

Interpretation of animal tracks vs. pictorial and linguistic narratives

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Overview. We undertake an initial attempt at extending the Super Linguistics research program ([Patel-Grosz et al. 2023](#)), which applies the toolkit and the mindset of a linguist to “non-standard” objects, to animal tracking (hf. *tracking*). We ask the broad question of how interpreting animal tracks compares to interpreting linguistic and especially pictorial discourse. To illustrate some of the insights and challenges of this comparison we look at how co-/disjoint reference of events and individuals is established in tracking.

Tracking and interpretation. Tracking is a process whereby a human tracker interprets diverse signs in the field (footprints, feeding traces, beds, etc.) by constructing connections and assemblages thereof that together narrate the story of the tracking subject (e.g., [Elbroch et al. 2011](#); [Louis 2013](#); [Dorfman et al. 2023](#))—with a variety of end goals (from catching an animal to understanding ecological systems). Here we focus on prints left by body parts (e.g., feet, tails, etc). We posit that experienced trackers form competences that resemble those developed by language users. We set aside determining the full architecture of “tracking grammars” and their modular nature (paralleling phonetic, phonological, and perhaps morphosyntactic levels) and focus on the meaning side of things, with the premise that when trackers interpret animal tracks, they create a narrative structure, asking questions like ‘What kind of events happened here? When? Who were the event participants? How did these events relate to one another, if at all?’, etc. We can thus meaningfully compare this process to interpretation of linguistic discourse (see, e.g., [Hewes 1994](#); [Shaw-Williams 2011](#) for preliminary intuitions) and especially pictorial discourse—a task which has not been undertaken so far, to our knowledge.

Animal tracks vs. pictorial narratives. It is natural to compare interpretation of animal tracks to that of pictorial narratives, with the latter having received much attention from linguists and philosophers (e.g., [Greenberg 2011](#), [Maier & Bimpikou 2019](#), [Abusch 2020](#)).

At first glance, in both cases, we have iconic (i.e., resemblance-based) projection of 3d reality on a flatter substrate. In pictures, these substrates are often 2d (but see e.g., embossing/debossing), and in animal tracks, they are 3d, with depth and interaction with the substrate playing an important role in interpretation (see below). A more fundamental difference is that in pictorial narratives we have representations of reality (including fictional reality) created intentionally for the purposes of being interpreted, whereas animal tracks are not representations, and are not left behind with communicative goals (although droppings, scratch marks, etc. can be used to, e.g., mark territory). Rather, trackers interpret the reality itself (as mediated by their visual processing system) and draw inferences about the events that caused this reality (cf. [Schlenker 2019](#) on source-based interpretations). One consequence is that in pictorial narratives, we have a lot of conventionalized phenomena, even leading to distinct idioms ([Cohn 2020](#)), while convention doesn’t apply to animal tracks.

Another difference is that in animal tracking, we have an unstructured signal. E.g., there are no clearly outlined narrative units, unlike in pictorial (and linguistic) discourse (even in so-called “continuous” pictorial narratives, with no distinct panels, there are distinct narrative units). Instead, such units are imposed by the tracker during interpretation. Relatedly, whereas in pictorial narratives one panel typically depicts a representation of reality at a single point in time, in tracking, we often have overlaying traces of events happening at different points in time—layers of “panels” of sorts—which the tracker must separate.

To illustrate some of the differences between interpretation of tracking vs. linguistic and especially pictorial narratives, we examine the way co-/disjoint reference of events and individuals is established in tracking: When interpreting several prints within a certain area of space, a tracker will often ask if they were left (i) as a result of a single spatiotemporally connected event or not (*event co-/disjoint reference*) and (ii) by the same individual or not (*individual co-/disjoint reference*). This is similar to the task of establishing co-/disjoint

reference in linguistic and pictorial discourse (see, e.g., [Klomberg et al. 2023](#); [Schlöder & Altschuler 2023](#) on the latter). But unlike in language, co-/disjoint reference can't be marked conventionally in animal tracks or (arguably) pictorial narratives, so this task always involves probabilistic reasoning in these two cases. Below we discuss some of the factors that are taken into account during this reasoning in tracking.

1. Size/shape/depth of individual prints. Differences in these parameters can indicate, e.g., smaller vs. bigger or lighter vs. heavier individuals and hence disjoint individual reference; e.g., 27 vs. 5 in Fig. 1. But such differences can also result from the same individual involved in different events, as in 28 vs. 16 (yielded by slower vs. faster walking), or stepping on different substrates, as in 18 vs. 17 (yielded by stepping on the free sand at the top of the ripple vs. on the lower part of the ripple, with less free sand).

2. Print age relative to that of other prints, or to the 'interpretation time' helps establish co-/disjoint reference of the events that caused them. It can be determined based on if/how the prints overlay, their sharpness (assuming the same substrate and climate conditions), etc.

3. Print arrangement patterns (distance between prints, their relative angles, etc.) help establish co-/disjoint event reference based on the physical (im)probability of two prints caused by the same spatiotemporally connected event. E.g., 4 vs. 17 are similar in size, shape, depth, and age, but couldn't have been left as part of the same connected walking event. In contrast, 19 and 16 are different in shape, but ostensibly belong to the same walking event by the same participants. Arrangement patterns can provide evidence of interacting events, e.g. mating (as in 6-9), attack, or chase, and hence establish disjoint reference of individuals.

4. Animal behavior patterns. These become particularly relevant in otherwise ambiguous cases. E.g., if we have two sequences of prints that could have been left by the same animal, e.g., by walking in one direction and then returning shortly thereafter (so the prints ag, the tracker might employ their knowledge of the behaviour patterns of this species, reason about the animal's goals, and whether it would make sense for the animal to return.

Discussion: While factors 1 and 3 can be taken to be broadly similar to what [Klomberg et al. 2023](#) call "continuity constraints" in pictorial narratives, and 4 is like high-level pragmatic reasoning in interpreting both linguistic and pictorial discourse, factor 2 is quite unique both due to the overlaying nature of tracks and more generally, due to the uniqueness of the goals in tracking, namely drawing inferences about the events that caused the signs (instead of about what events the signs are intended to represent, as in language and pictorial narratives).



Fig. 1. Tracks of two stone curlews (*Burhinus oedicnemus*) walking and mating.