

# Teaching as an Exaptation

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**Abstract:** We appreciate and endorse Kline's ethological taxonomy and its application. However, the definition of teaching she presents is problematic, as it replaces mentalistic intent with intention on the part of natural selection. We discuss problems with the strict adaptationist view and suggest instead that the five forms of teaching presented in the taxonomy may constitute exaptations rather than adaptations.

"Natural selection built the brain; yet, by virtue of structural complexities so engendered, the same brain can perform a plethora of tasks that may later become central to culture, but that are spandrels rather than targets of the original natural selection.... Surely, for something so complex and so replete with latent capacity as the human brain, spandrels must vastly outnumber original reasons, and exaptations of the brain must greatly exceed adaptations by orders of magnitude."  
(Gould, 1991, p. 57).

The target article is an important contribution toward an integrative understanding of teaching and its place in the broader field of social learning. The consilient integration of the human social sciences with the biological study of behavior is a desirable result, and we commend Kline for making headway regarding the study and classification of teaching. That said, we also believe that the adaptationist definition of teaching presented in the target article is problematic. Kline suggests that what separates teaching from other types of social learning is dependent on the evolution of the behavior *for teaching*, defining teaching as "behavior that evolved to facilitate learning in others." This definition was designed to avoid intent on the part of the teacher, prevalent in mentalistic approaches. However, the definition eschews mentalistic intent only to replace it with intention on the part of natural selection.

It is important to exercise caution in proposing adaptationist explanations of behavior (Gould & Lewontin 1979). We are concerned that viewing teaching as an adaptation – i.e., a trait that was explicitly selected for – obscures deeper truths about the social and

psychological nature of our species and others. Many of the traits that enable social species to successfully cooperate and interact might give rise to the behaviors described as teaching in Kline's taxonomy *without being directly selected for*. Indeed, the emergence of social behaviors that involve coordinated differentiation of roles is not easy to explain, particularly when those roles involve responsive learning and may result via other adaptive mechanisms (Smaldino, 2014). We propose that at least some of the teaching behaviors falling under each taxonomic category described by Kline may be better explained as *exaptations*, defined as "features that now enhance fitness, but were not built by natural selection for their current role" (Gould & Vrba, 1982, p. 4). Specifically, many of the adaptations that facilitate sociality across species – e.g. attraction, tolerance, etc. – combined with adaptations for parental and alloparental care may produce teaching without being explicitly selected for. Here we consider each type of teaching in Kline's taxonomy and discuss problems for the adaptationist argument.

**Teaching by social tolerance.** While tolerating observation or intrusion by a youngster may allow him or her to learn, it also allows the adult or teacher to supervise offspring or other wards while simultaneously completing a necessary task. Moreover, high levels of social tolerance often occur when no direct lesson is being taught. For example, parents often allow toddlers to climb on them, and this may increase the mother-child bond or facilitate exploration of bodies and reactions. In these ways, learning may be a byproduct of social tolerance, but social tolerance is unlikely to have evolved specifically for the facilitation of learning.

**Teaching by opportunity provisioning.** Even very young children will work to provide opportunities for others, such as when a toddler opens a cabinet when she sees an adult with his arms full trying to put things inside (Warneken & Tomasello, 2006; Newton et al., 2014). Although opportunity provisioning may be co-opted as a teaching mechanism, we suggest that it emerges from more general prosocial tendencies.

**Teaching by stimulus or local enhancement.** The behaviors involved in stimulating another's interest in something, be it through pointing at a target, physically moving a pupil, or using verbal communication, could have evolved for many reasons, including the immediate identification and communication of danger (Skyrms, 2010). This applies to Kline's example of human mothers using pointing or "motherese" to manipulate a child's attention. For example, Falk (2004) has proposed that motherese emerged in order to encourage juveniles to behave and follow their mother, which suggests that it likely became exapted only later as a teaching tool.

**Teaching by evaluative feedback.** Reinforcement learning is evolutionarily ancient, providing a readymade structure that can be co-opted for social influence. Any sort of manipulation can therefore tap into that rudimentary structure for general learning, including incidental behaviors that benefit the teacher. Consider Kline's example of primate mothers encouraging their offspring to walk by setting them down and then looking/calling for them to join. This could functionally free the mother's hands for other work, while incidentally facilitating and rewarding self-locomotion in the child. In general, behaviors incorporating evaluative feedback can benefit both teachers and

learners in multiple ways, making it unlikely that these behaviors evolved specifically to facilitate learning. Instead, these behaviors likely evolved for other purposes, and capitalize on a general sensitivity to reinforcement and punishment.

**Direct active teaching.** Direct teaching in humans requires joint attention and theory of mind, corresponding to complex adaptations related to communication and coordination. While one of the purposes of communication is the transmission of new knowledge or skills (i.e., teaching), there are others. For example, Tomasello and colleagues (2012) have proposed that communication, both verbal and non-verbal, evolved largely to solve cooperation and coordination problems, and not initially for teaching.

It is our supposition that many of the behavioral and cognitive aspects of teaching, in both humans and other animals, are best characterized as exaptations, calling into question a strictly adaptationist definition of teaching. Although understanding the evolution of teaching behaviors is an important research topic, incorporating a reliance on those behaviors' evolutionary histories into the definition of teaching is counterproductive.

We agree with Kline in rejecting constrained definitions of teaching such as those that rely exclusively on mentalizing. It may not be possible, in the end, to produce a single all-encompassing definition of teaching. Indeed, Kline's taxonomic categories may constitute a piecemeal but exhaustive definition, with each instantiation having qualitatively different evolutionary and emergent origins.

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