

Notes on vagueness & rationality

Michael Franke

April 19 2017

Where this is going

- The main question to be addressed is:

How is vagueness in language compatible with rationality and/or evolutionary selection for efficient communication?

- The answer I will try to give is something like:

If whatever we want to call “language” is not vague, it is likely quite a useless notion.

With “quite useless notion” I do mean “philosophically” or “theoretically useless”, much in the vein of Wittgenstein’s later views on logical analysis of language: yes, we can do most of this, but it shows us little.

- The way to give this answer is by a more careful analysis of rational or evolutionary efficient language use. We look at signaling games and models of rational agency / evolutionary selection. It is easy to identify multiple reasons why this idealized picture breaks by giving up a number of assumptions, none of which is necessarily that of idealized rationality or evolutionary optimization.
- The main reason for vagueness in language argued for here is this:
 - what counts as optimal crisp language use crucially depends on certain statistical properties of the world
 - language must be optimal in different language games (see below)
 1. sim-max games
 2. reference games without displacement
 3. reference games with displacement
 - optimal behavior for all of these language games depends on specifics of the game situation, most importantly the utilities and the priors about what happens in the real world
 - neither rationality, nor evolutionary pressure can eradicate uncertainty about a complex and dynamically changing world

- the main implicit premiss here is that it is not irrational not to be omniscient; it's not irrational to have remaining uncertainty after any finite number of observations; finiteness of life is not to blame on irrationality either
- neither rationality nor evolutionary selection could possibly guarantee an optimal crisp language
- Despite this uncertainty and the vagueness it gives rise to, there seems to be no need to postulate an idealized language as an explanatory ingredient of either agents beliefs (about language), nor about their actual linguistic practices.

Where do we find the meaning of a language?

- There are different places where “a language’s meaning” might reside:
 1. at the **population-level**; or
 2. at the **agent-level**, where we might be interested in either:
 - (a) an agent’s behavior (language use & interpretation across contexts); or
 - (b) her beliefs (about language use, or semantic meaning)
- it may seem natural to assume that population-level meaning supervenes on something at the agent-level (either behavior, beliefs or both) of individual agents;
 - this is putting aside the option that meanings are innate concepts or any such esoteric moves
- We note that there is no generally accepted (formal) criterion for how exactly a language’s meaning arises from anything more downstream (agent-level stuff, ways of interaction, etc.). We have to make do in this vacuum.
 - Some attempts to fill the vacuum: Harms (2004, 2010); Franke (2013)
- Although speculative and provocative, we here suggest that everything of observational relevance (agents linguistic behavior, possibly their beliefs) can be explained well (i) without postulating an idealized non-vague language, and (ii) without abandoning the ideas of idealized individual-level rationality or idealized long-run evolutionary selection.

A closer look at an agent’s beliefs and behavior

- game theoretic models of signaling agents define agent behavior as possibly probabilistic functions:
 - sender behavior $P_S(m \mid t)$ assigns a probability to the choice of message m to each state t

- receiver behavior $P_R(a \mid m)$ assigns a probability to the choice of reaction a after observing message m
- When we fix a context (think: sim-max signaling game), we can define which choices are rational. We see that, indeed, no vagueness shows.
 - MF2JPC: I'll skip this here; you did most of this already and its clear to us anyway
- This is all rather impoverished. You, I, she and he don't just play one game. Utilities differ in different situations. We also don't always play sim-max games, but may play a reference game. Speakers and listeners may have partial knowledge of the situation and of each other. They may also have beliefs about meaning, and their choices would depend on these. Recent probabilistic models of pragmatic use explicitly model agents' (beliefs) about each other's mental lexica (Bergen, Levy, and Goodman, 2012, to appear; Potts et al., 2016).
 - More on dynamic adaptivity to speaker idiolect (Yildirim et al., ... Davidson (1986))
- The picture of language users which we should minimally adopt is this:
 - speaker behavior is a probabilistic function $P_S(m \mid t, B_c^S, B_l^S)$ specifying a message choice probability for a meaning/state t , a belief after a (possibly partial) observation of the context B_c and a belief B_l about the language's meaning
 - listener interpretation behavior is similarly a probabilistic function $P_L(t \mid m, B_c^L, B_l^L)$
 - speaker and listener beliefs about context and meaning need not be the same; in fact, almost always they will be different
 - the beliefs about contextual parameters B_c which may influence choice behavior are bountiful:
 - think: shape and parameters of the utility function in a sim-max game; most importantly: prior distribution of states (more on this below)
 - imprecise perception of the referent set in a reference game
 - ...
 - the beliefs B_l about the (lexical & compositional) meanings of expressions could, for simplicity, be captured as a distribution over all possible Boolean lexica, where a Boolean lexicon l assigns a subset set of states to each message: $\llbracket m \rrbracket_l \subseteq T$
 - even if we do not want to have agents with "fancy" beliefs about meanings, a definition of rational choice would require a belief about opponent behavior; in a large population, this behavioral belief is good enough for our purposes: it will likewise be subject to heavy uncertainty, being obtained from finite (partial) observations about a dynamically changing world

Different language games and natural uncertainty

- Nothing has been said so far how beliefs are acquired, whether these beliefs are rational, how choice are made based on beliefs. There are many options. We cannot look at them all. We will browse a few and note how they all naturally give rise to something like “vagueness” without abandoning rationality.
- We do this by noting that language games are plenty. We do not just ever engage in a single sim-max games (with everlastingly fixed priors, utilities and co-players).
- Let us distinguish at least three relevant kinds of games in which gradable properties could be used for immediate communication:
 1. sim-max games
 - clear how they look like
 - a point which has so far not been stressed (at all? or enough?): the optimal strategy is a function of the prior; what counts as “tall” depends on (beliefs about) the distribution of states/degrees
 - if priors track, say the actual frequency with which someone is, say, 180cm tall that real world frequency is impossible to know precisely
 - as a result even perfectly rational agents would not be certain about the optimal strategy and will (given different life histories) have different strategies
 - being rational, they would also know that they don’t know for certain what the prior is and that there is no commonly known and temporally stable prior to begin with
 2. reference games without displacement
 - in each trial nature selects a variable number of referents (objects) as the *context*; she also selects a designated object for the speaker to refer to; speaker and listener both observe the context, but only the speaker observes the designated object; speaker and listener obtain a positive payoff if they coordinate on the designated referent (Franke, 2012b,a)
 - crucially, these could be considered as an infinite collection of games, all conditioned on the current context
 - optimal behavior for these games could be defined as a function of the actual context; the problem for even a rational agent is to predict the co-player’s behavior, for in almost any new trial there will not be a preceding trial in which the exact same context has been observed (adding perceptual noise and knowledge of perceptual limitations would make this even more pressing)
 - as a result, even rational agents will be highly uncertain (and aware of their uncertainty) as to how language is used in these situations
 - a rational response will take care of this uncertainty by preferring, if possible, expressions whose use conditions are clearer over those that

are less clear: borderline case uses will be avoided (especially when the language is rich) and underdetermination by use creates further uncertainty creates further underdetermination etc.

3. reference games with displacement

- similar to the above; these games have been considered (informally) by Lipman (2009) and Deemter (2009)
- the sender observes a referent and describes it for the listener; but unlike before, the listener will have to pick out the designated referent in a future context (not known by the sender): e.g., picking up a person from the airport, identifying a robber or (from the main paper draft) picking up a book from the next room based on the color
- as the sender does not know the future context in which the designated referent will occur (the other objects co-present in the environment), the sender's optimal choice depends crucially on a conjecture about the likelihood of seeing particular contexts
- again the sender must needs know the statistical properties of a changing world for genuinely optimal crisp language use

References

- Bergen, Leon, Roger Levy, and Noah D. Goodman (2012). "That's what she (could have) said: How alternative utterances affect language use". In: *Proceedings of the 34th Annual Meeting of the Cognitive Science Society*.
- (to appear). "Pragmatic Reasoning through Semantic Inference". to appear in *Semantics & Pragmatics*.
- Davidson, Donald (1986). "A Nice Derangement of Epitaphs". In: *Truth and Interpretation*. Ed. by Ernest LePore. Oxford: Blackwell, pp. 433–446.
- Deemter, Kees van (2009). "Utility and Language Generation: The Case of Vagueness". In: *Journal of Philosophical Logic* 38.6, pp. 607–632.
- Franke, Michael (2012a). "On Scales, Salience & Referential Language Use". In: *Amsterdam Colloquium 2011*. Ed. by Maria Aloni, Floris Roelofsen, and Katrin Schulz. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer, pp. 311–320.
- (2012b). "Scales, Salience and Referential Safety: The Benefit of Communicating the Extreme". In: *The Evolution of Language: Proceedings of 9th International Conference (EvoLang 9)*. Ed. by Thomas C. Scott-Phillips et al. Singapore: World Scientific, pp. 118–124.
- (2013). "An adaptationist criterion for signal meaning". In: *The dynamic, inquisitive, and visionary life of ϕ , $?\phi$, and $\diamond\phi$: A festschrift for Jeroen Groenendijk, Martin Stokhof, and Frank Veltman*. Ed. by Marial Aloni, Michael Franke, and Floris Roelofsen, pp. 96–104.
- Harms, William F. (2004). *Information and Meaning in Evolutionary Processes*. Cambridge University Press.
- (2010). "Determining truth conditions in signaling games". In: *Philosophical Studies* 147, pp. 23–35.

- Lipman, Barton L. (2009). “Why is Language Vague?” Manuscript, Boston University.
- Potts, Christopher et al. (2016). “Embedded implicatures as pragmatic inferences under compositional lexical uncertainty”. In: *Journal of Semantics* 33.4, pp. 755–802.

Snippets

- - uncertainty about threshold: - learning from finite examples - rich language makes decisions about borderline cases obsolete; enhances problem of learning data scarcity - imperfect memory - uncertainty about QUD, utility, interlocutor's beliefs
- => why not just have a prior and integrate and have a fixed threshold
- 1. Priors are non-introspective; sampling based assessment
- 2. Choice is probabilistic -> utilities are noisy
- Why not adopt a fixed threshold? Why is an agent with uncertainty in the lexicon better off? => revision cost? surprisal cost?
- If a single agent's semantic representation is the outcome of rational learning and possibly an internal optimization towards efficient communication.
- Finiteness of life is not irrational.
- Convince by number of examples of natural sources for vagueness.
- Any precise threshold must be a function of priors about properties, QUDs, utilities, and interlocutor beliefs. But these are not stable over time. Vagueness might be optimal to compensate mistakes in a changing environment. Assumption here: revision cost high when too low prob on observable events. (van Deemter example: DECENT behavior)
- If speakers' uncertain beliefs come from natural probabilistic evidence, they will not be sharp step-functions. If we measure success of communication by KL-divergence or similar, the update of a literal listener with a vague threshold would give higher utility. But what about pragmatic listeners?
- Suppose agents play repeated reference games with different natural kinds. Each kind has a mean and variance for each of several open and closed scale features. Learners entertain different hypotheses about lexical meaning (McNally?) They would like to assign a fixed degree to an expression because that is economical. They can do that for closed scale natural kinds unless their mean and variance is such that exemplars are frequently away from the end points. Think wine glasses! They cannot do this for open scales. They must consider a more difficult hypothesis, namely to use the prior after all.
- Good point by van Deemter: reliable metrics may be absent; the goal of communication may be expression of sentiment, and the real value may be assessed in a goal-oriented way (BIG when playing soccer not equal to big when painting).
- Languages supervene on agents' beliefs about lexica. Lexica are uncertain. They are still useful. Lexical uncertainty might even be rational in the light of belief revision in changing environments.

- Languages are optimized for communication and social interaction. Not necessarily for logical consistency.
- Plurality of language games forces uncertainty. Wittgenstein.
- So then logic breaks, so what? The possibility of visual illusions does not prove the visual system ill adapted or suboptimal.