The Curious Case of Measure Semantics

Problem This paper explores *measure constructions* (MCs) in English (*two kilos of apples*) and Turkish (the equivalent of *two kilo apple*) that are composed of a numeral, a classifier (a container noun, e.g. *glass*, or a measure term, e.g. *kilo*), and a substance noun. MCs have two interpretations: the *individuating* and *measure readings*. The former is realized as either the *container* or *portion readings* (Rothstein 2011, Partee & Borschev 2012, Scontras 2014, Khrizman et al 2015).

  (1) Mary brought two glasses/liters of water on the tray. They were blue.   CONTAINER READING
  (2) Mary drank two glasses/liters of water, one in the morning, one in the evening.   PORTION READING
  (3) Mary added two glasses/liters of water to the soup.   MEASURE READING

The character of the measure reading shows variation between English and Turkish. This disparity, to be outlined below, is the main focus here and argued to stem from a two-part semantics that MCs have and two different ways in which these parts are structurally composed.

1. <u>Distributive elements</u> such as reciprocals and *each* are only compatible with the individuating reading of MCs (Rothstein 2011). (4a) is true in a situation where three boxes are put next to each other in the closet, which can be identified as either the container (referring to the boxes) or portion reading (referring to the groups of books coming in boxes). However, it does not describe a situation where the individual books are put next to each other in the closet, referring to *three boxes* as a way of measuring the total amount of books. In contrast, this reading is available in Turkish (4b).

  (4) a. We put the three boxes of books next to each other in the closet.
      b. Üç   kutu kitab-ı   dolap-ta   yan yan-a   koy-du-k.
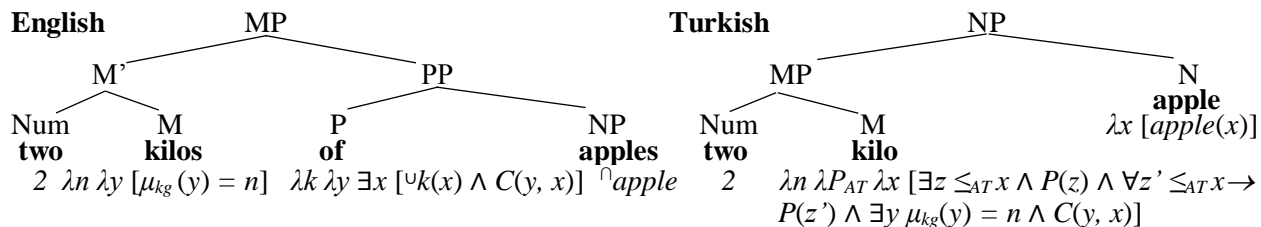   three box book-ACC closet-LOC next next-DAT put-PAST-1PL

2. English MCs can be embedded under <u>mass quantifiers</u> in their measure reading and under count quantifiers in their individuating reading (5) (Rothstein 2011).

  (5) We gave a little/a few of the twenty kilos of apples to the child we saw on the street.

In the latter case, since the individuated units are kilo-packs of apples, the quantification is over these units, not individual apples. In other words, *a few of the twenty kilos of apples* means a few kilos of the twenty kilos of apples, not a few apples from the given set. The fact that this latter reading is also not available through the measure reading of MCs together with their compatibility with mass quantifiers and incompatibility with distributivity makes it reasonable to assume that English MCs are mass expressions in the measure reading as Rothstein 2011 claims. Conversely, quantification over individual apples is available for Turkish MCs. *Yirmi kilo elmanın bir kaçı* 'a few of the twenty kilos of apples' can mean a few apples from the given set. Combining with the distributivity facts, this shows that when the substance noun is count, MCs in Turkish have a count denotation in the measure reading in contrast to English MCs.

Previous Accounts Generally, depending on the type of the substance noun, MCs are taken to denote sets of plural or mass individuals that measure the appropriate amount along a dimension. For e.g., for Scontras 2014 *two kilos of apples* equals to λx [$^{\cup\cap}apple(x) \wedge \mu_{kg}(x) = 2$] (cf. Krifka 1989, Champollion 2010). However, under this theory, MCs of English with a count noun have a count denotation, contrasting with the conclusion reached above. Alternatively, Rothstein 2011 claims that when the substance noun is count, it must shift from the count type to the mass type since measurement operates at the mass domain only. So, under her theory *two kilos of apples* is λx [$apples_{mass}(x) \wedge \mu_{kg}(x) = 2$]. First, this theory does not account for Turkish MCs. Second, although I follow the idea that measurement occurs at the mass domain, the motivation behind the shift of the count nouns to the mass type remains vague.

Proposal Instead, I argue that measurement universally operates at the domain of portions of matter which is connected to a substance noun by a *Constitution relation* (*C*) inside the derivation. That is, MCs with the measure reading are composed of two parts, the part with the count or mass substance noun and the part with the measured amount which is always mass. The notion of *portions of matter* and the *C* relation goes back to Link 1983. The famous example is a ring recently made up from some old gold. Their distinctive properties reveal that even if the ring and the gold in the ring share the portion of matter they are made of, they are not the same entities. They are connected by a *C* relation, denoted by the materialization function *h*, which maps every individual to its corresponding portion of matter, i.e. *C* (*a*, *b*) is true iff $a = h(b)$. If *a*, *b* are mass the semantic fact follows trivially because *h* denotes the identity function on mass individuals.

English   MP   **Turkish**   NP

     M'   PP   MP   N
                                                              apple
                                                           $\lambda x\ [apple(x)]$

Num   M   P   NP   Num   M

two   **kilos**   **of**   **apples**   **two**   **kilo**

2 $\lambda n\ \lambda y\ [\mu_{kg}(y) = n]$ $\lambda k\ \lambda y\ \exists x\ [^\cup k(x) \wedge C(y, x)]$ $^\cap apple$ 2 $\lambda n\ \lambda P_{AT}\ \lambda x\ [\exists z \leq_{AT} x \wedge P(z) \wedge \forall z' \leq_{AT} x \rightarrow$
                                                                  $P(z') \wedge \exists y\ \mu_{kg}(y) = n \wedge C(y, x)]$

E: $[[\textit{two kilos of apples}]] = \lambda y\ [\mu_{kg}(y) = 2 \wedge \exists x\ ^{\cup\cap}apple(x) \wedge C(y, x)]$

    a set of portions of matter that amount to 2 kilos in weight and constitute a plurality of apples

T: $[[\textit{two kilo apple}]] = \lambda x\ [\exists z \leq_{AT} x \wedge apple(z) \wedge \forall z' \leq_{AT} x \rightarrow apple(z') \wedge \exists y\ \mu_{kg}(y) = 2 \wedge C(y, x)]$

    a set of pluralities of apples constituted by a portion of matter that amount to 2 kilos in weight

English MCs take the portion of matter, hence the measured amount, as the basis of reference. This generates a mass denotation, which makes MCs compatible with mass quantifiers even if the substance noun is count. Since the set denoted by the substance noun is existentially closed, it is not accessible for reciprocals or count quantifiers. In Turkish MCs, the basis of reference is the substance noun, hence when it is count, the measure expression is also count and available for reciprocals and count quantifiers. This reversal lines up with the existence/absence of *of* which subsequently generates different syntactic structures for the MCs of the two languages (Schwarzschild 2006). English ones are headed by the classifier which introduces the amount measured, and the noun is the complement of *of* which introduces the C relation. In Turkish - a strict head-final language - due to the absence of *of* they are headed by the noun and the C relation is wired into the denotation of the classifier. This account not only addresses the two-way denotations of MCs but also contributes to the ongoing debates on the semantic and syntactic status of *of*.

Substance nouns of Turkish are singular or mass, contrasting with English nouns which are plural or mass. I follow Scontras 2014 in that the latter are kind terms and get instantiated inside the derivation. Based on Sağ's 2018 claim that singular nouns in Turkish are ambiguous between atomic properties and singular kind terms which cannot be instantiated (Dayal 2004), I propose that they are the simplest form of a predicate in Turkish, atomic if count, mass otherwise. Alternatively, they could be treated similar to singular substance nouns of Brazilian Portuguese. Building on Pires de Oliveira and Rothstein 2011, Rothstein 2017 claims that they are furniture-type mass nouns that are compatible with distributivity unlike in English. However, this account cannot be adopted for Turkish since it patterns with English in that sense.

Further Implications For some speakers of English, MCs in the measure reading allow distributivity and count quantification as in Turkish. I call this Grammar B of English, for which I assume that it is possible to treat *of* as a PF-inserted element and shift the head from the classifier to the substance noun. Although such a strategy is restricted to a dialectical variation in the measure reading, it is available to all speakers in the individuating reading, yielding the ambiguity between the container (headed by the classifier) and portion readings (headed by the noun) (Partee & Borschev 2012, Scontras 2014). On the other hand, Turkish MCs differ from English ones in not having the container reading. While (1) can refer to the containers as evidenced by the felicity of a follow-up as 'They were blue.', it can only refer to the water in Turkish as evidenced by the infelicity of such a follow-up. I argue that this is because Turkish MCs are always headed by the noun, given the absence of *of*. I believe that it must be harder to reanalyze a structure inserting an element that is not there than reanalyzing a structure by deleting an existing one. Instead, complying with the strict head-final property of the language, when the reference to the container is intended, a different structure is formed where the order of the container and substance nouns is reversed (e.g. *iki su-dolu bardak* 'two water-full glass'). As a final remark, while *of* is an indicator of the structural difference between English and Turkish MCs, it should be noted that its absence does not always implicate a Turkish-like behavior. What is actually at stake is which element the construction is/can be headed by. Namely, depending on the headedness properties of the language in question it is possible for its MCs to lack *of* but be headed by the classifier. For e.g., German and Dutch MCs lack *of,* yet still pattern with English both in the individuating and measure readings. Under the current proposal, this is expected if they have an English-like structural alignment, not Turkish-like. Confirming this, Grestenberger 2015 and Ruys 2017 respectively show that German and Dutch MCs are headed by the classifier in the measure and container readings as in English.