Diachrony of Aspectual Markers: Exploring Language Change with Game Theory

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Introduction. It is a well-known typological observation that languages without a distinct progressive (PROG) morphology realize the communicative function of the PROG through the imperfective (IMP) aspect (if morphologically instantiated). This primarily motivates to treat the PROG as a subdomain of the IMP (cf. Comrie 1976). In Russian, the imperfective form licences a PROG interpretation, while the same form refers to a habitual/generic (HAB/GEN) situation. In languages which have both the PROG and the IMP aspects, the IMP often does not licence a PROG reading, such as in English. In the case of Dutch and German, an optional PROG is innovated. There is a crosslinguistically robust generalization in the diachrony of such markers: functional elements restricted to PROG reading semantically generalize to licence IMP readings such as the HAB/GEN or the stative. This generalization has been attested according to data from, e.g., Turkish (Göksel & Kerslake 2005: 331): The verb form with *-(I)yor* in

(1) a. saat ikide   çaliş-**iyor-du**-m
         At two o'clock   work-PROG-PST.COP-1.SG
         'At two o'clock I *was working*.'

     b. genekkikle   iki saat   çaliş-**ir-di**-m
         Usually   for two hours   work-IMPF-PST.COP-1.SG
         'I *would* usually *work* for two hours.'

(1a) refers to an ongoing eventuality, while the inflected verb with *-ir* in (1b) refers to a HAB reading. Recently, the PROG *-(I)yor* has begun to licence a wider range of readings, notably in everyday language. (2) shows that *-(I)yor* occurs with a stative verb 'know' and is also interchangeably used with the Aorist form (IMP aspect) with a HAB/GEN reading (ibid.: 331).

(2)   sen   Ömer'i   benden   daha iyi   tan-**iyor-du**-n
      you   Omer   me   better than know-PROG-PST.COP.2.SG
      'You *knew (were knowing)* Ömer better than me.'

These data indicate that the Turkish PROG is expanding to semantically overlap with the domain of the IMP Aorist morphology, thus instantiating the PROG-to-IMP shift. This cycle starts with the language having only one broad IMP form covering all imperfective meanings, cf. (a) below. Then an optional PROG form is innovated, (b); it becomes obligatory for PROG meanings, (c); and at the last stage (d), it generalizes and takes the semantic place of the old broad-IMP form. Note that (a) and (d) are identical except for their formal exponents: the cycle ends where it started (Table 1). The four states (a-d) can be intuitively regarded as distinct strategies for communicating *phenomenal* and *structural* sub-meanings (Goldsmith & Woisetschlaeger 1982) within the IMP domain. In systems with two forms, namely emergent-PROG and categorical-PROG, the choice of form helps the hearer to correctly identify the speakers intended sub-meaning. The zero-PROG and generalized-PROG strategies use a single form while relying on the hearers understanding of contextual cues for successful communication. Importantly, PROG induces a cycle through (a-d), but HAB, though also being more specific than the broad IMP, does not eventually generalize to IMP (Deo 2015). In other words, there is no (d)-type stage for HAB, and therefore no HAB-to-IMP cycle.
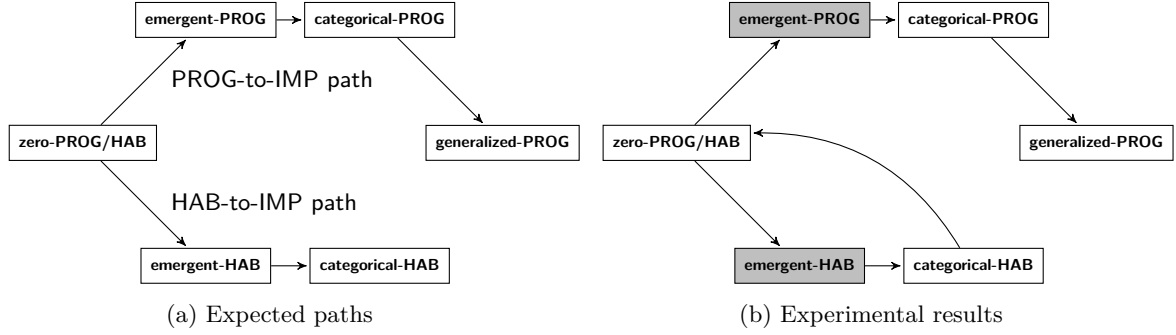
(a) Expected paths

(b) Experimental results

Figure 1: The expected diachronic development includes next to the *PROG-to-IMP path* its alternative deadlock *HAB-to-IMP path* (Fig. 1a). Our studies reveal: with i) reduced context cues by 20%, ii) increasing costs for a two-form system, and iii) childhood input asymmetry, the expected paths can be simulated (Fig. 1b). Note: unstable strategy pairs are displayed in gray.

	label	type	sample languages
(a)	X_{imp}	zero-PROG	Arabic, Russian
(b)	$(Y_{prog})X_{imp}$	emergent-PROG	Dutch, German
(c)	Y_{prog}, X_{imp}	categorical-PROG	English, Swahili
(d)	Y_{imp}	generalized-PROG	Turkish, Tigre

Table 1: The PROG-to-IMP historical cycle with representative languages.

The Imperfective Game. The Imperfective Game is modeled as a signaling game (Lewis 1969), a game-theoretic model that depicts the communication situation between a speaker and a hearer. The communicative act is modeled as a decoding/encoding process: with the goal to communicate a state t, a sender sends a form f, and the hearer construes f by choosing an interpretation state t'. Communication is valued as successful, iff $t = t'$. The model of the Imperfective Game abstracts i) from the concrete situation, but only considers the types of state t_s (structural) and t_p (phenomenal), and ii) from the concrete form, but only considers the types of form f_{pr} (PROG marking) and f_{im} (IMP marking). Furthermore, since contextual cues play an important role, the model includes two contexts C_s (licensing the structural state) and C_p (licensing the phenomenal state). The communicative behavior of players of the game can be modeled as a *strategy*. A speaker strategy defines which form to choose for each combination of context type and state type. Appropriately, a hearer strategy defines which state to construe for each combination of context type and form type. For the IMP Game, there are 16 logically possible speaker and hearer strategies. The expected steps of PROG-to-IMP cycling path and the HAB-to-IMP dead end path are depicted in Figure 1(a). To test hypotheses that are possible candidates for explaining the particular sequence of the PROG-to-IMP cycling path, we embedded the Imperfective Game in a computational model for simulation experiments. Our model is implemented as a population of agents that interact repeatedly and pairwisely by playing the Imperfective Game. Furthermore, agents i) update their communicative behavior by an update rule called Roth-Erev reinforcement learning (Roth & Erev 1995), and ii) are alive for a particular number of simulation steps. Accordingly, agents have an age level, and 'old' agents are posthumously replaced by 'young' agents.

Experiments and Results. With our simulation runs we tested the basic model and a range of additional assumptions. We were able to reconstruct the observed cycle by adding three assumptions to the basic model: (1) withdrawing the context cue from the hearer in 20% of all plays initializes the PROG-to-IMP or HAB-to-IMP path; (2) the cyclic completion of both the PROG-to-IMP and HAB-to-IMP path was forced by a gradually increasing symmetric cost for having two forms; and (3) when agents were mostly presented with phenomenal statements in the childhood, the empirically observed PROG-to-IMP cycle emerged, while the unattested hypothetical HAB-to-IMP cycle was ruled out, vindicating a

conjecture by Deo (2015).

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