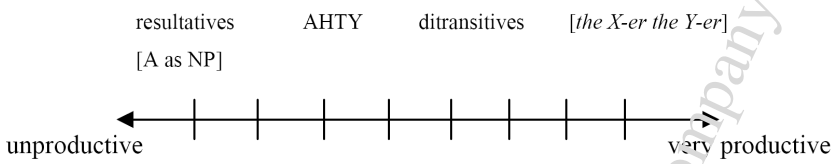

Figure 3. The productivity continuum

The fact that Goldberg's resultative construction is subject to more fine-grained constraints than her ditransitive construction means that its range of applicability is smaller. In other words, Goldberg's resultative construction is less productive than the ditransitive construction.

In fact, Boas (2002c, 2003a) argues that the productivity of resultatives is even more restricted. Based on an investigation of more than 6000 resultative sentences in the BNC, Boas (2003a) demonstrates that Goldberg's general semantic constraints are not precise enough to describe and predict the full range of English resultatives. This observation leads him to encode fine-grained semantic, pragmatic, and syntactic restrictions for resultatives in terms of so-called mini-constructions. On this view, each sense of a verb constitutes a form-meaning pairing (so-called mini-construction) specifying the conventionalized selection restrictions on postverbal arguments in resultative constructions. Non-conventionalized resultatives such as *Joe sneezed the napkin off the table* are licensed by analogical association on the basis of existing mini-constructions that conventionally encode this type of form-meaning pairing (e.g. *Joe blew the napkin off the table*) (see also Boas (in press)). Boas' (2003a) results suggest that the productivity of English resultatives is much more limited as each sense of a verb imposes its own particular selection restrictions on postverbal arguments.

Our discussion of constructional productivity has so far resulted in an interesting inventory of grammatical constructions that differ in productivity. Taken together, they can be located along different parts of what I call the productivity continuum.

On one end of the continuum, we find constructions such as the [*the X-er the Y-er*] construction (Fillmore et al. 1988) that are subject to very few constraints and are therefore very productive. On the other end of the continuum we find constructions that are extremely limited in their productivity such as what is commonly referred to as the resultative construction, but which is really a conglomerate of individual mini-constructions. Another example of extremely limited productivity is what Kay (2002) calls patterns of coining. Kay (2002) analyzes phrases such as *dumb as an ox*, *green as grass*, *dark as night*, *easy as pie* and *cold as hell* as instances of a pattern 'A as NP [interpretation: extremely A]'. Based on an extensive review of data he shows that one cannot freely use the patterns to coin

new expressions. He argues that this pattern is not very productive, which leads him to call it 'patterns of coining.' In between the opposite poles of the productivity continuum we find Goldberg's (1995) ditransitive construction, which exhibits a small number of constraints.

Finally, we return to the AHTY construction, which is located between the resultative and the ditransitive constructions on the productivity continuum. As our discussion in Section 4.4 has shown, there are a number of significant semantic constraints that restrict verbs from unifying with the AHTY construction. While these constraints are somewhat more fine-grained than those placed on Goldberg's ditransitive construction, the AHTY construction nevertheless exhibits a fair amount of productivity (cf. examples (33a)–(33g)) that sets it apart from the less productive resultative construction and Kay's (2002) [A as NP] pattern of coining.

Clearly, future research is needed to investigate the relevance of constructional productivity and its role in Construction Grammar. The goals of this section have been more modest: to determine the relationship of the AHTY construction vis-à-vis other grammatical constructions by locating them at different points along the productivity continuum. These constructions demonstrate not only that productivity is a matter of degree. They also show that research in Construction Grammar must develop a more coherent set of procedures that allow us to measure productivity more precisely in order to arrive at a more integrated view of linguistic usage.

6. Conclusions and outlook

This paper confirms that sameness in form does not always entail sameness in meaning. I first argued that the [NP V NP PP] frame associated with Goldberg's caused-motion and resultative constructions does not yield the proper interpretation when it comes to specific types of sentences containing *a hole through*. This observation led me to search for a more specific construction, whose unique combination of different elements is not predictable on the basis of other constructions. In doing so, I started with an abstract Goldberg-type construction in order to see whether its semantics matched the [NP V NP PP] frame. I finally arrived at a construction that is semantically much more specific. In other words, we have pursued a bottom-up approach to arrive at the proper interpretation of AHTY. Postulating mini-constructions representing conventionalized form-meaning pairings of Class II verbs allowed us to arrive at an abstract AHTY Construction (a higher-level generalization over a number of sub-schemas) that is instantiated by all Class II verbs. For the interpretation and production of non-conventional-

ized instances involving AHTY, we resorted to the AHTY construction supplying Class I verbs with additional constructional arguments.

The picture emerging from our discussion is clear: when analyzing a syntactic surface pattern, we should first attempt to pair form with meaning at the most abstract level. Only when we do not arrive at any proper interpretation do we need to look into discovering other types of constructions that are semantically more specific. In doing so, we need to be careful to consider the relationship between independently existing meaningful constructions and individual senses of verbs represented in terms of mini-constructions. For example, a number of recent Construction Grammar analyses argue that Goldberg's independently existing meaningful constructions are too powerful with respect to the range of possible argument expressions they license (Kay 1996/2002; Morita 1998; Nemoto 1998; Boas 2002b/2003a; and Iwata 2002). As we have seen in this paper, our analysis of AHTY does not run into this problem because the AHTY Construction is not only very specific in its semantic scope (i.e., the types of possible situations it may denote), but its productivity is limited by a number of construction-specific constraints that keep it from generating non-attested sentences.

This paper has examined the nature of a very specific type of construction, which I dubbed AHTY Construction, in order to show how form-meaning discrepancies may be dealt with in Construction Grammar. But there is still much work to be done. To begin with, we need to investigate the semantic relationship between the AHTY Construction and other types of constructional patterns that are closely related in meaning. For example, the interpretation of sentences such as *Sascha dug a hole in the snow* and *Nicole poked a hole into the butter* involves similar verbs as those found with AHTY, yet there are slight differences in meaning caused by the interpretation of the prepositional phrases. The question here is whether there might be a single higher level construction that subsumes the three individual constructional patterns including different types of prepositional phrases, thereby allowing for a compositional analysis with an open slot for different types of prepositions encoding different types of situations. Another topic to be investigated in more detail concerns the relation between constructional productivity and semantic specificity of constructions. That is, the AHTY Construction differs from other types of constructions such as the [A as NP] pattern of coining (Kay 2002) or the resultative construction as analyzed by Boas (2003a) in that it is far more productive. If it turns out that there is a direct correlation between a construction's productivity and the types of semantic spaces it describes, we may well be a step closer to a better understanding of how to go about compiling a complete inventory of constructions of a language. This would include not only high-level argument structure constructions, but also the types of detailed

mini-constructions discussed by Boas (2003a, 2005b), as well as intermediate level constructions as discussed in Figure 3 above.

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