TELICITY, MEASURES, AND ENDPOINTS[*]

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1 The problem

Languages like English are remarkable as to how telicity of a complex verbal predicate based on manner of motion verbs (e.g., *walk* or *swim*) interacts with expressions specifying a goal of motion and the length of the path:

(1) a. **Telicity through specifying a source and goal of motion**
Mary walked from the university to the capitol in an hour ǁ *for an hour.
b. **Telicity through specifying the length of a path**
Mary walked two kilometers in an hour ǁ *for an hour.

Both *to the capitol* and *two kilometers* in (1a-b) lead to telicity, as evidenced by the tests on co-occurrence with durative and time-span adverbials like *in an hour* and *for an hour*. In the absence of these expressions, the predicate based on *walk* is atelic:

(2) Mary walked for an hour ǁ *in an hour.

The similar pattern obtains with degree achievements: telicity is obligatory if an endpoint or degree of change is overtly specified, as in (3):

(3) a. **Telicity through specifying an endpoint of change**
Mary heated the water to 90°C in an hour ǁ *for an hour.

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b. **Telicity through specifying the degree of change**
Mary heated the water by 60°C in an hour || *for an hour.

Krifka (1998) argues that the parallelism of manner of motion predicates and degree achievements is naturally accounted for by appealing to the notion of movement along a path which underlies both types of predicates in (1)-(3):

(4) "Change of qualities is structurally similar to movement in space. For example, the change of temperature of an object can be seen as a movement in temperature space. When we assume a linear directed path structure to model temperature, then we can treat sentences <like (3a-b)> in the same way as we treated <(1a-b)>. (Krifka 1998: 228-229)

Krifka argues that goal and measure expressions lead to quantized event predicates, which provides a principled explanation for telicity of (1) and (3), since quantized event predicates are telic. (A predicate P is quantized iff $\forall x \forall y[P(x) \wedge y < x \rightarrow \neg P(y)]$.) Thus, specifying source and goal locations creates event predicates in (5a-b), which represent the meaning of (1a) and (3a):

(5) a. $\lambda e \exists x[\text{WALK}(M, x, e) \wedge \text{SOURCE}(x, U, e) \wedge \text{GOAL}(x, C, e)]$
b. $\lambda e \exists x[\text{HEAT}(M, W, x, e) \wedge \text{SOURCE}(x, 30°C, e) \wedge \text{GOAL}(x, 90°C, x)]$

Intuitively, (5a) is quantized, since no proper part of an event in which the path from the university to the capitol has been walked is an event in which the path from the university to the capitol has been walked. The same reasoning extends to (5b).

Measure expressions represent another way of making an event predicate quantized. If they are analyzed as extensive measure functions, (1b) and (3b) would be represented as in (6a-b):

(6) a. $\lambda e \exists x[\text{WALK}(M, x, e) \wedge \text{KM}'(e) = 2]$
b. $\lambda e \exists x[\text{HEAT}(M, W, x, e) \wedge \text{CENTIGRADE}'(e) = 60)]$
where KM′ and CENTIGRADE′ are extensive measure functions for events.

No proper part of an event of walking 2 km is an event of walking 2 km, hence the event predicate in (6a) is quantized; similarly for (6b). This informal reasoning will suffice for our current purposes; for more details see Krifka 1998: 228-230.

In sum, the overall idea underlying Krifka's account for telicity of sentences like (1) and (3) is that as soon as the path is fixed, the event predicate is quantized. Goal and measure expressions represent two distinct ways of accomplishing this: the generalized path can be defined either by specifying either source and goal locations or its length. With this in mind, let us look at the data from two Turkic languages, Chuvash and Karachay-Balkar.

Like in English, degree achievements and manner of motion verbs form a natural class as to how their telicity interacts with expressions that measure the *degree of change* or *length of the path (measure expressions* henceforth) and define the *endpoint of change* or *goal of motion* (*endpoint expressions* henceforth). However, in Turkic languages measure and endpoint expressions do not pattern in the same way. Consider (7)-(8):

(7) **Karachay-Balkar: measure expressions**
a. *Degree achievements: telic only*
kerim suw-nu {eki minut-xa || *eki minut} on gradus-ta zɨlɨt-xan-dɨ.
K. water-ACC 2 min-DAT 2 min 10 degree-LOC heat-PFCT-3SG
'Kerim heated the water by 10 degrees {in two minutes || *for two minutes}'.

b. *Manner of motion predicates: telic only*
kerim züz meter {eki minut-xa || *eki minut} cap-xan-dɨ.
K. 100 m 2 min-DAT 2 min run-PFCT-3SG
'Kerim ran 100 m {in two minutes || *for two minutes}.'

As (7a-b) indicate, like in English, if the degree of change or length of the path is specified by a measure expression, the verbal predicate is *obligatorily telic*. However, unlike in English, *both telic and atelic interpretations* are compatible with an overt specification of the endpoint, either of motion or of change in a gradable property:

(8) **Karachay-Balkar: endpoint expressions**
a. *Degree achievements: telic **or atelic***
kerim suw-nu {eki minut-xa || eki minut} altɨ on gradus-xa deri zɨlɨt-xan-dɨ.
K. water-ACC 2 min-DAT 2 min 6 10 degree-DAT to heat-PFCT-3SG
1. 'Kerim heated the water to 60 degrees {in two minutes }.'
2. Lit. 'Kerim heated the water to 60 degrees {for two minutes}, (but stopped when the water was 50 degrees).'

b. *Manner of motion predicates: telic **or atelic***
kerim šqol-ʁa {eki minut-xa || eki minut} cap-xan-dɨ.
K. school-DAT 2 min-DAT 2 min run-PFCT-3SG
1. 'Kerim ran to the school in two minutes.'
2. Lit. 'Kerim ran to the school for two minutes (but then changed his mind and went to the cinema).

On the first reading, (8.a1) and (8b.1) indicate that the culmination has been attained, that is, that the water has reached the temperature of 60 degrees, and the running event ended up in a location referred by the goal expression 'to the school'. On the second, atelic, reading, the culmination is not reached. In (8a.2) the agent performs a certain activity which should bring about a state of the water being 60C hot. However, the activity terminates before this state is attainted. Similarly, in (8b.2) the running-to-the school event stops before the agent reaches his destination.

The same range of interpretations is obtained in Chuavsh, where measure and endpoint expressions differ as to whether telicity is obligatory or the atelic interpretation is available as well:

(9) **Chuvash: measure expressions**
a. *Degree achievements: telic only*
maša šywa allă gradus čuxle {2 minut xuššănče || *2 minut} ăšăt-r-ĕ.
M. water-ACC 50 degree by minute within minute heat-PST-3SG
'Masha heated the water by 50 C {in two minutes || *for two minutes}.'

b. *Manner of motion verbs: telic only*
samalot pin š^j^uxrăm-a {ike sexet xuššănče || *ike sexet} vĕš^j^-r-ĕ.
plane thousand km-ACC two hour within two hour fly-PST-3SG
'The plane flew 1000 km {in two hours || *for two hours}.'

(10) **Chuvash: endpoint expressions**
a. *Degree achievements: telic **or atelic***
maša šywa allă gradus tarat {2 minut xuššănče || 2 minut} ăšăt-r-ĕ.
M. water-ACC 50 degree to minute within minute heat-PST-3SG

1. 'Masha heated the water to 50 degrees {in two minutes}.'
2. Lit. 'Masha heated the water to 50 degrees {for two minutes}, (but stopped when the water was 40 degrees)'.

b. *Manner of motion verbs: telic **or atelic***

samalot	muskwa-na	{ike	sexet	xuššănče ‖	ike	sexet}	vĕš^j-r-ĕ.
plane	Moscow-DAT	two	hour	within	two	hour	fly-PST-3SG

'The plane flew to Moscow in two hours.'
'The plane was in flight to Moscow for two hours.'

Given the distribution of measure and endpoint expressions in Turkic as compared to English, two questions arise immediately. First, we need to know why endpoint expressions in Turkic are compatible with both telic and atelic interpretations, while measure phrases necessarily create telic predicates. Secondly, we have to figure out how the difference between languages like English and Karachay-Balkar/Chuvash can be accounted for.[1]

In what follows, I will develop an analysis providing answers to both questions. Essentially, I will assume the degree semantics for both degree achievements and manner of motion verbs, and argue that the observed variation can be reduced to the way in which measure and endpoint expressions are integrated into the event structure. The proposal I develop to explain Turkic data is based on the assumption that measure expressions saturate the degree argument position, while endpoint expressions modify a scale from which the degree variable takes its values. To account for the cross-linguistic variation, I will hypothesize that in languages like English, unlike in Turkic, both measure and endpoint expressions appear in the degree argument position.

2 Semantics for degrees and endpoints of change in Turkic

Krifka's (1998) dynamic theory of incrementality and its extensions in Beavers 2009, 2011 provide an example of analysis where measure and endpoint expressions both receive an explicit treatment in terms of path structures. Much recent work in the field is based on another type of framework, namely, on the degree-based approach to telicity (Hay et al. 1999; Caudal, Nicolas 2004, Kennedy, Levin 2002, 2008; Winter 2006, Piñon 2008, Kennedy 2010, a.o.; see Beavers 2009 and elsewhere suggesting that the two frameworks ultimately converge). However, these analyses only cover measure of change, but not the endpoint expressions. The proposal developed below makes use of degree semantics, too. It builds on and extends the idea that the meaning of verbs like 'walk' or 'heat' is basically a relation between events *e*, individuals *x* and degrees *d* such that the degree to which *x* possesses a certain gradable property changes *d*-much in the course of *e*.[2] Specifically, I will rely on a recent development of Kennedy and Levin's

[1] I believe that one possibility can be rejected to begin with. One could argue that variable telicity of (8b) and similar examples has to do with the variable interpretation of goal PPs in the Dative, ambiguous between 'to' and 'towards'. This is not the case, however: 'towards' is rendered by a separate postposition, *taba* in Karachay-Balkar. Predicates with *taba*-PPs are obligatorily atelic, as expected:

(i)

kerim	Sqol-Ra	taba	{eki	minut ‖	* eki	minut-xa}	cap-xan-dy.
K.	school-DAT	towards	2	min	2	min-DAT	run-PFCT-3SG

'Kerim ran towards the school {for two minues ‖ *in two minutes}.'

I am grateful to Peter Svenonius and Beth Levin who independently turned my attention to this issue.

[2] Specific ways of implementing this idea may vary. Hay et al. 1999 and Kennedy, Levin 2002 represent the meaning of relevant class of verbs by means of the INCREASE relation, a relation that holds of a gradable property *G*, event *e*, degree *d*, and individual *x* iff the difference between the degrees to which *x* possesses the property *G* at the beginning and at the end of *e* is *d*. Piñón's (2008) system relies on incremental degree functions (IDFs) from

theory (Kennedy, Levin 2008, Kennedy 2010) where the verb meaning is represented by *measure of change functions*. I am not able to discuss wider theoretical implications of this type of analysis. I believe that what I say below about the interpretation of measure and endpoint expressions can be translated into other frameworks, possibly with minor technical adjustments.

In the remainder of this section, I will establish an argument that measure and endpoint expressions in languages like Turkic are integrated into semantic representations of event predicates in considerably different ways. Measure expressions saturate the degree of change argument positions, hence obligatorily lead to quantized event predicates (exactly as Kennedy, Levin (2008), Kennedy (2010) propose, and much in the spirit of Krifka 1998, putting technical differences aside). The novel aspect of my proposal has to do with how endpoint expressions are treated. I will argue that in languages like Turkic endpoint expressions modify a scale from which measure of change functions take their values by determining the maximal value on that scale. Variable telicity of derived event predicates then follows independently given the semantics of the positive form and Interpretive Economy (Kennedy 2007:36 *et seq.*)[3].

2.1 Measure of change functions

This section provides a brief overview of the framework. Given that the information provided below can be found elsewhere (e.g., Kennedy and Levin 2008:173 *et seq.*), I will keep the discussion to the necessary minimum. Crucial for the analysis is the notion of measure of change function in (11):

(11) **Measure of change function**
For any measure function **m**, $\mathbf{m}_{\Delta} = \lambda x \lambda e.\mathbf{m}{\uparrow}_{\mathbf{m}(x)(init(e))}(x)(fin(e))$
where $\mathbf{m}{\uparrow}_{\mathbf{m}(x)(init(e))}$ is a difference function based on a measure function **m**, of type <e, <i,t>>, and *init(e)* and *fin(e)* are initial and final temporal intervals of an event e, respectively.

In (11), $\mathbf{m}_{\Delta}$ is a function from ordinary individuals and events to degrees that represent how much an individual changes with respect to the property measured by **m** in an event[4].

The way this system works can be illustrated by comparing denotations of the adjective stem *wide* and the verb stem *widen*. *Wide* denotes a measure function **wide** that takes an individual *x* and a time *t* and returns the degree *d* on the width scale in (12) such that *x* is *d*-wide at *t*:

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individuals, properties of individuals and events to degrees, whereby, e.g, $\mathbf{read}_{\delta}(x)(O)(e)$ is the degree to which *x* qua type *O* is read in *e*. Unlike in Kennedy and Levin's work, IDFs are taken to be primitives of the theory: they are not reduced to underlying gradable properties (of type <e, <i,d>>). More significantly, one of the arguments of IDFs is a property of individuals, since it is cumulativity/quantization of this property that the telicity of a resulting event description derives from (Piñón 2008: 209-211).

[3] The Interpretive Economy principle — "Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions" — explains, among other things, why the computation of truth conditions on the basis of the conventional meanings is preferred over context-dependent truth conditions.

[4] The definition in (11) is based on the notion of difference function in (i):

(i) **Difference function**
For any measure function **m** from objects and times to degrees on a scale S, and for any d ∈ S, $\mathbf{m}_d{\uparrow}$ is a function just like **m** except that:
i. its range is $\{d' \in S \mid d \leq d'\}$, and
ii. for any x, t in the domain of **m**, if $\mathbf{m}(x)(t) < d$ then $\mathbf{m}_d{\uparrow}(x)(t) = 0$.

According to (12), a difference function $\mathbf{m}_d{\uparrow}$, based on a measure function **m**, is the function from individuals and times to degrees which is just like **m** except for one thing: the degrees it returns represent the difference between the individuals's projection on the scale and the comparative standard *d*.

(12) **The range of the *wide* function**

(WIDTH: min ⟶ max)

Widen, a corresponding verb of gradual change, denotes a measure of change function $\mathbf{wide}_{\Delta}$, of type <e, <v,d>> based on **wide**. According to (11), part of the definition of $\mathbf{wide}_{\Delta}$ is a difference function $\mathbf{wide}_{\mathbf{wide}(x)(init(e))}\uparrow$, hence the range of $\mathbf{wide}_{\Delta}$ are degrees from a derived scale in (13), a bracketed part of (12), where the minimal element is the degree an individual possesses at the beginning of the event.

(13) The range of the $\mathbf{wide}_{\Delta}$ function:

(WIDTH: min ——— [⟶ max])

wide(x)(init(e))

where the value returned by $\mathbf{wide}_{\Delta}$ is the width of *x* at *end(e)*;

After saturation of the individual argument position, a function from events to degrees obtains. For a simple sentence in (14), this function would look like (15):

(14) The crack widened.

(15) $\lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e)$, a function of type <v,d>.

Functions from events to degrees like (15) can participate in the further derivation in two ways, by merging with the positive morpheme pos_V, of type <<v,d>, <v,t>>, or with the degree morpheme μ, of type <<v,d>, <d, <v,t>>> (Svenonius, Kennedy 2006). Semantics of the positive morpheme is represented in (16):

(16) $\| pos_V \| = \lambda g_{<v,d>}\lambda e.g(e) \geq stnd(g)$

The degree morpheme, on the other hand, creates a relation between events and degrees by abstracting over output degrees:

(17) $\| \mu \| = \lambda g_{<v,d>}\lambda d\lambda e.g(e) \geq d$

Combining the positive morpheme in (16) with (15) yields an event predicate in (18):

(18) $\| pos_V \text{ [crack widen] } \| = \lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e) \geq stnd(\mathbf{wide}_{\Delta})$.

The crucial fact about any scale from which measure of change functions take their values is that they are at least lower closed (for scale typology, see Rothstein, Winter 2004, Kennedy, McNally 2005, among others), by virtue of having a minimal degree. For any $\mathbf{m}_{\Delta}$, its minimal degree is **m**(x)(init(e)). If **m** is also upper closed (which is the case for ‘empty’, ‘stright’, etc., but not for ‘wide’ or ‘deep’), so is $\mathbf{m}_{\Delta}$**.** Due to Interpretive Economy (Kennedy 2007) that maximizes the contribution of conventional meanings to the computation of truth conditions, for measure functions associated with closed scales, endpoints on these scales are used to fix the standard of comparison, as stated in (19a-b):

(19) a. If a scale S associated with a measure function g is lower closed, $stnd(g) = d_{min}(S)$

b. If a scale S associated with a measure function g is upper closed, $stnd(g) = d_{max}(S)$

For *widen* (as for any other predicate based on a measure of change function), the scale is trivially lower closed. It is not upper closed, since the scale for *wide* is not. The analysis therefore predicts the following: $\|$ pos_V [crack widen] $\|$ = $\lambda e.\mathbf{wide}_\Delta(crack)(e) \geq 0$. This event predicate fails to be quantized and is cumulative. One can show, with minimal additional assumptions guaranteeing graduality of change, that if the crack widens by some positive degree in an event *e* and by some (possibly different) positive degree in an event *e´*, it also widens by some positive degree in $e \oplus e'$.

The degree morpheme μ turns a function from events to degrees into a relation between events and degrees. The degree argument of the derived relation in (20) is saturated by overt degree expressions like *3 meters* (*The crack widened 3 meters*), and an event predicate, (21), obtains:

(20) $\|$ μ [crack widen] $\|$ = $\lambda d\lambda e.\mathbf{wide}_\Delta(crack)(e) \geq d$

(21) $\|$ 3m μ [crack widen] $\|$ = $\lambda e.\mathbf{wide}_\Delta(crack)(e) \geq 3m$

The event predicate in (21) is quantized, since no proper part of an event of widening of the crack by 3m is an event of widening by 3m. A complete proof of this would require some additional technical effort, but for our purposes the informal reasoning will suffice.

With this overview of the system, we have everything we need for developing an analysis of Turkic data. In the next section I will modify the system in order to handle endpoint expression in languages Karachay-Balkar and Chuvash. Given the obvious conceptual advantages of the framework outlined above, the desideratum will be to keep modification to the necessary minimum. I believe that whatever shortcomings Kennedy and Levin's theory may turn out to have, possible adjustments will not affect the overall line of argument I develop below.

2.2 Turkic measure expressions: derivation by μ

We start by taking a closer look at measure expressions. Relevant examples from Turkic, (7a-b) and (9a-b), are exactly like their English counterparts in being obligatorily telic. With no evidence to the opposite, one can safely assume that both types of languages are subject to the same explanation. I suggest that Kenndy and Levin's (2008) and Kennedy's (2010) analysis applies to cases like (7) and (9) straightforwardly. As in English, measure expressions like '(by) ten degrees' and '100 m' saturate the degree of change argument position created by the application of μ. The derivation of (7a) is shown in (22):

(22) 'Kerim heated the water by 10 degrees.'
   a. $\|$ heat $\|$ = $\lambda x\lambda e.\mathbf{hot}_\Delta(x)(e)$
   b. $\|$ heat water $\|$ = $\lambda e.\mathbf{hot}_\Delta(water)(e)$
   c. $\|$ μ $\|$ = $\lambda g_{<v,d>}\lambda d\lambda e.g(e) \geq d$
   d. $\|$ μ [heat water] $\|$ = $\lambda d\lambda e.\mathbf{hot}_\Delta(water)(e) \geq d$
   e. $\|$ 10C μ [heat water] $\|$ = $\lambda e.\mathbf{hot}_\Delta(water)(e) = 10C$.

The event predicate in (22e) is true of an event *e* just in case the temperature of the water has increased in *e* by 10C. The same analysis applies to the predicate based on the manner of motion verb 'run' in (7b). Here, $\mathbf{path}_\Delta$ is a measure of change function that represents the degree to which an individual advances along a path (with a contextually salient initial location), and the event predicate specifies the manner of motion.

(23) 'Kerim ran 100m'
a. || run || = $\lambda x \lambda e.\text{run}(e) \wedge \textbf{path}_\Delta(x)(e)$
b. || Kerim run || = $\lambda e.\text{run}(e) \wedge \textbf{path}_\Delta(\text{Kerim})(e)$
c. || μ || = $\lambda g_{<v,d>} \lambda d \lambda e.g(e) \geq d$
d. || μ [Kerim run] || = $\lambda d \lambda e.\text{run}(e) \wedge \textbf{path}_\Delta(\text{Kerim})(e) \geq d$
e. || 100m μ [Kerim run] || = $\lambda e.\text{run}(e) \wedge \textbf{path}_\Delta(\text{Kerim})(e) = 100\text{m}$.

Much in the same way as in (22), the event predicate in (23e) is true of a running event *e* just in case the length of the path covered by Kerim is 100 m. Predicates in (22e) and (23e) are quantized, hence telic, for the same reason as in (20): no proper part of an event of heating the water by 10 degrees is an event of heating the water by 10 degrees, similarly for running 100 meters. Note that this analysis can be thought of as a reconstruction of Kirfka's treatment of similar examples in (6a-b) by means of degree semantics.

With this easy part of the analysis done, we can turn to a more complicated case, the one where endpoint expressions yield predicates of variable telicity.

2.3 Turkic endpoint expressions: change in the scale plus *posv*

As we have seen in (8) and (10), endpoint expressions create predicates that allow for both telic and atelic interpretations. The problem with variable telicity of (8) and (10) is as follows. If the endpoint expression ('to 60 degrees' or 'to the school') contributes to specifying the value of the degree variable in the same or similar manner as in (22) or (23), the atelic reading comes out as a complete surprise. As we have seen in the previous section, as soon as the degree argument is assigned a specific value, the event predicate cannot escape from being quantized.

To account for the variable telicity of (8), (10) and similar examples, I hypothesize that the endpoint expression does not participate in establishing the degree of change. Instead, it modifies a scale from which the degree argument takes its values by specifying the maximal degree on that scale:

(24) **The endpoint hypothesis**
Endpoint expressions in Turkic languages produce derived measure of change functions, which are exactly like measure of change functions in the initial denotation of verbs of gradual change except that they take their values from (upper) closed scales. The maximal value on a scale is determined by the endpoint expression.

To implement (24), we can define an upper limited measure of change function as follows:

(25) **Upper limited measure of change function**
For any measure function **m** from individuals and times to degrees on a scale S, and for any d ∈ S, $\mathbf{m}_\Delta^d = \lambda x \lambda e.\mathbf{m}^d_{\text{m(x)(init (e))}}\uparrow(x)(\mathit{fin}(e))$
where $\mathbf{m}^d_{\text{m(x)(init (e))}}\uparrow$ is an upper limited difference function based on a measure function **m** with the upper limit *d*, of type <e, <i,t>>, and *init(e)* and *fin(e)* are initial and final temporal intervals of an event e, respectively.

(26) **Upper limited difference function**

For any measure function **m** from objects and times to degrees on a scale S, and for any d, d′ ∈ S, $\mathbf{m}^{d}_{d'}\!\uparrow$ is a function just like **m** except that

i. it is only defined if $d' \leq d$. When defined,
ii. its range is $\{d'' \in S \mid d' \leq d'' \leq d\}$;
iii. for any x, t in the domain of **m**, if $\mathbf{m}(x)(t) < d$, then $\mathbf{m}^{d}_{d'}(x)(t)\uparrow = 0$;
iv. for any x, t in the domain of **m**, if $\mathbf{m}(x)(t) \geq d'$, then $\mathbf{m}\!\uparrow^{d}_{d'}(x)(t)\uparrow = d'$.

Intuitively, upper limited measure of change functions are like plain measure of change functions except that scales they are associated with are necessarily upper closed, and the maximal value is determined by the endpoint expression. Whereas the verb *heat* denotes a measure of change function $\mathbf{heat}_{\Delta}$ with the range in (27), the measure of change function $\mathbf{heat}^{60C}_{\Delta}$ associated with *heat to 60C* takes its values from the scale in (28):

(27) Range of $\mathbf{heat}_{\Delta}$
(TEMPERATURE: min ——————— [———————————→ max])
hot(x)(init(e))

(28) Range of $\mathbf{heat}^{60C}_{\Delta}$
(TEMPERATURE: min ——————— [——————] ————→ max)
hot(x)(init(e)) 60C

With this adjustment, the relevant part of (8b) would be analyzed as a function from events to degrees in (29), which takes an event *e* and returns a degree from the bracketed part of a scale in (28) that represents a change in the temperature the water undergoes in *e*.

(29) ‖ heat the water to 60C ‖ = $\lambda e.\ \mathbf{heat}^{60C}_{\Delta}(\text{water})(e)$

We know already how to turn the function in (29) to an event predicate. All we need is a positive morpheme in (15). Applying it to (29) yields (30):

(30) ‖ pos_V [heat the water to 60C] ‖ = $\lambda e.\ \mathbf{heat}^{60C}_{\Delta}(\text{water})(e) \geq \text{stnd}(\mathbf{heat}^{60C}_{\Delta})$

At this point, a crucial fact about upper limited degree of change functions comes into play: such functions are based on totally closed scales. These scales are lower closed for the same reason as in the case of plain degree of change functions: they have a minimal value, **m**(x)(init(e)). They are upper closed due to the maximal value identified by the endpoint expression.

Since upper limited degree of change functions take their values from totally closed scales, the Interpretive Economy predicts two standards determined by the minimal and maximal values.

(31) a. If a scale S associated with a measure function g is lower closed, $\text{stnd}(g) = d_{min}(S)$
b. If a scale S associated with a measure function g is upper closed, $\text{stnd}(g) = d_{max}(S)$

It follows from (31) that (30) can be reduced to two event predicates in (32a-b), where the former is obtained by setting the standard to the minimal and the latter — to the maximal degree:

(32) a. $\| pos_V$ [heat the water to 60C] $\| = \lambda e.\ \mathbf{heat}_{\Delta}^{60C}$ (water)(e) > 0 (minimal standard)

b. $\| pos_V$ [heat the water to 60C] $\| = \lambda e.\ \mathbf{heat}_{\Delta}^{60C}$ (water)(e) = d_{max} (maximal standard)

where d_{max} is a degree of change where the temperature of the water reaches 60C.

The event predicate in (32a) holds of events where there is *some* change in the temperature of the water, while (32b) contains events in its extension in which the temperature reaches the maximal value on the scale in (28), that is, 60C. By the same reasoning as before, (32a) is cumulative and not quantized. (32a) is thus responsible for the atelic reading of (8a). (32b), to the contrary, is quantized and not cumulative: with minimal additional assumptions, one can show that if the water has been maximally heated in an event *e*, in has not been heated to the same degree in any of proper part of *e*. This is how the telic reading in (8a.1) emerges.

One good consequence of (32a-b) is that variable telicity of predicates containing endpoint expressions is reduced to the case where the same analysis has been independently motivated. According to (32a-b), in Turkic, predicates like 'heat the water to 60C' show variable telicity for exactly the same reason as non-derived predicates like *dry* and *straighten* based on at least upper closed gradable adjectives *dry* and *straight* in English. The scale of being dry associated with **dry** and $\mathbf{dry}_{\Delta}$ is lexically upper closed. For $\mathbf{dry}_{\Delta}$, as for any other measure of change function, it is also lower closed. Hence, stnd($\mathbf{dry}_{\Delta}$), according to Interpretive Economy, yields two values, maximal and minimal, which give rise to telic and atelic readings, respectively:

(33) a. The shirt dried in a few minutes.
b. The shirt dried on the line for a few minutes (but was then soaked by a passing shower). (Kennedy 2010: 5)

Therefore, it is scalar structure that underlies variable telicity of English verbs like *dry* and Turkic predicates like 'heat to 60C'. As soon as the maximal degree on a relevant scale is specified, the telic reading results whereby this degree is attained at the end of the event. The only difference between *dry* in English, based on $\mathbf{dry}_{\Delta}$, and 'heat to 60C' in Turkic, based on $\mathbf{heat}_{\Delta}^{60C}$, is that in the latter case the upper bound of the scale is specified by the endpoint expression rather than lexically provided. The atelic reading, where an individual undergoes *some* change along a scalar dimension in question, obtains when the standard is specified through the minimal degree, the one the individual has at the beginning of an event.

Additional evidence supporting the same treatment of English predicates like *dry* and Turkish 'heat to 60C' comes from the relative availability of telic and atelic readings. Kennedy and McNally (2008:159), following Kearns (2007), observe that for verbs like *dry,* the telic interpretation is a default choice in the null context:

(34) The shirt dried ($^{??}$but it didn't become dry).

To get the atelic reading, one needs strong contextual support, durative adverbials, etc. Whatever is responsible for this asymmetry,[5] one can use it as a test for determining if the same mechanism derives variable telicity in our Turkic case. It turns out that 'heat to 60C' patterns with dry in this respect, as (35) indicates:

[5] One possibility is that by default the strongest meaning is a preferred option, and the telic interpretation is stronger: the proposition 'the maximal degree of X-ness is attained' entails that 'some degree of X-ness is attained', but not vice versa.

(35) kerim suw-nu altɨ on gradus-xa deri zɨlɨt-xan-dɨ.
K. water-ACC 6 10 degree-DAT to heat-PFCT-3SG
'Kerim heated the water to 60 degrees, (??but stopped when the water was 50 degrees)'.

To sum up, endpoint expressions in Turkic are scale modifiers that establish the maximal degree on a scale from which measure of change functions take their values. Variable telicity follows with no extra cost from the semantics of the positive form and Interpretive Economy. Above, I focused on degree achievements like 'heat'; the extension to manner of motion predicates is straightforward. In the rest of the paper, I discuss implications of the analysis for cross-linguistic variation. Specifically, leaving out the precise elaboration for a separate occasion, I put forward a hypothesis explaining why in English, unlike in Turkic, endpoint expressions only yield the telic interpretation.

3 Cross-linguistic variation

In Section 1, we have seen that telicity of predicates containing degree and endpoint expressions is subject to cross-linguistic variation summarized in (36):

(36)

	Degrees of change	Endpoints of change
English	telic	telic
Turkic	telic	**telic, atelic**

The obvious question to address at this point is where the difference between languages like English and languages like Karachay-Balkar and Chuvash comes from. To approach this question, I take the following line of reasoning.

The generalization about Turkic is that degrees and endpoints of change do not pattern together as to the telicity of event predicates they modify. The above account relies on the hypothesis that the difference manifests distinct ways in which degrees and endpoints are integrated into the event structure. By the same reasoning, a natural suggestion would be that in English, where degrees and endpoints both obligatorily lead to telicity, their contribution to the internal make-up of event structure is the same: both are involved in determining the value of the degree of change argument.

For measure expressions, as we have seen above, the analysis is straightforward: in English, as in Turkic, they provide the value of the degree argument directly:

(37) a. The crack widened 3 m.
b. $\|$ **3m** μ [crack widen] $\|$ = $\lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e) = \mathbf{3m}$

I suggest that endpoint expressions in languages like English accomplish the same task, but indirectly, by submitting a degree from which the measure of change can be calculated. I propose the following derivation of the event predicate denoted by *widen to 10 m* in (38):

(38) The crack widened to 10m.
(39) a. $\|$ [the crack widen] $\|$ = $\lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e)$
b. **Degree subtraction operator**
$\| \nu \| = \lambda g_{<v,d>}\lambda d\lambda e.g(e) = d -' \mathbf{d}$,
where "–′" is a subtraction of positive degrees, and **d** a free variable over degrees representing a contextually salient initial width of an object.
c. $\|$ ν [crack widen] $\|$ = $\lambda d\lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e) = d -' \mathbf{d}$.
d. $\|$ [to 10m ν [crack widen]] $\|$ = $\lambda e.\mathbf{wide}_{\Delta}(\text{crack})(e) = \mathbf{10m} -' \mathbf{d}$

In (39a), we start with the function from events to degrees denoted by the VP *the gap widen,* see (14b). I propose that when combining with an endpoint expression, this function makes us of an operator represented in (39c). This operator, ν, is of the same logical type <<v,d>, <d, <v,t>>> as μ in (16), and, like μ, it specifies the degree of change. Unlike μ, however, it does so by identifying the difference between the final width of the crack, supplied by the endpoint expression, and its contextually salient initial width: the degree of change is obtained by subtracting the latter from the former. (Subtraction of (positive) degrees has its standard definition, see, e.g., Piñón 2008.) Combining the relation between events and degrees in (39c) with the endpoint expression produces the event predicate in (39d). The predicate is quantized, as required: no proper part of an event in which the width increases by *10m –′***d** is an event that falls under the same event description.

With this sketch of the analysis (the full version would require a bit of further technical elaboration), we can take a wider look at cross-linguistic variation. If the above analysis tells a true story about endpoint expressions, and cross-linguistically, such expressions can participate in the derivation in two different way (scale modification plus pos_V vs. ν), the prediction would be as follows:

(40) **Prediction about cross-linguistic variation**
If two distinct mechanisms of integrating endpoint expressions into the event structure are empirically real, one can expect to find a language where both are operative.

I believe that the prediction is born out, an example of such a language being Russian. Russian differs from both English and Turkic in the following way. Degree achievements and manner of motion verbs discussed so far form a natural class as to how degrees and endpoints of change interact with telicity. In English, for both types of expressions telic interpretation is obligatory; in Turkic, endpoints lead to variable telicity. In Russian, manner of motion verbs pattern with their English counterparts, but degree achievements exhibit 'Turkic' behavior. Let us look at the latter type of predicates first.

For Russian degree achievements, endpoint and measure expressions contrast in much the same way as in Karachay-Balkar in (7a) and (8a) and Chuvash in (9a) and (10a). For most speakers, the atelic interpretation is available for the former, but is drastically degraded for the latter, as (41a-b) show:

(41) *Endpoint expression; perfective and atelic.*
Vasja po-na-gre-va-l rastvor do 60 gradusov.
V. DLM-on-heat-IPFV-PST solution.ACC to degrees
'Vasja spent some time heating the solution to 60 degrees.'

(42) *Measure expression: perfective and atelic*
??Vasja po-nagre-va-l rastvor na 60 gradusov.
V. DLM-on-heat-IPFV-PST solution.ACC on degrees
'Vasja spent some time heating the solution by 60 degrees.'

(41) and (42) illustrate so called delimitative verbs, which are perfective but obligatorily atelic (e.g., Dickey 2000, Mehlig 2011 and elsewhere, Kiseleva and Tatevosov 2011). (Their telic counterparts have their obvious interpretation, same as in English and Turkic, and are left out for the reasons of space.) Crucially, the atelic interpretation, which is readily available for the endpoint expression in (41), is inappropriate for the degree expression in (42). This is exactly the

pattern we have seen in Turkic languages throughout this paper: endpoint expressions are compatible with atelicity, measure expressions do not. Manner of motion verbs are different:

(43) *Endpoint expression; perfective and atelic*

*Vasja	po-pribeg-a-l	v	škol-u.
V.	DLM-to-run-IPFV-PST	in	school-ACC

'Vasja spent some time running to the school.'

(44) *Measure expression; perfective and atelic*

*Vasja	po-pro-beg-a-l	10	km.
V.	DLM-through-run-IPFV-PST		km

'Vasja spent some time running 10 km.'

One can see from (43)-(44) that manner of motion part of the system resembles that of English: all atelic predicates are ungrammatical, no matter if they are combined with measure or endpoint expressions.

To sum up, what we see in Russian is: endpoint expressions exhibit different behavior in different lexical contexts. Like in Turkic, they allow for both telic and atelic interpretations when modifying degree achievements. Like in English, they lead to telicity when the predicate describes movement in the physical space. What makes manner of motion predicates different from degree achievements in Russian is a question I am not trying to address. What is of importance for the present discussion is the very fact that endpoint expressions exhibit variation, not only across languages, but also within the same language. If there is exactly one mechanism of integrating endpoints into the event structure, Russian data look confusing: if this mechanism generates the atelic interpretation for degree achievements, it is difficult to see what prevents it from creating atelic manner of motion predicates. If, on the other hand, the grammar makes two distinct ways of handling endpoint expressions available to the semantic computation, (41)-(44) start looking considerably less unexpected.

4 Summary

In this paper, I have argued that measure expressions and endpoint expressions make different contribution to the semantics of the whole event predicate. Measure expressions saturate the degree of change argument position, hence lead to quantization. Endpoint expressions are subject to cross-linguistic variation. In Turkic, they modify a scale from which a measure of change function takes its values. Modified scales possess a maximal value, hence give rise to the telic reading. Since they also have, for independent reasons, a minimal value, the atelic reading obtains. In this way, variable telicity of Turkic verbal predicates based on endpoint expressions is correctly predicted. In English, endpoint expressions do not modify a scale, but rather determine, although indirectly, the degree to which an object changes with respect to a relevant gradable property in the course of an event. For this reason, endpoint expressions yield invariably telic predicates. I believe the analysis I propose captures the whole range of facts with minimal stipulations: apart from a restricted number of assumptions about the semantics of endpoints, the job of accounting for their interpretation is accomplished by the machinery independently motivated in the theory.

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