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Commentary

Tinbergen's take on the evolution of leadership: A framework for clarifying and integrating contributions

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ABSTRACT

Investigating the evolution of leadership is important. From ultimate questions about the origins of leadership to proximate questions about its current form, an evolutionary lens clarifies what we know. However, to ensure knowledge growth is valid and reliable, scholars need to extend from an accurate assessment of the existing literature. To demonstrate my concern, I comment on Pietraszewski (in press). I question three claims, suggest opportunities for improvement, and utilize a Tinbergen Four Questions framework to organize what we know about the evolution of leadership. Fundamentally, Pietraszewski's publication is valuable, spanning a number of Tinbergen quadrants. The shortcoming is not with core assumptions, rather the work requires a clear and accurate representation of how it fits within existing work. I note that Pietraszewski is not an isolated case and encourage the development of a Tinbergen-style knowledge base (i.e., a wiki) where collaborators can update and systematically organize output.

The evolution of leadership is a fascinating topic attracting broad attention. Streaming in from biologists and neuroscientists to anthropologists and psychologists, compelling research questions are diverse, plentiful, and growing. In short, interest in the evolutionary trajectory and adaptive value of leadership is here to stay. It is therefore extremely important to establish contribution clarity and a systematic framework for integrating diverse perspectives.

To serve as a working example, I would like to comment on Pietraszewski's publication, "The evolution of leadership: Leadership and followership as a solution to the problem of creating and executing successful coordination and cooperation enterprises" (in press). I first want to commend the author's contribution. The concepts of "market dynamics" and "information processing functions" are important conceptualizations of leadership and followership. Future research on the evolution of leadership will indeed benefit from this framing.

That said, there are points in the publication where the author discusses nonexistent gaps in our understanding. I will show that the literature actually addresses these gaps, but the perceived dearth is understandable considering the lack of a framework for organizing existing research. To address this issue, my commentary introduces a framework inspired by ethologist Niko Tinbergen's Four Questions (Tinbergen, 1963). The framework divides evolved traits, such as leadership, into four quadrants based on proximate (how) and ultimate (why) questions as well as thin-sliced and temporal questions. For

example, evolutionary biologists often ask *why* leadership evolved over time while psychologists tend to ask *how* leadership operates in a modern context. A Tinbergen approach connects these questions by placing high-level outcomes (e.g., CEO behavior) in the context of deeper evolutionary processes (e.g., the selection pressures associated with status). The outcome is an integrative foundation for connecting the natural and social sciences. Thus, the value of the framework is its ability to systematically organize the complex network of what we know about leadership.

My critique of Pietraszewski (in press), using this lens, provides a method for accurately mapping the landscape of existing evolutionary leadership research. In addition, my commentary also highlights some of the actual blind spots in our collective knowledge. I do this not as a default contrarian, but as an academic who wants to ensure the value of a contribution, such as Pietraszewski (in press), is not diluted with invalid claims.

Questioning and reinterpreting Pietraszewski (in press)

Three claims of Pietraszewski (in press) I question are:

- (1) Pietraszewski states that, "First, nearly all analyses to date have taken a *phenomena-first* approach" (in press, p. 2) rather than an "adaptive-problem-first" perspective - noting that the author uses

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much of Van Vugt et al.'s work to make this claim (e.g., Van Vugt, 2006; Van Vugt, Hogan, & Kaiser, 2008).

This is an inaccurate stance. Van Vugt's work, my work, and others' work does fundamentally consider the adaptive problem first. For instance, Van Vugt and I frequently start by stating that humans (among other social groups) need to solve coordination problems such as exploiting old certainties versus exploring new possibilities or waging war versus brokering peace (e.g., Spisak, Grabo, Arvey, & van Vugt, 2014; Spisak, Nicholson, & van Vugt, 2011). We then introduce leadership as a solution – i.e., an “adaptive-problem-first” perspective, *not* a “phenomena-first approach.” The foundations Van Vugt laid on this matter are quite clear.

Thus, the author is unnecessarily misinterpreting the literature. A better approach would have been to argue that though the existing work considers adaptive problems first, empirical evidence is lacking for the relative fitness costs and benefits associated with different types of problems and subsequent solutions. This accurately represents the state of the literature while effectively setting the stage for the author's interpretation of market dynamics and information processing. Using this “lack of empirical evidence” approach would have also allowed the author to take a stronger stance on what should be done. For instance, as I discuss below, our ability to leverage “big data” in everything from genetics and birthrates to likes on Facebook introduces new opportunities for investigating fitness-relevant leadership dynamics.

(2) The author writes, “...by assuming that the group already exists, we are assuming away a large part of what leadership is for: for creating groups in the first place” (Pietraszewski, *in press*, p. 3).

Here the author suggests that existing research does not consider group formation. This is also inaccurate. Yes, it is very difficult to get at the underlying evolutionary drivers of sociality, but Van Vugt and many others have definitely considered *how* and *why* leadership facilitates group formation (e.g., Hooper, Kaplan, & Boone, 2010; Johnstone & Manica, 2011; King, Johnson, & van Vugt, 2009; Tooby, Cosmides, & Price, 2006).

As with my first concern, the author did not need to make such a claim. The formation of cooperative groups is a fascinating puzzle occupying the minds of scholars for decades (e.g., Axelrod & Hamilton, 1981; Dunbar, 1993; Gintis, Bowles, Boyd, & Fehr, 2003; Hamilton, 1964; Hammerstein, 2003; Henrich, 2017; Rand & Nowak, 2013; Richerson, Boyd, & Henrich, 2003; Trivers, 1971). Either indirectly or directly, much of this large body of work touches on leadership's ability to aid in group formation and maintenance. For example, Gintis et al. (2003) discuss how a relatively small number of “strong reciprocators” can enforce cooperation in groups. Further, Richerson et al. (2003) directly look at how the structure of leadership hierarchies can help or hinder cooperation. The author could have thus demonstrated that leadership is inherently woven into research on group formation. This alternative “interwoven” approach highlights the boundary-spanning value of studying leadership from an evolutionary perspective.

(3) The author argues that, “The identification of these information-processing functions allows us to re-define the evolved psychology of leadership and followership as a set of information-processing roles, rather than as kinds of people” (Pietraszewski, *in press*, p. 5).

Here, again, the author is overstating the lack of current thinking. A number of scholars (e.g., the majority cited above) have clearly discussed leadership as an evolved process rather than kinds of people. Indeed, “scholars often frame leadership more in person than in process terms” (Spisak, O'Brien, Nicholson, & van Vugt, 2015, p. 292), and this shortcoming is one of the core reasons why an evolutionary perspective is a valuable alternative. The focus on evolution ultimately requires one to view leadership as a process *not* a person. Yes, there are aspects of

leaders (as people) in evolutionary models, but they fit within the overarching leadership process – i.e., the interaction between leaders, followers, and the pressure to solve situational challenges such as in-group free-riding and out-group conflict (Hooper et al., 2010; Sharpanskykh & Spisak, 2011).

An alternative route would have been to first restate the existing problems others have identified in the literature and then introduce his process perspective. For instance, existing research demonstrates that thinking of leadership as a person can lead to attribution errors such as the romance of leadership (e.g., Meindl, Ehrlich, & Dukerich, 1985; Shamir, 1991). These errors represent a breakdown of “information-processing functions” where individuals misinterpret inputs during the processing phase (e.g., undervaluing situational factors) and subsequently generate maladaptive outputs (e.g., false positives and false negatives when selecting a leader). Integrating existing research this way promotes connectivity across disciplines and clarifies what we know and do not know about the evolution of leadership.

Extending Pietraszewski (*in press*)

Overall, the author's valuable contribution is missing the fact that many scholars have already explored the adaptive value, mechanisms, ontogeny, and phylogeny of leadership (i.e., Tinbergen's Four Questions; Tinbergen, 1963). Indeed, if one focuses on a subset of publications, then it will appear as if there are larger gaps than what reality dictates. Quite simply, the true value of the author's paper is hindered by not accurately representing existing research. This sort of oversight, however, is not unique to the current publication. Rather, the shortcoming of Pietraszewski (*in press*) is an example of the broader need for a framework to effectively capture our understanding of leadership. If one places existing research into a Tinbergen-style framework, then it becomes clear that much progress has been made since Van Vugt's seminal papers in 2006 and 2008.

Accordingly, to extend on Pietraszewski (*in press*), I built a Tinbergen's Four Questions framework of leadership to demonstrate how existing research does address the proposed gaps identified by the author.¹ The four questions are based on a 2 × 2 matrix consisting of a dynamic versus a static view of a characteristic such as leadership (i.e., a historical sequence versus a current snapshot) and a proximate versus an ultimate view of that feature (i.e., *how* questions versus *why* questions). This structure subsequently yields four quadrants in which to place knowledge about leadership (see Table 1).

In the ontogeny quadrant, scholars ask dynamic developmental questions. For example, “*how* do dominant-style leaders develop over time?” and “what is its genetic basis?” In the phylogeny quadrant, scholars ask dynamic historical questions. For example, “*why* does dominant-style leadership manifest the way it does in human groups?” and “what is the evolutionary history of dominant leaders?” In the mechanism quadrant, scholars ask static causation questions. For example, “*how* do dominant-style leaders operate in groups?” Finally, in the adaptive value quadrant, scholars ask static functional questions. For example, “*why* does dominant-style leadership solve reproductive problems in the current environment?” Table 1 provides a description of leadership across the Tinbergen questions and an extremely abridged list of citations to substantiate each quadrant.

The deliverable of this framework is clarity about the evolution of leadership and how the author's commendable work fits within this growing field of study. For example, the ontogeny quadrant highlights an opportunity for deeper connections with research in developmental psychology. There is a large amount of work on relevant topics such as the ontogeny of status and the effects of environmental stress on social

¹ I used a basic interpretation of Tinbergen's framework to serve as an introduction. For a nuanced and detailed discussion see Bateson and Laland (2013a, 2013b) and Nesse (2013).

Table 1
Tinbergen's four questions for leadership.

	Developmental	Single form
	A sequence that results in leadership	Leadership at one point in time
Proximate	Ontogeny (Development)	Mechanism (Causation)
“How” questions about leadership	Individuals in groups develop and socially learn (a) concepts related to leadership (e.g., status) and (b) how to adjust leadership structures to solve (meta)coordination problems. -Antonakis and Dalgas (2009) -Arvey, Zhang, Avolio, and Krueger (2007) -Safra et al. (2017) -Zacher, Clark, Anderson, and Ayoko (2015)	Leadership is an emergent process based on individual traits and perceptions of leader characteristics, follower characteristics, and situational demands of the (meta)coordination problem. -Pettit, Ákos, Vicsek, and Biro (2015) -Sharpanskykh and Spisak (2011) -Van Vugt and Spisak (2008)
Ultimate	Phylogeny (Evolution)	Adaptive value (Function)
“Why” questions about leadership	Leadership evolved (across species) to address various (meta) coordination problems. -Glowacki and von Rueden (2015) -Johnstone and Manica (2011) -Powers and Lehmann (2014)	Individuals in groups with effective leadership are better equipped to solve (meta)coordination problems. -Cartwright, Gillet, and Van Vugt (2013) -Gillet, Cartwright, and Van Vugt (2011) -Smith et al. (2016) -von Rueden et al. (2014)

problem solving (e.g., Coie & Kupersmidt, 1983; Flinn, 2006; Geary, 2006; Safra et al., 2017; Van Vugt & Smith, 2019). It may be that a moderate amount of stress in one's environment promotes the development of problem-solving skills and prosociality, thus increasing an individual's leadership capabilities and status.

This Tinbergen approach to exploring the literature also reveals the need for more empirical work on the adaptive value of leadership. A quick search identifies a number of conceptual publications investigating the fitness benefits of leadership, but data actually demonstrating leadership's fitness-enhancing quality is sparse. Though there is some empirical evidence suggesting that leadership increases fitness returns for both leaders (e.g., Von Rueden, Gurven, & Kaplan, 2011) and followers (e.g., Von Rueden, Gurven, Kaplan, & Stieglitz, 2014), much more work is required.

Thus, rather than identifying gaps pertaining to leadership as an information processing phenomenon for solving (meta)coordination problems, scholars need to provide further evidence for the reproductive advantages associated with leadership. I suspect our ability to leverage “big data” in leadership research (see Banks, Dionne, Sayama, & Schmid Mast, 2019) will provide compelling insights about adaptive value. For instance, Von Rueden et al., 2011 investigated “the entire adult male population” of two Tsimane villages ($n = 88$ men aged 18+ years) to explore the adaptive value of status. Now, with the growing availability of big data, computing power, and artificial intelligence, scholars can significantly increase the scale of their research. For example, computational advancements in population genetics will improve our ability to map the spread of leadership-relevant traits across vast populations and isolate those traits having adaptive value in the current environment (e.g., Li, Iliès, & Wang, 2017; Sugden et al., 2018).

Pietraszewski (in press) fits into this exciting future as a quadrant spanner. Integration of perspectives is key for true discovery, and the author's work is an important step in that direction. For instance, connecting information processing units with market dynamics incorporates the mechanism quadrant with the adaptive value quadrant. This is a crucial connection considering the many forms leadership can take in a fitness market (e.g., calibrated for change versus stability or war versus peace; see Smith et al., 2016). As with any market, making the right (or wrong) investments can significantly impact payoffs (e.g., investing in the exploitation of fossil fuels when exploratory change is

required). It is therefore interesting and relevant to quantify the adaptive value of mechanistic alternatives.

Accordingly, the next step is increasing the empirical output of quadrant-spanning research. The literature will benefit from data on how individuals perceive coordination problems and mechanistic alternatives in light of adaptive values. Scholars can also see how ontogenetic factors influence perceptions and decisions. Individuals who experienced extreme levels of stress throughout their childhood may make very different leadership decision than those who experienced low levels of stress (e.g., Safra et al., 2017). Such developmental concerns add value to both how we process information in the mechanistic quadrant and experience market dynamics in the adaptive value quadrant.

Finally, given the rapid growth of research on the evolution of leadership, I encourage the development of a formalized framework to integrate contributions. Perhaps a Tinbergen-style knowledge base (i.e., a wiki) is necessary for the continued accumulation and systematic integration of research. Such an initiative will help identify blind spots, emphasize areas in need of empirical attention, and encourage better communication across boundaries.

Conclusion

Pietraszewski (in press) is a valuable addition to the study of evolution and leadership. There are many interesting aspects of this ambitious publication. However, I also noted three particular claims in need of questioning and reinterpretation. Specifically, the author claimed that the existing literature incorrectly (a) takes a phenomenon-first approach (rather than an adaptive-problem-first perspective), (b) does not consider how leadership initiates group formation in the first place, and (c) views leadership as a person rather than a process. Addressing these points subsequently crystalized two important observations: (a) There is a wealth of research that either directly or indirectly connects to the study of leadership as an evolved, problem-first, group formation process and (b) the field has matured to the point where a framework is necessary to keep track of what we know and do not know. Accordingly, I stood on the shoulders of a giant (i.e., Tinbergen) and generated a preliminary map of our understanding from this perspective. I thank Pietraszewski for the motivation and hope my commentary demonstrates the pure value of his offering.

Declaration of competing interest

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