Two ways of measuring time:
Can Keats have done anything before Shakespeare?

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A usual semantics for times[1] assumes that the domain of quantification for times is an ordered set of times T_u called a 'timeline', with a total ordering relation < over T_u which is transitive, irreflexive, and antisymmetric. The default timeline is from the beginning of the universe to the end of the universe, passing through now, with a one-to-one mapping to $\Re$ (T_u is dense). Predicates can be modeled as functions from individuals to times to truth values, <e, <i, t>> (abstracting away from world and event variables). This gives the standard interpretation for synonymous examples like (1) as in (2):

(1) a. Keats ate lunch before Shakespeare.
b. Keats ate lunch before Shakespeare did.
c. Keats ate lunch before Shakespeare ate lunch.

(2) $\exists t[t \in T_u](t < n \ \& \ \text{eat.lunch}(\text{keats})(t) \ \& \ \exists t'[t' \in T_u](t' < n \ \& \ \text{eat.lunch}(\text{shakespeare})(t') \ \& \ t < t'))$

In the actual world, in which John Keats was born considerably after William Shakespeare died, (1) is not true, and could not be true, since (even assuming additional contextual restrictions on time spans considered for the relevant events of eating lunch, as famously noted first in Partee 1973; see also Schlenker 2004) there are no times at which the predicate 'eat lunch' is true of Keats that precede any involving Shakespeare.

Now consider the following, which could be true:[2]

(3) a. Keats learned to read before Shakespeare.
b. Keats learned to read before Shakespeare did.
c. Keats learned to read before Shakespeare learned to read.

The examples in (3) all have the paraphrases in (4).

(4) Paraphrases:
a. The age at which Keats learned to read is less than the age at which Shakespeare learned to read.
b. Keats was younger when he learned to read than Shakespeare was when he learned to read.

The puzzle is clear: how can the standard semantics for tense yield the apparently contradictory result that (3) could be true in the same models in which (1) must be false? How is this?

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[1] See Kamp and Reyle 1993, Ogihara 1996, Smith 2003, and the papers in Guéron and Lecarme 2004 for recent approaches and references.

[2] I am ignorant of any historical evidence to settle whether this is true in the actual world, but it could be, which is the point. For the sake of judgments, assume it is true.

The solution is to admit that an individual *i* can trigger separate domains of quantification for a *t* variable of a predicate of which *i* is an argument. In other words, the domain of quantification can be relativized to an individual as in (5a) and the ordering relation < can be defined as in (5b).

(5) a. For each individual *i*, there is a distinct timeline T, T_i (the lifetime of *i*), which starts at *i*'s birth (t_b in $T_u = t_0$ in T_i) and ends at *i*'s death. (*i*'s age, in other words, which for any time *t* in T_u equals $t - t_b$).

b. For all *t*, let the real correspondent of *t*, *R(t)*, be the real number that maps to *t*, with $t_0 = 0$, etc.
For any *t*, *t′* , $t < t'$ is true iff $R(t) < R(t')$.

Using such domains, the puzzling examples in (3) can be assigned the semantics in (6).

(6) $\exists t[t \in T_{keats}](\text{learn-to-read(keats)}(t) \ \& \ \exists t'[t' \in T_{shakespeare}](\text{learn-to-read(shakespeare)}(t') \ \& \ t < t'))$

Whether the default domain of quantification (the timeline of the universe) or an individual's timeline is used is a pragmatic matter (as Musan 1995, 1997 posits for temporal anchoring in nominals as well). Certain predicates, especially those denoting significant milestones in an individual's life, seem to allow easier access to T_i for that individual. 'Learn to read' is clearly one such, while 'eat lunch' is not ('learn to speak', 'learn to walk', 'menstruate', 'begin shaving', 'leave home', 'finish school', 'marry', 'be baptized', 'have a child', 'buy a house', 'get a job', 'retire', are several more among a large number of others, whose number is limited only pragmatically). 'Die' seems for many speakers to fall fairly squarely in the middle: an example like (7) fluctuates between the true claim that Keats was younger when he died (at age 25, in 1821) than Shakespeare was when he died (at age 52, in 1616) and the false claim that in absolute (universe timeline) terms, Keats's death preceded Shakespeare's (false, since, $1821 \not< 1616$). This is accounted for by assigning the semantics in (8), and by noting that the pragmatics of choosing which domain of quantification T is chosen (T_u or T_i) is subject to individual variation and effort.

(7) a. Keats died before Shakespeare.
b. Keats died before Shakespeare did.
c. Keats died before Shakespeare died.

(8) $\exists t[t \in T](t < n \ \& \ \text{die(keats)}(t) \ \& \ \exists t'[t' \in T](t' < n \ \& \ \text{die(shakespeare)}(t') \ \& \ t < t'))$

Even otherwise close paraphrases like (9) seem to lack the relativized-to-individual reading, or if not lack completely, at least make such a reading extremely difficult; this seems to indicate that T in nouns is less accessible to such adjustment.

(9) Keats's death preceded Shakespeare's.

Next, note that we need some restrictions on when such pragmatic shifts are possible. We don't want (10a) to come out true in the situation in (10b), which it would if assigned the semantics in (10c) (since 6 < 29), with the lifetimes of the individuals switched. (Above I restricted the domain shift to those individuals that are arguments of the predicate whose domain is shifted—perhaps only the most prominent argument on some scale, usually the subject in a language like English.)

(10) a. John's father got baptized before John got baptized.
b. John's father got baptized at age 30 in 2000 (when his son was 6) and John got baptized at age 5 in 1999 (when his father was 29).
c. $\exists t[t \in T_{john}](\text{got-baptized}(\text{john's-father})(t) \ \& \ \exists t'[t' \in T_{\text{john's-father}}](\text{got-baptized}(\text{john})(t') \ \& \ t < t'))$

Note also that if the lifetime T_i is chosen for one predicate, it must be chosen for all relevant predicates (with possibly different individual anchors)—we don't want (11) to come out true if John got married at age 30 in 2000 and his father got married at age 20 in 1965 by virtue of the fact that 30 (= $R(t)$, $t \in T_{john}$ such that *marry(john)(t)* is true) is less than 1965 (=$R(t)$, $t \in T_u$ such that *marry(john's-father)(t)* is true).

(11) John got married before his father got married.

Lifetime effects apply to non-human individuals as well, of course, including buildings, sicknesses, jobs, and the like. And these effects seem to be found with *after*, *later than*, and *earlier than* as well, which is to expected if the account rests on a general pragmatic effect and is not due to some idiosyncrasy of the semantics of the connective *before*.

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