



Answering big questions with small data: the use of field experiments in primate cognition

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Understanding how animals navigate the information landscape is challenging in the wild. Field experiments are a powerful approach to understanding information use and, consequently, cognition in natural settings. Here, we review three types of experiments used to study primate cognition in the wild: 1) presentation experiments that manipulate the availability of information, 2) presentation experiments that manipulate the coherence of information, and 3) interactive experiments that allow subjects to generate new information. Together these approaches have uncovered a rich but varied cognitive world in primates. Going forward, we see these successes continuing to grow as cognitive experiments can be combined with biologging and large behavioral data sets, automated to increase sample sizes, and combined with physiological measures.

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Introduction

The internal machinery of cognition is difficult to observe directly, favoring an indirect approach to studies of cognition by assessing how animals use information. Cognition is tightly linked to information [1] and information is readily observed and manipulated allowing researchers to ask: What information do animals attend to? How do they acquire information? How do they manipulate and share information? These questions are

easiest to explore in captive settings where the availability and distribution of information (the ‘information landscape’ [2]) can be tightly controlled. However, as is clear from the theme of this special issue, we are often interested in connecting cognition to real fitness outcomes that are most apparent in the wild. Studying cognition in the wild allows for a better understanding of what information animals attend to, how they use that information to make informed decisions, and the adaptive value of those choices.

Wild primates use a range of information sources in a variety of contexts to increase the efficiency of their behavior. For example, navigation decisions may be based on relatively simple information like the position of a specific landmark [3] or more subtle information about the expected food availability of ephemeral food sources [4]. Similarly, it is probably beneficial to avoid an animal that is actively providing information in the form of an aggressive signal but social decisions can be based on much more complicated sources of information. For example, the effective choice of alliance partners might rely on the nested kin-dominance relationships of others [5]. In addition, reproductive choices can benefit from attending to information whether in the form of quality (or fertility) signals, previous behaviors, or potential risks associated with certain individuals (e.g. potentially infanticidal males). Yet, it is precisely the variety of potential information sources in wild environments that creates a key challenge for researchers: it can be quite difficult to know which of the many potential sources of information animals are using. Critically, to understand an animal’s information gathering strategy, we need to know both what information they use, what potential information they ignore, and how they generate new information to solve problems. That is, we need to have a full understanding of the information landscape, which is rarely straightforward.

Field studies typically rely on observation and, more recently, biologging of behavior to make inferences about information use. However, it can be difficult to make strong causal inferences from observational data. Correlations are useful for detecting potential causation, but without systematically adding or withholding information, it is difficult to know exactly what information animals are using. Even reliable correlations might

Table 1**Properties of three different types of experiments reviewed here.**

	Experiment type Presentation 1: Presence	Presentation 2: Coherence	Interactive
Stimulus type	Auditory, visual, olfactory	Auditory, visual, olfactory	Physical
Information source	Stimulus	Stimulus	Stimulus and subject
Information type	Presence/absence	Coherence	Generated via interaction
Type of cognition	Information use	Relational, higher order	Innovation, information transmission, decision-making

be spurious. For example, the presence of a conspecific's alarm call might be reliably correlated with predator avoidance behavior suggesting that alarm calls might be a source of information. Yet both alarm calls and avoidance behavior are also correlated with the presence of a predator so it is difficult to know if the source of information is the predator or the alarm call. Experiments allow the researcher to present only one potential information source at a time (e.g. the conspecific alarm call). Field experiments also have efficiencies relative to the observational approach; robust conclusions can be based on small but controlled samples and experiments can be less invasive and cheaper than darting and tagging animals for biologging (although remotely collected data are becoming more precise).

Here, we review the use of cognitive field experiments in primatology using an information perspective. Information includes any feature of the world (e.g. the color of a fruit or alarm calls from a conspecific) that might reduce an animals' uncertainty about the world. Much of the potential information available (the information landscape) will be inaccessible to (or ignored by) animals. However, understanding how animals forage for information requires understanding both the information they do and do not use. Experiments are particularly useful for this because they allow researchers to directly manipulate the information landscape. We focus on three ways that experiments change the information landscape (Table 1); presenting new information, altering the relationship between potential information sources, and providing an opportunity to interactively generate novel information.

Our goal is not to provide an exhaustive catalog of experiments but rather to illustrate the varied types and uses of experiments. For reviews of methods and technical aspects of field experiments (see Ref. [6]). We distinguish two broad types of field experiments (Table 1). First, 'presentation experiments' involve adding a specific source of information, most often with playback experiments of vocalizations. Presentation experiments can be further divided into experiments that ask, 'what information do animals take from X' and those that ask 'do animals attend to information about the relationship between X and Y'. The former can be achieved by manipulating the presence or absence of X

and is useful for understanding information-gathering strategies, while the latter involves manipulating the coherence between X and Y and is useful for studying more sophisticated relational cognition. The second broad type of experiment is 'interaction experiments' in which the subject can manipulate the environment, usually interacting with an apparatus or stimulus (e.g. puzzle boxes), therefore, both obtaining and generating new information (useful for understanding problem solving and social learning abilities). Pinpointing how animals use cognition in the wild is a key step in understanding not only the fitness consequences of cognition, but also variation in cognition across species that can reveal potential evolutionary changes in cognition related to selective pressures such as social complexity. In addition to reviewing these three experimental approaches, we point to areas for future advances with the goal of stimulating the continued development of cognitive experiments in the wild.

Type I. Presentation experiments: manipulate the presence of information

One way that information is acquired is through communication [7]. Primates use a wide array of vocal, visual, and olfactory signals to convey information about internal state, environmental factors, and motivation [8]. There is some debate about how information is transferred in communication with some arguing that the information is entirely generated by the recipient and is detected by their responses [9]. However, we prefer to see information as a general property of the external world (including, but not limited to, communicative signals) that may or may not be attended to by a recipient. This view both generalizes to non-communicative sources of information and allows us to study cases where animals fail to acquire information, a key step for understanding information foraging strategies. Given the importance of information for communication, it is perhaps unsurprising that many presentation experiments are designed to better understand the information content of, and responses to, these signals. Most often this involves the use of playback experiments, where recorded vocalizations are played back to a study subject to systematically examine their response to the various forms of information that might be available (e.g. identity, sex, location, condition, hormone status, and context) from the call [10,11]. By

comparing these responses to control stimuli (or contrasting vocalizations), ideally in a paired design to limit individual variation in responsiveness, playback studies can assess what, if any, information the subjects extract from the vocalization.

Perhaps the most widely known presentation experiments were playback experiments aimed at understanding what information vervet monkeys gleaned from hearing conspecific alarm calls (*Cercopithecus aethiops*; [12]). In this study, acoustically distinct alarm calls were played to monkeys in the absence of predators, a controlled design that tested whether the calls themselves conveyed information about predator type. As predicted, the monkeys responded differently to the different calls, looking down upon hearing a snake alarm and running into the trees when a leopard alarm was played, highlighting that these calls conveyed information about a specific predator type that individuals attended to when deciding on the best escape route. Recent reanalysis [13] found a more complicated picture, but this pioneering study demonstrated how presentation experiments can narrow down the information acquired from a call. This approach has since been used in a variety of other species to understand the information received from alarm calls (e.g. [14,15]), the integration of context and alert call [16], how subjects differentiate acoustically related calls [17,18], and to explore the information content of potentially deceptive alarm calls [19,20]. These experiments show the importance of context in responding to vocalizations, possibly suggesting a relational understanding between two information sources (call and context). Such relational cognition is explored more directly in the next section on coherence. In addition to playback experiments, studies of predator responses often involve presentations of predator models or other visual stimuli. A recent study compared responses of saki monkeys (*Pithecia rylandsi*) to visual and acoustic predator presentations and found stronger responses to the visual presentations [•21]. This difference may represent a cognitive bias towards visual information but it may also be that visual presentations provide more information (e.g. precise location and activity of the predator). How and why animals respond to different information sources will benefit from further experimentation.

Presentation experiments can also decode the information content and function of vocalizations used in social interactions. After fights between female baboons (*Papio cynocephalus ursinus*), a playback experiment tested whether grunts function to reconcile opponents by playing screams from the dominant female, depending on whether the dominant female had grunted after the fight [22]. Subjects responded more strongly to screams from the same individual when there was no grunt after the fight, supporting the hypothesis that grunts help alleviate anxiety about the dominant individual after a

fight. In chimpanzees (*Pan troglodytes*), playbacks were used to simulate the arrival of individuals with differing relationships to the subject who was feeding. The subjects preferentially responded with food calls to playback stimuli from close associates, indicating a flexible and directed use of food calling [23]. This experiment not only helps us understand the reason for producing the food calls (i.e. to alert close associates to food rather than to defend food from competitors) but also how chimpanzees forage cooperatively by sharing information about food sources.

Lastly, presentation experiments are particularly useful in highlighting the information primates attend to when making reproductive choices. For example, playback experiments in wild geladas (*Theropithecus gelada*) have investigated the function of various vocalizations that appear to be sexually selected. Here, interest lies in how variation in the *same* vocalizations can convey important information about a male's quality as a potential mate or rival. In one study, female geladas were presented with call sequences of different males with varying levels of unique, derived elements [24]. Females spent more time in proximity to the speaker when calls contained more derived elements, compared to simpler calls, suggesting that females were particularly attracted to more complex call sequences. In another study, male geladas were presented with loud 'display calls' of varying acoustic quality previously shown to be linked to male condition [25,26]. Display calls are produced by male geladas with reproductive access to females (i.e. leaders) in the presence of threatening all-male groups (i.e. bachelors). Interestingly, both bachelor and leader males attended to acoustic differences in display calls, with bachelors preferentially approaching the speaker when 'weak' calls were played and leaders preferentially attending to strong calls. Similarly, playbacks in baboons have found that males respond differently to display calls based on rank [27], and on the duration of the hoo component of the call [28], paying closer attention to features associated with high-quality and high-ranking males. These studies suggest that features of gelada and baboon display calls contain information about male quality, and that males attend to these acoustic features when making decisions about a would-be rival.

Type II. Presentation experiments: manipulate the coherence of information

Beyond assessing how the information in a call itself is used, playbacks are also used to assess what a primate subject knows about the world around them [6,29]. Specifically, the violation-of-expectation paradigm can explore what information, particularly what social information, primates are tracking. In these experiments, subjects are presented with vocalizations simulating a scenario consistent with the animal's experience and

hypothesized knowledge in a control trial and vocalizations simulating events inconsistent with their hypothesized knowledge in an experimental trial (e.g. [5]). These experiments take advantage of a bias first used in studies of human infant perception and cognition — individuals tend to look longer toward more interesting or surprising stimuli [30]. Essentially, these studies manipulate the coherence of the information presented to a subject. A stronger response to incoherent information suggests that an individual holds an expectation about the world, and that expectation was violated. Therefore, these experiments are useful for exploring relational cognition as the response depends on the relationship between two separate information sources. Relational cognition may have particular relevance for social theories of cognitive evolution because complex societies generate extensive relational information [31].

How primates use and communicate social information has direct relevance for theories of cognitive and language evolution [32]. Therefore, we often ask, what aspects of conspecifics' identities, relationships, movements, and knowledge do nonhuman primates track? To address these questions, the coherence of social information can be manipulated in presentation experiments. This is possible due to evidence that vocalizations of social animals commonly vary by caller and therefore carry information about caller identity [33]. For example, manipulating the social coherence of information provided by vocalizations has revealed that chacma baboons maintain detailed knowledge of social relationships in their groups [31]. Female baboons looked longer in the direction of the playback speaker when vocal sequences simulating aggressive interactions reversing dominance ranks between families, compared to within families, were played, suggesting they maintain hierarchical knowledge of group members' kinship and dominance ranks [5]. Such knowledge can help individuals successfully recruit allies, predict others' behavior, and respond adaptively [33]. Baboons also track shorter term social relationships, such as sexual consortships. When subordinate male baboons were played female copulation calls from one location and male grunts from another location in quick succession, they responded more strongly when the played back calls were from a female and her current consort male, compared with when they were from a female and a different nonconsort male [34]. This experiment suggests subordinate male baboons attend to the identities, and relative locations, of fertile females and their current consorts, which could help them take advantage of mating opportunities. Furthermore, chimpanzees respond differently to the presentation of a snake model depending on whether or not they had previously heard the playback of an alert hoo [35]. This suggests chimpanzees attend to the coherence between a social partner's knowledge state and the state of the outside world,

in this case, the presence of a predator. Though these results should be interpreted conservatively regarding chimpanzee theory of mind, the clever experimental design demonstrates the utility of presenting multiple types of information to assess how animals combine that information to guide behavior in the wild.

Presentation experiments can also manipulate the spatial coherence of information provided by vocalizations in order to test primates' recognition of individuals, particularly those in neighboring groups, and their ranging patterns. When black howler monkeys (*Alouatta pigra*) were played a neighboring individual's loud calls from the direction of a different neighboring group's home range, for example, they looked longer and approached the speaker faster than when played a neighbor's call from the correct direction [36]. This response pattern suggests howlers not only recognize neighbors' vocalizations but also organize that identity information along with specific knowledge of neighboring groups' territories. An experiment manipulating both spatial coherence and social coherence revealed that gelada males lack vocal recognition of other males outside of their core units [37]. Dominant gelada males responded more strongly when another male's grunts were played from the direction of a bachelor group than when they were played from the direction of his own social group. This effect held regardless of whether the vocalizations were those of a stranger male, which could pose a threat to the male's dominance, or those of a male in another unit within their larger band, which posed no threat, suggesting geladas use spatial information rather than social knowledge to assess risk. Guinea baboons (*Papio papio*), which have a similar hierarchical social structure, also did not differentiate between individuals within their higher-level groups and strangers [38]. Differences in social knowledge between these two species and chacma baboons reveal that living in a multilevel primate society does not necessarily require greater cognitive complexity, as it does not require tracking a greater breadth of social information or differentiating a greater number of relationships [39].

Another promising application of manipulating information coherence explores primates' expectations of communication structure. Captive western lowland gorillas (*Gorilla gorilla gorilla*) look longer toward playbacks of vocal exchanges in which calls overlapped with one another compared to vocal exchanges that included time between calls, suggesting they hold expectations for the structure of vocal exchanges [40]. Wild Campbell's monkeys (*Cercopithecus campbelli*) also respond differently to vocalizations 'suffixed' and 'unsuffixed' alarm vocalizations, providing support for the idea that these vocal forms carry different meanings [41]. Such manipulations of pragmatic or semantic coherence can help us explore the complexity of nonhuman primate communication systems.

Type III. Interactive experiments: opportunities to generate information

In the first two sections, we have focused on the advantages of using presentation experiments that mainly tell us what information primates attend to. Interactive experimental paradigms, such as bar-pulls (e.g. [42]) and artificial fruit boxes (e.g. [43]), provide a flexible framework for tackling a variety of cognitive questions regarding how animals gain and share information to solve ecological and social problems. We define *interactive experiments* as any paradigm where an animal interacts with an experimental stimulus to both obtain and generate information from that interaction. These types of interactive experiments have a solid tradition in captive primate studies but are rarely incorporated into the field with wild primates, perhaps due to the difficulty of conducting controlled experimental paradigms in unpredictable environments [44–46]. A few groundbreaking studies aimed at understanding innovation, social learning, and cooperative choices have, however, begun to overcome these logistical challenges.

Innovation and social learning in particular are exceedingly difficult to document in wild animals. There are certainly notable examples of the onset and diffusion of material traditions that strongly suggest a propensity for social learning in wild primates, for example, tool use in chimpanzees [47] and capuchin monkeys (*Cebus sp.*) (e.g. [48]). However, field studies based solely on observations often lack the precision to capture the onset of novel behaviors (i.e. innovation) [49], and the experimental rigor to confirm that the transmission of that behavior is related to learning from others [50]. Foraging boxes and ‘artificial fruit’ box paradigms, that is, baited puzzle boxes that have multiple possible solutions, provide researchers with the experimental control to understand how primates acquire information (e.g. solving a novel puzzle box) and who they acquire information from [43]. In one pioneering study, researchers presented a group of wild baboons (*Papio anubis*) with three different foraging tasks commonly used with captive baboons [51]. Wild baboons could only solve the first task successfully, pulling a string to obtain a reward, but were unsuccessful in the two tasks that required using a stick to extract food suggesting that experience with tool manipulation is essential for baboons to successfully solve tool-use task. Similar methods have been used to study innovation and behavioral flexibility in wild ring-tailed lemurs (*Eulemur rufifrons*) [52] and more recently Barbary macaques (*Macaca sylvanus*) [•53].

A number of studies have found that wild vervets learn from others when tackling novel foraging problems but who they choose to learn from may differ depending on the social context [54–57]. In the initial paradigm, a dominant individual was ‘trained’ to open the box using one of two color-coded doors by locking one solution

ensuring that only one opening was available to the model. Once one monkey mastered that technique, multiple boxes with both methods were made available to the group. When given the opportunity to interact with the box, group members were more likely to copy the solution of the initial model, but only when the model was a female [54]. In another study, they found that social transmission extends to arbitrary food preferences. Four groups of vervets were seeded with an initial preference for either blue or pink dyed corn by making one variant distasteful [58]. Naive individuals (with no experience with distasteful corn) quickly conformed to the preference of their social group and changed their preference to the alternate color upon joining a new group feeding on a different color. Further studies with the puzzle box combined social network analyses with an open-diffusion interactive paradigm (all individuals have equal opportunity to interact with no prior training) to get at the dynamic pathways of information transmission. Dominant individuals were the first to solve the boxes and while they were not observed more often by conspecifics, network analysis showed that higher-ranking individuals were more influential demonstrators than lower ranking ones [•57]. These studies reveal that vervet monkeys selectively attend to social information when faced with a novel problem, highlighting the importance of social context in studies of social learning.

Another area that benefits from the integration of interactive paradigms in the wild are studies of cooperation. Like with social learning, choosing cooperative partners requires obtaining and maintaining detailed information about other’s motivations and actions. Indeed, being choosy about a cooperative partner improves the chances of successful cooperation and decreases the likelihood of exploitation [59]. While studies with socially housed primates have highlighted the importance of free-partner choice [60,61], it is in the wild where partner choice is even more flexible, where we can begin to unpack the information primates use to make cooperative choices. Observations have documented the importance of relationship strength and social tolerance in primate cooperation but interactive experiments in the wild allow researchers to build on this by providing a controlled context in which cooperative choices can be measured and compared to understand the underlying factors that promote or impede cooperation in a social context. One such interactive experiment is a modified bar-pull paradigm, which requires two individuals to coordinate to pull in a tray of food. This was recently done in a study with wild Barbary macaques (*Macaca sylvanus*) which modified the bar-pull to be more field friendly. In the training conditions, monkeys learned to pull a rope connected to a food tray inside opaque boxes. In the test condition, the two trays were attached to each other and utilizing a ‘loose string paradigm’ [62], which required individuals to

Table 2

Table of the most common challenges to integrating experimental paradigms in the wild with possible methodological solutions, and examples of studies that have overcome these challenges or introduced novel approaches that may be of use in developing field-friendly interactive paradigms.

Challenges	Possible approaches	Examples
Limited participation	Test when food availability is low (e.g. dry season), use portable apparatuses, habituate to permanent testing stations	Feeding platform to examine foraging cognition in wild capuchins [70] Food access puzzles set up near sleeping cliffs of wild baboons [51]
Monopolized by a few participants	Multiple apparatuses, remote triggering, automation of the interaction (e.g. triggering via facial recognition).	Multiple puzzle boxes in vervet monkeys to assess social learning [55]; RFID readers combined with computer testing in socially housed macaques [71]
Limited sample sizes/ limited number of trials	Automation of collection (e.g. remote triggering of apparatuses), integration of computer testing, large number of flexible sessions	Use of AI face recognition in wild primates [72]; automated audiovisual tool use techniques in wild chimpanzees [73]; computerized testing system in free-ranging baboons [71]
Lacks broader behavioral context	Pair with behavior observations, biologging, social network analyses.	Partner choice in a cooperative bar pull paradigm in wild Barbary macaques [63]; Social transmission of learning techniques in wild vervet monkeys [57] Innovation in wild Barbary macaques [53]
Missing internal states	Pair with physiological sampling and or manipulation	Interaction between a male baboon's testosterone levels and response to a playback simulating a male approach [67]; Manipulating oxytocin to assess changes in social behaviors and cooperation in socially-housed capuchins [68]

simultaneously manipulate the rope to move the apparatus, Molesti and Majolo demonstrated that wild Barbary macaques successfully cooperate to pull in the food reward [63]. When deciding to cooperate, social tolerance and relationship strength were critical factors, highlighting the importance of social information when making cooperative choices in this species. More studies need to incorporate these paradigms in wild primates to understand overarching patterns and species-specific differences in how primates make cooperative choices. Continuing combining data and efforts derived from field and lab experiments promises to provide a much more comprehensive understanding of these social cognitive strategies.

Conclusions and future directions

It is certainly an exciting time for cognitive research on wild primates. With the broader implementation of presentation and interaction experiments, we are starting to understand how wild animals navigate the information landscape. Playback experiments have been key to understanding what information individuals are taking from vocalizations, specifically removing the potential confounds of other cues. This approach has demonstrated that primate vocalizations may carry information about the external world, social intentions, and the quality of the signaler. Violation of expectation experiments can pinpoint second-order information use as they can detect an understanding of the relationship between two information sources. We have learned that some nonhuman

primates maintain in-depth, hierarchical knowledge of their social worlds. Importantly, we have also learned that the extent of social knowledge varies across primates, and that the type of social information tracked and maintained is likely to depend on the demands of living within different social structures. This highlights both the need to extend these experiments to more species but also the importance of linking information use to our understanding of social complexity as it relates to cognitive evolution. Complex-looking societies are only cognitively challenging to the extent that animals are tracking social information in those societies [39]. In addition, more experimental work is needed to understand variation in the use of nonsocial or ecological information as well as the ways that animals integrate social and ecological cognition. With interactive experiments, researchers are increasingly able to bridge captive and wild systems with shared experimental approaches to answer difficult questions about cognition (e.g. [64]). Bringing interactive experiments to the field comes with several potential benefits, including understanding how primates actually learn and make cooperative decisions under natural conditions. Puzzle boxes and field-friendly bar pulls provide opportunities to pinpoint how individuals acquire novel information, who they attend to when presented with a novel problem, and how that information is transmitted within a social group.

Despite the benefits of field experiments, there are several logistical challenges that must be addressed for these paradigms to be more widely integrated into field

studies (for a full summary of challenges and solutions see Table 2). First, with field experiments, sample sizes tend to be relatively small. Recent technological advances in biologging enable a ‘brute force’ approach to understanding how animals use information in the wild. By assembling large numbers of observations, it can be possible to separate an information signal from information noise. For example, baboons appear to integrate information about the movements of multiple members of their group, resulting in ‘democratic’ movement decisions [65]. The big data and experimental approaches are currently operating largely in parallel but we see strong potential for further integration. Broader behavioral context from biologging provides a rough draft of the information landscape enabling targeted field experiments that, in turn, can strengthen the causal conclusions drawn from observational data.

Another challenge is that with ecological and social validity of wild studies comes the cost of limited experimental control which is particularly challenging for interactive experiments. In captive studies, testing subjects separately ensures that all individuals are exposed to the testing stimuli. In the wild, there is no guarantee that primates will approach the apparatus, interact with the apparatus, solve the apparatus, or prevent others from interacting with the apparatus. This requires flexibility in testing schedules; there is no set amount of time in which an individual will be trained or a group will successfully complete the paradigm. Furthermore, experiments in the wild are often one-shot interactions with each interactive paradigm often being limited to one reward allowing for one individual to dominate the apparatus. Technological advances, such as an integration of AI facial recognition and automated testing, allow for greater experimental control over testing paradigms and reward distribution, increasing the number of trials per session and preventing others from monopolizing a reward. To date, these methodologies have been mostly confined to captive free-ranging primates (e.g. [66]) (see Table 2) but with some ingenuity could be introduced into wild populations. Lastly, we see enormous potential for pairing cognitive experiments with physiological assessments (e.g. [67]) and noninvasive manipulations (e.g. [68]) to gain a better mechanistic understanding of responses (Table 2). This can be done by combining field-friendly methods of hormone assessment (e.g. fecal and urine collection), and using noninvasive methods for manipulating hormones in wild primates, for example promoting fur-rubbing in capuchin monkeys to increase oxytocin levels [68]. Future studies would benefit from understanding both how internal states (e.g. hormone levels) and external environments influence information processing and decision-making in wild primates (e.g. [69]).

Author contributions

Marcela E. Benítez: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Melissa C. Painter:** Investigation, Writing – original draft, Writing – review & editing. **Nicole Guisneuf:** Investigation, Writing – original draft, Writing – review & editing. **Thore J. Bergman:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing.

Conflict of interest statement

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- of outstanding interest.

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