Idioms and Compositionality

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Abstract

A standard view is that idioms present problems for compositionality. The question of compositionality, however, should be posed for a semantics, not for individual phrases. The paper focuses on the *idiom extension problem*: Suppose in a given language a certain phrase acquires the status of an idiom. How can the syntax and semantics be extended to accommodate the idiom, while preserving desirable properties such as compositionality? Various ways to achieve such extensions are discussed within an abstract algebraic framework for language due to Wilfrid Hodges.

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1 Introduction

If there is one piece of received wisdom in the linguistic community about idioms, it probably is that they spell trouble for the principle of compositionality. After all, the meaning of a typical complex idiom is *not* determined by the meaning of its parts and the way they are composed, right? If you know English, and in particular the meaning of *kick* and *the bucket*, but are unfamiliar with the idiom, there is no way you can compute the (idiomatic) meaning of *kick the bucket*. Like lexical items, idioms have to be learned one by one. Yet they appear to have syntactic structure, so compositionality is in trouble. Or is it?

In the present paper I want to do two things. First, I claim that the received view as commonly expressed is misleadingly put, and may confuse the issues. Second, a handy algebraic framework (due to Wilfrid Hodges) will be used for a first stab at approaching some of the formal semantic issues that do exist concerning idioms and compositionality. Details and proofs must be deferred to another occasion; here I try to state the main ideas.

There is no way I could do justice to the vast linguistic literature about idioms. Instead I will take one paper, Nunberg, Sag and Wasow [4], as background, because it surveys a fair amount of that literature, and furthermore, it propounds a general view of idioms that seems reasonably widespread, at least in its broad outlines, these days. More precisely, Nunberg et. al amply exemplify with many quotations what I called the received view about idioms and compositionality, and for *some* idioms such as *kick the bucket*, they too subscribe to that view. On the other hand, for many other idioms, of which we can take *pull strings* as a prototype, they claim that compositionality does hold, provided one realizes that the parts or 'chunks' of such idioms also have idiomatic meanings.

2 A methodological point

A simple methodological point needs to be made, I think, in connection with the received view about idioms: *While it makes good sense to ask if a semantics is compositional or not, it makes no sense to ask the same question about a particular phrase.*

Consider how the received view might be put forward, indeed how it might seem self-evident: The meaning of *kick the dog*, say $\mu(\textit{kick the dog})$, is a function, say r, of the meanings of *kick* and *the dog*:

(1) $\mu(\textit{kick the dog}) = r(\mu(\textit{kick}), \mu(\textit{the dog}))$.

But, for the idiomatic reading,

(2) $\mu(\textit{kick the bucket}) \neq r(\mu(\textit{kick}), \mu(\textit{the bucket}))$.

Yes, but so what? Compositionality only asks that *some* function determine the meaning, not that this function be r. Simply redefining r for the idiomatic case will do the trick.

This is trivial, but ask any semanticist what the principle of compositionality says, and you will most likely get something like

(C) The meaning of a complex expression is determined by the meanings of its parts and the mode of composition.

And here 'is determined' is taken as 'is a function of', possibly with some added requirement of computability of that function. But that extra requirement makes no difference to the present issue. One idiomatic exception (hence any finite number) can always be taken care of, it seems.

Perhaps it is retorted that the claim about *kick the bucket* is in fact intended as a counterexample to the compositionality of a particular semantics. This could be spelled out as follows. Consider the relation $\equiv_\mu$ of synonymy: $p \equiv_\mu q$ iff $\mu(p) = \mu(q)$. Assume that *bucket* $\equiv_\mu$ *pail*. Then

(3) *lift the bucket* $\equiv_\mu$ *lift the pail*,

as compositionality would have it, but

(4) *kick the bucket* $\not\equiv_\mu$ *kick the pail*.

contradicting functionality.

This might look better, but actually it only reveals another trivial point. Meanings cannot be assigned to surface manifestations, because then *kick the bucket* would be *ambiguous*. Now, ambiguity is not our problem here. Any statement of the compositionality principle already presupposes single-valuedness of meaning. And indeed, as writers about idioms generally acknowledge, on the level where meaning is assigned the idiomatic version of *kick the bucket* must be distinct from the ordinary version, if only by the presence of an idiomatic 'marker'.

But once this is acknowledged, the argument loses all force. For then, the 'modes of composition' in (1) and (2) are distinct, so there is no reason to expect the same function to operate in both cases. Similarly, on both sides of the synonymy sign in (3), and on the right hand side in (4), we have one 'mode of composition', but on the left hand side in (4) we have another, so no violation of compositionality occurs.

Perhaps what the received view really comes down to, in the case at hand, is rather something like this: There is a *familiar* way to compose a transitive verb meaning with a NP meaning to form a VP meaning, but (a) that way is not used to derive the idiomatic meaning of *kick the bucket*, and (b) no other *familiar* way to compose the meanings of *kick* and *the bucket* gives the correct result. The familiarity of the function or rule is required to explain how we can *figure out*, or *know*, or *understand* the meaning of a complex phrase. This question is worth discussing, but it is hardly one about compositionality.

Likewise, when Nunberg et al. (appear to) claim that for idioms like *pull strings* we actually can use the familiar meaning function, given that in the idiom, *pull* and *string* have non-standard meanings, this is an interesting issue, but it is still misleading to call those idioms 'compositional' and contrast them with 'non-compositional' ones. The question is rather: Is there a reasonable compositional semantics for a language containing both kinds of idioms?

3 Real issues about idioms and compositionality

Assume again that *bucket* $\equiv_\mu$ *pail*, and suppose we have agreed on a particular 'mode of composition', or rule, or marking, that is at work in the idiomatic version of *kick the bucket*. Can we then avoid, except by ad hoc stipulation, that the same 'mode of composition' is applied to yield also an idiomatic version of *kick the pail*? If not, then, by compositionality, the latter has to mean *die* as well.

This is a real issue, an instance of *the overgeneration problem*. Note the difference from the alleged argument above. There we (falsely) claimed to have a counter-instance to compositionality by ignoring that two distinct 'modes of composition' were involved. Here we acknowledge the need for an 'idiomatic mode of composition', and ask if our analysis, together with compositionality, forces us to countenance idiomatic expressions that do not exist.

The overgeneration problem has been widely discussed in the literature. Other debated issues concern the fact that certain syntactic operations apply to some idioms but not to others. For example,

(5) The bucket was kicked by John yesterday

cannot mean that John died yesterday: this idiom does not allow passivization. A similar point concerns anaphoric reference:

(6) Andrew kicked the bucket in June last year, and a month later, Jane kicked it too.

Here too, the idiomatic meaning is hard or impossible to get. But with the literal reading (5) and (6) are both fine (if a bit odd). For the idiom *pull strings*, on the other hand, both of these operations are all right:

(7) Strings were pulled to secure Henry his position.

(8) Kim's family pulled some strings on her behalf, but they weren't enough to get her the job. ([4], p. 502.)

One suggestion here is that *kick the bucket* is somehow an *atomic* expression, in contrast with *pull strings*. This suggestion is worth exploring. But a different idea is that the former idiom stands for a one-place predicate, the latter for a two-place one, so it is natural that passivization and anaphoric reference to the object position apply precisely in the latter case. Then the two idioms could both have syntactic structure but semantics would explain the difference between them.

I think there is some point in discussing such issues also in the abstract, independently of the details of current theories of syntax and semantics. In the rest of this paper I will indicate how to do this within a general algebraic framework for language.

4 The idiom extension problem

Let a language with a compositional semantics be given. Suppose a complex expression in that language acquires, for reasons we need not go into, an idiomatic meaning. How can the given syntax and semantics be *extended* in a natural way, which accounts for (some of) the behaviour of the new idiom and still preserves compositionality, and perhaps other desirable properties too?

This is the situation I will focus on. It is clear and simple enough and, I think, one we should be able to give a general account of, abstracting from the details of the history of the particular idiom.

5 An algebraic framework

The following definitions are essentially from Hodges [1]. The framework is a much simplified version of the term algebra account of syntax and semantics first introduced by Montague and developed in, for example, Janssen [3].

5.1 Definition.

- A *grammar*
$$(E, A, \underline{\alpha})_{\alpha \in \Sigma}$$
consists of a set E of *expressions* (preliminarily to be thought of as unstructured surface strings), a set $A \subseteq E$ of *atomic* expressions, and for each function symbol $\alpha \in \Sigma$ a corresponding *syntactic rule*, which is a partial map $\underline{\alpha}$ from E^n to E, for some n.[1]
- Let Var be a set of variables, not belonging to E. The set $T(E)$ of *terms* is defined as follows.
  - $Var \cup E \subseteq T(E)$
  - If $t_1, \ldots, t_n \in T(E)$ and $\alpha \in \Sigma$ is n-ary, then $\alpha(t_1, \ldots, t_n) \in T(E)$.

  $T(E)$ is a set of auxiliary terms which includes (meta)variables and is only introduced to handle substitution conveniently. The interesting terms come next:
- The set $GT(E)$ of *grammatical terms* and the function $val : GT(E) \longrightarrow E$ are given by:
  - $a \in A$ is an *atomic* grammatical term, and $val(a) = a$.
  - Suppose $\alpha \in \Sigma$ is n-ary, and that $p_1, \ldots, p_n \in GT(E)$ with $val(p_i) = e_i$. If $\underline{\alpha}(e_1, \ldots, e_n)$ is defined, the term $\alpha(p_1, \ldots, p_n)$ is in $GT(E)$, and $val(\alpha(p_1, \ldots, p_n)) = \underline{\alpha}(e_1, \ldots, e_n)$.

  If $val(p) = e$ then p is a *structural analysis* of e.
- A *semantics* for E is a partial function μ from $GT(E)$ to some set M of meanings. $p \in GT(E)$ is *μ-meaningful* if $p \in dom(\mu)$, and p and q are *μ-synonymous*, $p \equiv_\mu q$, if $\mu(p) = \mu(q)$. $\equiv_\mu$ is an equivalence relation on $dom(\mu)$.

If a term is grammatical, then by definition so are its subterms. The corresponding condition for μ-meaningfulness is called the *domain principle* in [2]. Thus, the domain principle states that if $q \in dom(\mu)$ and p is a subterm of q, then $p \in dom(\mu)$. We can now give one formulation of compositionality (there are several more or less equivalent ones in [1]):

5.2 Definition. μ is *compositional* if it satisfies the domain principle and for each $\alpha \in \Sigma$ there is function r_α such that, whenever $\alpha(p_1, \ldots, p_n)$ is μ-meaningful,
$$\mu(\alpha(p_1, \ldots, p_n)) = r_\alpha(\mu(p_1), \ldots, \mu(p_1)).$$

Syntactic and semantic categories are not given at the outset here, but can be defined as follows: two terms have the same syntactic (semantic) category if they can be substituted everywhere with preserved grammaticality (meaningfulness). More precisely, if s and p are terms, let $s(p|x)$ be the result of replacing all occurrences of the variable x in s by p.

[1] I use 'E' in what follows ambiguously for the grammar and for its set of expressions.

5.3 Definition.

- For all $p, q \in GT(E)$,

$$p \sim_E q \iff \forall s \in T(E)(s(p|x) \in GT(E) \Leftrightarrow s(q|x) \in GT(E))$$
$$p \sim_\mu q \iff \forall s \in T(E)(s(p|x) \in dom(\mu) \Leftrightarrow s(q|x) \in dom(\mu)).$$

  $\sim_E$ and $\sim_\mu$ are equivalence relations on $GT(E)$. The syntactic (semantic) *category* of $p \in GT(E)$ is its equivalence class $[p]_E$ ($[p]_\mu$). Cat_E is the set of syntactic categories of E.

- E is *categorial* if, for each $\alpha \in \Sigma$,

$$\alpha(p_1, \ldots, p_n), \alpha(p'_1, \ldots, p'_n) \in GT(E) \text{ implies } p_i \sim_E p'_i,\ 1 \leq i \leq n.$$

5.4 Definition. μ is (a) *husserlian*, (b) *weakly husserlian* if, correspondingly,

(a) For all $p, q \in GT(E)$, $p \equiv_\mu q$ implies $p \sim_\mu q$.

(b) For all $p, q \in GT(E)$, $p \equiv_\mu q$ implies $p \sim_E q$.

Now we can consider the idiom extension problem. Fix a grammar E, a semantics μ for E, an expression $q_0 = \alpha_0(q_{01}, \ldots q_{0k}) \in dom(\mu)$ with surface form

$$e_0 = val(q_0).$$

Suppose that q_0 acquires the status of an idiom, which is to mean m_0. How can E and μ be extended?

6 Atomic extensions

We noted that one idea (also hinted at in Hodges [2]) is that some idioms are new atoms, looking like familiar expressions on the surface but in fact without syntactic structure. This is easily modeled in the present framework: assume $e_0 \in E - A$, and consider

$$E^a = (E, A \cup \{e_0\}, \underline{\alpha})_{\alpha \in \Sigma}.$$

Thus, the expressions are the same, and so are the grammatical rules. We call E^a an *atomic extension* of E.[2] Note that $T(E^a)$, $GT(E^a)$, and val^a are now uniquely determined.

6.1 Lemma.

(a) $GT(E) = \{p \in GT(E^a) : e_0 \text{ not in } p\}$ *and* $val = val^a|GT(E)$.

[2]Treating *kick the bucket* as an atom does not necessarily force us to treat (very implausibly) *kicked the bucket* or *kicks the bucket* as atoms too. There might be a rule β taking, for instance, *John* and *lift the bucket* to a term with value *John lifted the bucket*, where val(*lift the bucket*) $= e_1$ is not an atom, and the *same* rule can form the term with value *John kicked the bucket*, even though val(*kick the bucket*) = *kick the bucket* is an atom.

(b) $e_0 \sim_{E^a} q_0$

(c) *If s is an e_0-free term, then $s(e_0|x) \in GT(E^a) \Leftrightarrow s(q_0|x) \in GT(E)$, and $val(s(q_0|x)) = val^a(s(e_0|x))$.*

(d) *If $p, q \in GT(E)$, then $p \sim_E q \Leftrightarrow p \sim_{E^a} q$.*

7 Paraphrase semantics

We still have to extend μ. Actually, there are two ways to think about this; the first is considered in this section. Assume then that q_0 has a *paraphrase* (for example, *die* for *kick the bucket*), i.e., an expression $p_0 \in dom(\mu)$ such that $p_0 \sim_E q_0$ and $\mu(p_0) = m_0$ is the meaning we want to give to e_0.[3]

Now there is an obvious way to extend μ: just replace e_0 by p_0 and use the meaning of the resulting term, whenever defined. Let $\mu(e_0/p_0)$ be the resulting semantics.

7.1 Proposition. *If μ is (a) (weakly) husserlian, (b) total, (c) compositional, or (d) obeys the domain principle, then the corresponding property holds for $\mu(e_0/p_0)$.*

Observe that $\mu(e_0/p_0)$ is not at all the *smallest* compositional idiomatic extension of μ. Since e_0 is an atom, it is possible to just add the meaning of e_0 and nothing else, preserving compositionality. This is a trivial and uninteresting extension of μ, since it does not allow the idiom as a proper constituent in any meaningful term. In such a semantics, even though the meaning of *kick the bucket* was determined, the meaning of, say, *John kicked the bucket* would not be. Instead we have chosen

$$K(e_0/p_0) = \{s(e_0|x) : s(p_0|x) \in dom(\mu)\}$$

as domain for $\mu(e_0/p_0)$. But isn't this allowing too much, since some rules, such as passivization, do not seem to apply to the idiomatic reading as they did to the literal one? We will see that, as suggested in section 3, independent semantic mechanisms can be used to filter out such terms. These mechanisms would restrict $dom(\mu)$ and consequently $dom(\mu(e_0/p_0))$ (but not $GT(E^a)$).

Call two semantics for a given grammar *equivalent* if they have the same associated synonymy relations.

7.2 Proposition. *If μ is compositional, then $\mu(e_0/p_0)$ is, up to equivalence, the unique compositional extension of μ which has domain $K(e_0/p_0)$ and gives e_0 the meaning $\mu(p_0)$.*

8 How to handle new idiomatic meanings

The strategy from the preceding section does not work if there is no expression of the same syntactic category with exactly the desired idiomatic meaning; *pull*

[3]One can see that it would be too much to require that $p_0 \sim_\mu q_0$.

strings might be a case in point. There is still a clear intuition, I think, that one should be able to easily modify the existing compositional machinery to accommodate the idiom. This intuition can be cashed out in the following way.

Assume now that E is categorial (Def. 5.3). Next, we slightly strengthen the assumption of compositionality.

8.1 Definition.

- A *type system* for E has the form $T = \langle r_\alpha, D_c \rangle_{\alpha \in \Sigma, c \in Cat_E}$. $D_{[p]_E}$ is the *type* of p, and we assume that types are pairwise disjoint, and that for $\alpha \in \Sigma$, if $\alpha(p_1, \ldots, p_n) \in GT(E)$, r_α is a *total* function

$$r_\alpha : D_{[p_1]_E} \times \cdots \times D_{[p_n]_E} \longrightarrow D_{[\alpha(p_1,\ldots,p_n)]_E}.$$

  (since E is categorial, this is independent of the choice of $p_1, \ldots, p_n$).
- T is *μ-compositional* if μ satisfies the domain principle and, whenever $\alpha \in \Sigma$, $p \in GT(E)$, and $\alpha(p_1, \ldots, p_n)$ is μ-meaningful,
  (i) $\mu([p]_E) \subseteq D_{[p]_E}$
  (ii) $\mu(\alpha(p_1, \ldots, p_n)) = r_\alpha(\mu(p_1), \ldots, \mu(p_n))$.

Actually, this strengthening of the notion of compositionality is very slight:

8.2 Proposition. *Let μ be a semantics for E. The following are equivalent:*

(a) *μ is weakly husserlian and compositional.*

(b) *There is a μ-compositional type system for E.*

Now recall our atomic extension E^a.

8.3 Lemma.

(a) *If E is categorial, so is E^a.*

(b) *If $s(e_0|x) \in GT(E^a)$, $[s(e_0|x)]_{E^a} = [s(q_0|x)]_{E^a}$.*

(c) *The map $'$ defined by $([p]_E)' = [p]_{E^a}$ is a bijection from Cat_E to Cat_{E^a}.*

(d) *With $D_{c'} = D_c$, $T = \langle r_\alpha, D_{c'} \rangle_{\alpha \in \Sigma, c \in Cat_E}$ is a type system for E^a.*

Now even if the desired meaning m_0 for our idiom is not in the range of μ, as long as it is in $D_{[q_0]_E}$ there is an obvious way to use the compositional type system T for E to extend μ inductively to a semantics μ^a such that $\mu^a(e_0) = m_0$; we just follow the given meaning operations r_α, which works since they are total. The domain of μ^a will be

$$K(e_0/q_0) = \{s(e_0|x) : s(q_0|x) \in dom(\mu)\}.$$

Of course this strategy for extending the semantics applies also when we do have a paraphrase; in that case the extensions are the same, as stated in the next result which summarizes our findings so far.

8.4 Theorem. *Suppose that E is categorial and that E^a is obtained by adding $e_0 \in E - A$ as a new atom, where $e_0 = val(q_0)$. Suppose further that μ is a semantics for E in which q_0 is meaningful, and that $T = \langle r_\alpha, D_c \rangle_{\alpha \in \Sigma, c \in Cat_E}$ is a type system for E which is μ-compositional. Finally, suppose $m_0 \in D_{[q_0]_E}$. Then the following holds:*

(a) *There is a unique extension μ^a of μ to $K(e_0/q_0)$ such that T is μ^a-compositional and $\mu^a(e_0) = m_0$.*

(b) *Suppose $m_0 = \mu(p_0)$ for some paraphrase $p_0 \in dom(\mu)$ such that $p_0 \sim_E q_0$. Then for all $p \in K(e_0/p_0) \cap K(e_0/q_0)$, $\mu(e_0/q_0)(p) = \mu^a(p)$.*

9 Idioms with syntactic structure

Having some idioms as atoms is just one idea. In other cases, or perhaps always, one may prefer idioms with syntactic structure. Then we still need to distinguish the idiomatic reading to avoid ambiguity, while respecting the intuition that at surface level the idiomatic and the literal versions coincide. There are several ways one could go about this, for our chosen expression $q_0 = \alpha_0(q_{01}, \ldots q_{0k})$. For example, one could have a special rule/operation which only applied to the arguments $(e_{01}, \ldots e_{0k})$, where $e_{0i} = val(q_{0i})$, and was undefined for all others. This treatment, which essentially amounts to just using an idiomatic 'marker', is possible although it leads to some problems with categories. Here I will only consider one alternative account, where the idea is to keep using the old operation $\underline{\alpha_0}$, but give it a new name.

This means that our given grammar E will now be extended in the following way.

9.1 Definition.

$$E^i = (E, A, \underline{\alpha})_{\alpha \in \Sigma^i},$$

where $\Sigma^i = \Sigma \cup \{\alpha_0^i\}$, and α_0^i is a new k-ary function symbol such that $\underline{\alpha_0^i} = \underline{\alpha_0}$. E^i is called a *duplicated rule extension* of E. Let $q_0^i = \alpha_0^i(q_{01}, \ldots, q_{0k})$.

So now we have a new function symbol, hence new grammatical terms, but the same expressions and the same operations on expressions as before. The relations between E and E^i are easily described. For $s \in T(E^i)$, define

$$s^- = \text{ the result of deleting all superscripts } ^i \text{ in } s.$$

Note that $s^{--} = s^-$ and $s(p|x)^- = s^-(p^-|x)$. Also define, for $X \subseteq T(E)$,

$$X^+ = \{s \in T(E^i) : s^- \in X\}.$$

That is, X^+ consists of all those terms that are obtained from terms in X by adding the superscript ^{i} to zero or more occurrences of α_0.

9.2 Lemma.

(a) $T(E^i) = T(E)^+$ *and* $GT(E^i) = GT(E)^+$.

(b) *For* $p, q \in GT(E^i)$, $p \sim_{E^i} q \Leftrightarrow p^- \sim_E q^-$.

(c) *If* $p \in GT(E^i)$ *then* $[p]_{E^i} = [p^-]_{E^i}$, *and if* $p \in GT(E)$ *then* $[p]_{E^i} = [p]^+_E$.

(d) *If* E *is categorial, so is* E^i, *and the map* $'$ *from* Cat_E *to* Cat_{E^i} *defined by* $([p]_E)' = [p]_{E^i}$ *is a bijection.*

Again, there are two ways to extend the semantics μ. With a paraphrase p_0 we can do the paraphrase semantics $\mu(q_0^i/p_0)$. The domain will be $K(q_0^i/p_0) = \{s(q_0^i|x) : s(p_0|x) \in dom(\mu)\}$, and the same results as before hold.

Alternatively, suppose that E is categorial, and that $T = \langle r_\alpha, D_c\rangle_{\alpha\in\Sigma, c\in Cat_E}$ is a μ-compositional type system for E. Assume $m_0 \in D_{[q_0]_E}$. Letting $D_{c'} = D_c$ as before, define a new type system

$$T^i = \langle r_\alpha, D_c\rangle_{\alpha\in\Sigma^i, c\in Cat_{E^i}},$$

where $r_{\alpha_0^i}$ is a function with the same domain as r_{α_0}, defined as follows:

$$r_{\alpha_0^i}(m_1, \ldots, m_k) = \begin{cases} m_0 & \text{if } m_j = \mu(q_{0j}), 1 \leq j \leq k \\ r_{\alpha_0}(m_1, \ldots, m_k) & \text{otherwise.} \end{cases}$$

Now if $\alpha_0^i(p_1, \ldots, p_k) \in GT(E^i)$ then $(\alpha_0^i(p_1, \ldots, p_k))^- = \alpha_0(p_1^-, \ldots, p_k^-)) \in GT(E)$. Also, $D_{[p_j^-]_E} = D_{[p_j]_{E^i}}$ and $D_{[\alpha_0(p_1^-,\ldots,p_k^-)]_E} = D_{[\alpha_0^i(p_1,\ldots,p_k)]_{E^i}} = D_{[q_0]_{E^i}}$ (since E^i is categorial). Hence,

$$r_{\alpha_0^i} : D_{[p_1]_{E^i}} \times \cdots \times D_{[p_n]_{E^i}} \longrightarrow D_{[\alpha(p_1,\ldots,p_n)]_{E^i}}.$$

It follows that T^i is a type system for E^i. Again, we can use the compositional machinery to extend μ inductively to a semantics μ^i for E^i such that $\mu^i(q_0^i) = m_0$. We will have $dom(\mu^i) = K^i = dom(\mu)^+$. The following result holds.

9.3 Theorem. *Suppose that* E *is categorial and that* E^i *is obtained as above by duplicating the last syntactic rule used in forming the term* q_0. *Suppose further that* $T = \langle r_\alpha, D_c\rangle_{\alpha\in\Sigma, c\in Cat_E}$ *is a* μ*-compositional type system for* E, *and that we wish to give* q_0 *the idiomatic meaning* $m_0 \in D_{[q_0]_E}$. *Then the following holds:*

(a) *There is a unique extension* μ^i *of* μ *to* K^i *such that* T^i *is* μ^i*-compositional and* $\mu^i(q_0^i) = m_0$.

(b) *Suppose* $m_0 = \mu(p_0)$ *for some paraphrase* $p_0 \in dom(\mu)$ *such that* $p_0 \sim_E q_0$. *Then for all* $p \in K(q_0^i/p_0) \cap K^i$, $\mu(q_0^i/p_0)(p) = \mu^i(p)$.

10 Discussion

We have looked at some ways of extending both syntax and semantics in order to incorporate a new idiom. To see that these extensions are at least reasonable, we may observe that criteria like the following have been satisfied:

- *Surface identity.* On the surface, the idiom looks the same as the non-idiomatic expression.

- *Preservation.* The extensions preserve various desirable properties, in particular, compositionality. We saw that other properties (such as the husserl property) were also preserved, and we may also note (where E' and μ' stand for the extensions that have been considered)
  - *Preservation of syntactic categories.* For $p, q \in GT(E)$, $p \sim_E q$ implies $p \sim_{E'} q$.
  - *Preservation of semantic categories.* For $p, q \in dom(\mu)$, $p \sim_\mu q$ implies $p \sim_{\mu'} q$.
- *Uniqueness.* The extension is (in some suitable sense) uniquely determined (given that it should have certain properties).
- *Conservativity.* If $p \in GT(E) - dom(\mu)$ then $p \in GT(E') - dom(\mu')$.
- *Semantic domain.* The extended semantics should have a reasonable and non-trivial domain, allowing the idiom to be used in all contexts one expects to be able to use it.

In the connection with the last item there is also the issue of *overgeneration.* Let us look at two cases. First, operations such as passivization or anaphoric reference to the object position may not apply to some idioms, like *kick the bucket*. What happens, on the accounts considered here, with sentences like *The bucket was kicked by John*? Syntactically, the 'idiomatic version' of this sentence will belong to the extended grammar. But semantically we may assume already in the given semantics that, say, passivization does not apply to one-place predicates. That is, applying the passive operation to something like *John died* will not be meaningful. Then, if we extend by the paraphrase semantics, neither will the 'idiomatic version' of *The bucket was kicked by John.* Thus, regardless of whether we treat the idiom as an atom or as having syntactic structure, passivization can be blocked in the paraphrase semantics by semantic restrictions in the given language. On the other hand, when there is no paraphrase and we just have the syntax and semantics of the literal reading to work with, the idiomatic reading of *The bucket was kicked by John* as *John died* will not be blocked (with μ^a and μ^i). It remains to be seen if there are other means in the present framework to achieve that effect.

Another example concerns the case of *John kicked the pail*, assuming that *the pail* and *the bucket* are synonymous. With the atomic approach, there is no idiomatic reading of this sentence, so the problem does not appear. But suppose we think of *kick the bucket* as having syntactic structure. Now (an idiomatic version of) *John kicked the pail* is not in the domain of the paraphrase semantics $\mu(q_0^i/p_0)$ (since it is not obtained by replacing *die* by *kick the bucket*). But it is meaningful in μ^i, and there it will mean *John died.* Less seriously, a sentence like *John lifted the pail* will also have an 'idiomatic version' (obtained by applying the duplicated function symbol instead), but its meaning will be the ordinary one.

11 Further directions

I have only approached a small number of the problems concerning idioms and compositionality here. An example of something that must be accounted for is the fact that, say, *pull strings* occurs freely in contexts like

(9) pull all/some/a few/several/many/most/no strings.

But it is still *one* idiom, not several, so an atomic analysis seems far-fetched, to say the least. The syntactic form is something like

$$\alpha_0(\mathit{pull}, \beta_0(q, \mathit{strings})),$$

where q is a determiner. Here the proposed analysis does not apply, and it remains to be seen if it can be suitably adapted.

Also, I have not addressed the proposal in Nunberg et al. [4] that for *pull strings* we should have the ordinary syntactic rule but idiomatic versions of *pull* and *string* instead. It is easy to see the intuitive appeal of this approach, where the meaning of *pull strings* is computed in the ordinary way from the meanings of new atoms pull^i (say, 'exploit') and string^i (say, 'connection'). But the notion of atomic extension from the present paper will not work in this case. For the case of *kick the bucket*, the corresponding surface string is in $E - A$ and so can be taken as a new atom without requiring additional rules, but this does not hold for pull^i and string^i. They are not in E, so rules have to be extended, but furthermore we took the value of an atom to be itself, and then we cannot account for the ambiguity between *pull* and pull^i. In other words, the framework needs to be adjusted in order to accommodate this proposal. I think such adjustment can be done, but I have not tried to do it here. Note that any treatment of this proposal will have to avoid, in a non-ad hoc way, a more serious kind of overgeneration than what we encountered so far, namely, expressions like pull^i *the wagon* and *tie* $\mathit{strings}^i$, which appear to make no sense at all.

However, even with these limitations, I hope to have shown that there are interesting problems concerning idioms and compositionality which, when the standard — and sometimes misleading — formulations of these matters have been demystified, can be profitably treated in a general algebraic framework such as the one presented here.

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