Title: Collaboration and Open Science Initiatives in Primate Research

By **ManyPrimates**, consisting of (in alphabetical order):

Drew Altschul (The University of Edinburgh, UK)
Manuel Bohn (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany)
Charlotte Canteloup (University of Lausanne, CH)
Sonja J. Ebel (Philipps University of Marburg, Germany)
Daniel Hanus (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany)
R. Adriana Hernandez-Aguilar (University of Barcelona, Spain)
Marine Joly (University of Portsmouth, UK)
Stefanie Keupp (German Primate Center, Germany)
Miquel Llorente (University of Girona, Spain)
Cathal O'Madagain (Université Mohammed VI Polytechnique, Morocco)
Christopher I. Petkov (Newcastle University, UK)
Darby Proctor (Florida Institute of Technology, USA)
Alba Motes-Rodrigo (University of Tübingen, Germany)*
Kirsten Sutherland (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany)
Anna Szabelska (Psychological Science Accelerator)
Derry Taylor (University of Portsmouth, UK)
Christoph J. Völter (University of Veterinary Medicine, Vienna, Austria)
Nicolás G. Wiggendauser (Stony Brook University, New York, USA)

Please cite as: ManyPrimates, Altschul, D., Bohn, M., Canteloup, C., Ebel, S., Hanus, D., Hernandez-Aguilar, R. A., Joly, M., Keupp, S., Llorente, M., O'Madagain, C., Petkov, C. I., Proctor, D., Motes-Rodrigo, A. M., Sutherland, K., Szabelska, A., Taylor, D., Völter, C. J., & Wiggendauser, N. G. (2021). Collaboration and Open Science Initiatives in Primate Research [Preprint]. Open Science Framework. <https://doi.org/10.31219/osf.io/7c93a>

*corresponding author: albamotes7@gmail.com

Abstract

Traditionally, primate cognition research has been conducted by independent teams on small populations of a few species. Such limited variation and small sample sizes pose problems that prevent us from reconstructing the evolutionary history of primate cognition. In this chapter, we discuss how large-scale collaboration, a research model successfully implemented in other fields, makes it possible to obtain the large and diverse datasets needed to conduct robust comparative analysis of primate cognitive abilities. We discuss the advantages and challenges of large-scale collaborations and argue for the need for more open science practices in the field. We describe these collaborative projects in psychology and primatology and introduce ManyPrimates as the first, successful collaboration that has established an infrastructure for large-scale, inclusive research in primate cognition. Considering examples of large-scale collaborations both in primatology and psychology, we conclude that this type of research model is feasible and has the potential to address otherwise unattainable questions in primate cognition.

Large-scale collaborations, open science, replications, primate cognition, primate evolution

Introduction

A brief history of primate cognition research

Understanding the extent and nature of shared and divergent behavioral and cognitive traits across species has captured human curiosity since the beginnings of recorded history (e.g., Aristotle's [350 B.C.] *De Anima*; in Aristotle & Hamlyn, 1968). However, it was Darwin's seminal works (1859, 1871; see also Huxley, 1863) and his claim "that there is no fundamental difference between man and the higher mammals in their mental faculties" (Darwin, 1871; p. 35) that set the stage for a modern systematic comparison of animal's cognition. This type of comparison would later become known as comparative psychology, a discipline founded by Morgan (1894) at the end of the 19th century. Whereas comparative psychology is a vast field, here we will focus specifically on the history of primate cognition research.

Early research on primate cognition was well underway by the beginning of the 1900s. Laboratory researchers were exploring a variety of cognitive abilities and traits including imitation (Thorndike, 1901; Haggerty, 1909; Witmer, 1910), handedness (Franz, 1913), stimulus discrimination (Kinnaman, 1902), food sharing (Nissen & Crawford, 1936), language acquisition (Kellogg & Kellogg, 1933; see also Gardner & Gardner, 1969), and reasoning and problem-solving (Köhler, 1925; Yerkes, 1916, 1929). Much of this work highlighted similarities between humans and other primates and is still of interest today.

While the early researchers expanded our knowledge of primate cognition, this line of work was largely halted by the rise of behaviorism in the US, ethology in Europe, and the two world wars. Behaviorism focused exclusively on observable phenomena and therefore rejected research on the internal lives of animals such as their reasoning abilities (e.g., Watson, 1913). Meanwhile, ethology, focused on studying instinctive behavior of animals in their natural habitats (Moreno & Muñoz-Delgado, 2007), rather than their cognitive abilities (Seed & Tomasello, 2010; Tomasello & Call, 1997).

In the post-war period of the 1950-60s, a cognitive revolution took place in the field of psychology, and the study of mentalistic concepts was once again pursued (Miller, 2003). However, several decades had to pass before its tenets were adopted by the field of animal behavior (Seed & Tomasello, 2010). In the meantime, Imanishi and Itani helped found the subfield of Japanese primatology with their pioneer study of wild Japanese macaques (*Macaca fuscata*) at the end of the 1940's (Nishida, 2011; Matsuzawa & McGrew, 2008). In the 1960's field researchers started reporting on wild primate behavior in Africa, such as the famous tool-using abilities of chimpanzees (*Pan troglodytes*) (Goodall, 1964; Suzuki, 1966; Jones & Sabater-Pi, 1969), which prompted further research into primate cognitive abilities. Gradually, the focus of much primate research expanded from the study of behavior to the exploration of mental processes and representations, such as self-recognition (Gallup, 1970), theory of mind (Premack & Woodruff, 1978), numerical abilities (Matsuzawa, 1985), conservation of quantity (Czerny & Thomas, 1975; Pasnak, 1979), short-term memory (Marriott & Abelson, 1980) and learning skills (Rumbaugh & Gill, 1973).

Building upon these pioneering studies, a large volume of primate cognition research was produced between the late 20th century and early 21st century, spanning many aspects of primates' physical and social cognition including causal understanding and reasoning (Povinelli, 2000; Seed et al., 2011), knowledge about features and categories (Savage-Rumbaugh et al., 1980; Thompson & Oden, 2000), social learning (Hirata et al., 2008; Whiten & van de Waal, 2017), theory of mind (Premack & Woodruff, 1978; Call & Tomasello, 2011) and communication (Fischer & Price, 2017; Seyfarth & Cheney, 2017), to mention a few. Breakthroughs in molecular biology highlighted the importance of evolutionary theory, and the field of comparative cognition burgeoned based on the premise that cognitive processes, like physical traits, are shaped by natural selection (Morange, 2000). Similarly, advancements in neuroscience allowed the study of relationships between neural substrates and behavioral responses as well as drastically increased our understanding of the proximate causes of cognitive functions (Striedter, 2016; Zeise, 2021).

Today, primate cognition research is an interdisciplinary field that combines areas of psychology and biology, including ethology, physiology, neuroscience and genetics. A variety of primate species (including humans) are currently being studied for their own intrinsic value as well as comparatively in order to draw inferences regarding the evolution of cognitive traits (cf., Call et al., 2017).

Key Challenges in primate cognition

One of the main aims of primate cognition research is to understand the evolutionary processes that shaped the cognitive abilities of extant primates, including our own species. However, in order to draw robust phylogenetic inferences, varied and large samples are needed. Unfortunately, accessing such large and diverse samples has rarely been achieved in contemporary research. Most primate cognition studies that are not purely observational take place in captivity (but see exceptions by Seyfarth et al., 1980; Visalberghi et al., 2009; Crockford et al., 2012; van de Waal et al., 2015). Captive populations generally include few individuals because of space restrictions and the elevated costs associated with the animals' housing and sustenance. Furthermore, gaining access to captive primate populations requires establishing collaborations with zoo or sanctuary managers as well as the cooperation of animal keepers, a process that can be logistically challenging and time consuming. In addition, testing captive primates in novel experimental paradigms often involves long periods of habituation and testing which can be cost intensive. Because of these factors, studies on primate cognition are often limited to small sample sizes. A recent review conducted by the ManyPrimates group found that primate cognition studies published between 2014 and 2019 included a median of 7 individuals (ManyPrimates et al., 2019a, see below).

Such small sample sizes often limit our ability to draw robust statistical inferences, but this does not mean that small sample studies are intrinsically flawed. Such studies often represent exploratory investigations that can provide important information regarding the extent of the abilities of a few (often highly experienced / trained) individuals. Preliminary results of studies with small samples can then be used to formulate hypotheses that can be tested in studies including more individuals. In addition, studies with small samples can provide valuable data regarding limitations in cognitive performance when one or a few individuals are tested, as well as within-individual or temporal variation when these studies are conducted over extended periods of time (e.g., Toth et al., 1993; Savage-Rumbaugh & Fields 2006). Nonetheless, it is important to remember that studies with small sample sizes prevent us from drawing inferences about possible sources of individual and group level variation. When the focus of a study is on comparative cognition, small samples often constrain how generalizable results are to the species level and consequently limit the value of such studies for extracting evolutionary and/or phylogenetic conclusions. For example, Persson et al. (2017) reported spontaneous, reciprocal interspecies imitation between four captive chimpanzees and zoo visitors. However, a later replication study testing 32 chimpanzees did not find such evidence (Motes-Rodrigo et al. 2021), suggesting that the results of Persson et al. were specific to the individuals tested.

In addition to small sample sizes, primate cognition studies often include homogeneous samples with individuals from the same species and/or institution. As with small sample studies, although such sampling design is not problematic *per se* (it actually removes confounding factors that might influence the results of some experiments), environmental standardization can lead to a biased account of a species cognitive performance (Forss et al., 2020) and to poor reproducibility of experimental results (Richter et al., 2009). Furthermore,

when the focus of phylogenetic investigations is on how different factors (e.g., social structure, hierarchical structure, food availability, climate) influence or shape cognitive performance, it is necessary to test a set of species for which ecology and/or biology varies within the factor of interest. The above-mentioned review by ManyPrimates et al. (2019a) found that from 2014 to 2019 only 19% of primate cognition studies included more than one species and of those, only 20% compared the species quantitatively. A related issue contributing to the lack of diversity in the samples typically included in primate cognition research is the overrepresentation of certain species. ManyPrimates et al. (2019a) quantified this bias by reporting that great apes and Old World monkeys are included in 38% and 40%, respectively, of the recently published literature in primate cognition. Therefore, a collective effort should be made to include varied samples both in terms of individual characteristics as well as species in comparative studies.

An additional problem faced by the field of primate cognition is the difficulty of conducting replication studies. Replication studies are fundamental to assess the generalizability of findings and they increase the robustness of the field as a whole (see also Farrar et al., in this volume). Full replications involve the application of a previously used methodology to a comparable but new sample, for example a different population of the same species (Farrar et al., 2020a, 2020b). Partial replications are those that target the same question addressed by a previous study, but employing a modified methodology or a different sample than the original study (e.g. another species). Full replications are rare in primate cognition (see Farrar et al., in this volume), whereas partial replications are slightly more common (Setchell et al., 2016). However, partial replications are often criticized on the basis that it is unclear how comparable the methodology is to the original study that is being replicated. Thus, there is a need for coordination in primate cognition replications to ensure that equivalent methods are used to compare populations within and across species when testing the same hypothesis. To this end, authors should also describe their methodology in detail to ensure the potential reproducibility of their experimental designs. Replications are also scarce because of the lack of incentives from most peer reviewed journals, which prioritize novelty above studies that validate or question previous findings. It is often considered that replication studies constitute second class research as they do not involve the development and application of novel methodologies. However, replications constitute a fundamental validity check in any field and more and more journals have recently started to encourage the submission of replication studies (e.g., *Animal Behaviour and Cognition*, *Psychological Science*, *Journal of Experimental Psychology*; *Royal Society Open Science*), hopefully indicating that the publishing system might be on the verge of change in this regard.

An additional reason why replications (as well as phylogenetic investigations) are relatively uncommon in primate cognition research is their elevated costs. Applying an experimental method to several species of primates and populations requires considerable funds, qualified personnel, contacts in testing facilities and time. Such a combination of resources is generally not available to single research groups or departments, and consequently phylogenetic comparisons and replications are scarce. In the following section, we expand on the

challenges that the field of primate cognition currently faces and we discuss how large-scale collaborations can address and mitigate some of these issues.

The need for large-scale collaboration

What problems are large-scale collaborations solving?

As outlined above, primate cognition research faces the problem of relying on a very limited resource (access to a restricted number of research sites, such as zoos, sanctuaries and field sites) as well as a historic lack of sufficient collaborations to tackle the ever-present challenge of small sample sizes and limited species diversity. In addition, research sites differ in how they are managed, which type of research they allow according to local research ethics, which species they host, and who has access to them. Large-scale collaborations initiatives offer opportunities to overcome some of these challenges.

Collaboration initiatives solve the problem of limited sample sizes in primate cognition studies, allowing to increase the number of subjects and species tested with the same paradigm across sites. The underlying rationale of primate cognition research is often (but not always) to learn more about the evolution and development of certain cognitive skills, their interaction with social or ecological factors, and what we can learn about human evolution by comparing different species. A recurrent problem is that each individual research project can usually only cover a small number of individuals and study species, which does not allow to properly address phylogenetic questions. Increasing the number of species and sample sizes within species by engaging in large-scale collaborations allows more robust phylogenetic analyses, which operate unreliably when the number of groups is too small (Freckleton et al., 2002). Such increases in sample size often lead to studies with higher statistical power that can detect smaller effect sizes. However, it is important to take into consideration that mindless increases of sample sizes can lead to overpowered analysis and meaningless effect sizes (Friston, 2012).

Similar to the phylogenetic questions, how a species' ecology is related to cognition and behavior is difficult to address with only one or two study groups. Rearing conditions, human exposure and previous participation in experiments can impact task performance (e.g. Forss et al., 2020). If only one group per species is tested it is impossible to disentangle such effects from actual species differences. Being part of a collaborative initiative can mitigate this issue by allowing access to a wider sample of species and groups. Collaborative projects can facilitate obtaining large enough samples from underrepresented species in the literature (specially those that can only be found in small numbers in captivity). Although "proof of principle" studies are important, it is unlikely that data from a few individuals (even if from an understudied species) would be published as a stand-alone finding, losing the opportunity to further our knowledge of rarely studied species. For example, the Norwegian zoo of Kristiansand houses three black-handed spider monkeys. Usually, there would be no scientific outlet for studies conducted with such a small sample size, and investing in research and training with this group would not provide much benefit. However, when part of a large-

scale collaboration, data from these monkeys is valuable because it diversifies the overall sample (ManyPrimates et al., 2019b). Hence, researchers can make a valuable contribution and might receive more support in planning and running a study with them.

Collaboration initiatives can also make replication projects more attractive for individual researchers and thus increase the likelihood that more researchers invest in replication attempts. Collaborations make replications easier because they reduce individual workload and costs by pooling expert skills from different research groups. For example, in the ManyPrimates pilot study (ManyPrimates 2019b), project members contributed to one or more of the following task forces: coordination, study planning/conceptualization, data collection, data curation, data analysis, data visualization, manuscript writing and manuscript editing (Klein et al., 2014; ManyPrimates et al., 2019b; Monshontz et al., 2018; The ManyBabies Consortium, 2020). Within such a project structure, individual time and effort for study preparation is reduced because everything is planned collaboratively in advance and does not have to be devised from scratch. Replications are often not attractive because limited testing slots or a field season can be used for other more innovative and easier-to-fund projects. However, large-scale collaborations might increase the chance that a researcher or site manager can spare some resources and contribute data when the only workload is to follow an established protocol.

Collaboration initiatives may also provide opportunities for a more detailed assessment of why findings do or do not replicate. For example, it might be possible to compare the impact of test experience or type of long-term basic training on test performance across sites. In addition, they can foster exchange between sites, such as experiences with basic training methods to facilitate relaxed separation from the group and experimental training.

Large-scale collaborations can also have other positive outcomes. For example, seeing colleagues investing their resources on the overarching goal of collaborative science can increase motivation to follow suit. Large-scale collaborations can help to set standards in the field by following good scientific practice of replications, data reporting, and pre-registration (Open Science Collaboration, 2015; Popper, 2002a, 2002b). Furthermore, researchers can also benefit directly. Low entry barriers and the various ways in which a scientist can be involved in a large-scale collaboration (design, data collection, analysis, manuscript writing) offer a multitude of possibilities for researchers in different stages of their careers. These types of projects also present valuable opportunities to make new contacts, initiate new collaborations, and connect with a bigger community on a regular basis. For early career researchers, large-scale collaborations provide an excellent opportunity to work with more senior colleagues and to benefit from their experience.

Taken together, collaboration initiatives can solve practical problems in a field with limited resources, such as access to non-human primates, by increasing the number of tested individuals within a species, the individuals' characteristics, and the species diversity. Large-scale collaborations are based on the principle that scientists should foster good scientific practice, which can be overshadowed by the everpresent competition for excellence,

innovation, funding, and self-promotion. Finally, large-scale collaborations offer opportunities for individual researchers such as the possibility to connect with scientists from different disciplines who share similar interests, exchange perspectives, learn new skills and practices, and to answer questions in ways that are not possible otherwise (e.g. to do quantitative phylogenetic analyses, see section below on ManyPrimates as a case study).

What challenges are large-scale collaborations facing?

Large-scale collaborations represent a wholesale shift in scientific practice, from how research questions are chosen and approached, to how research is logistically coordinated and how credit for research efforts is allocated (Moshontz et al., 2018). As such, although large-scale collaborative research carries a wide range of advantages and offers solutions to prevalent problems in contemporary science (e.g., Open Science Collaboration, 2015), it also creates new challenges for researchers.

Although large-scale collaboration lifts some of the restrictions that are imposed on researchers by the network topology of mainstream academia (Foster & Deardorff, 2017), it also imposes new limitations. Large-scale collaborative research can involve a trade-off between the number of studies that can be conducted and the scale of those studies. Mainstream academia is characterised by many small-scale studies with diverse research focuses (Vostal, 2016), whereas large-scale collaborative projects may reduce the diversity of topics by covering them at a scale that would be unfeasible by independent research groups (Vazire, 2018). How these topics are approached can also be restricted for similar reasons – in mainstream academia this is done at the discretion of the laboratory members (Vostal, 2016), whereas in large-scale collaborations methodologies and analyses are typically pre-registered which despite its many benefits may reduce the scope for alternative approaches (van't Veer & Giner-Sorolla, 2016). Moreover, the method for selecting research topics in large-scale collaborative research is rather different to mainstream academia. Large consortia need to pick the criteria for studies' selection: whether they are interested in asking novel questions, novel methods, or maybe answering old, previously unanswerable questions, or maybe all of those. Agreeing on project selection, study design, stimuli, analysis plan, and findings' interpretation is not easy in big groups. For example, psychological studies conducted by large consortia are often limited to those that can be done online because this ensures procedural consistency across sites, that can be administered quickly and have a fairly simple design. In the case of ManyPrimates, research questions are selected democratically - proposals for projects are submitted and members vote to select which projects will be carried out. It could be argued that although this process is fair, research questions ought to be selected based on theory and prior observations rather than on majority preference, and thus democratic selection imposes an unusual restriction on research directions. Of course, smaller scale research within laboratories and large-scale collaborations can co-exist. However, this does introduce a novel challenge in striking a balance between the two, for instance, by deciding which questions are best suited to large-scale collaborative efforts and which are not. In general, questions that can be addressed

using testing methodologies that require simple and cheap materials would be favoured by collaborative projects over complex methodologies involving expensive or rare equipment. Similarly, research questions addressed by collaborative projects do not normally require the application of overly specialized skills such as the collection of eye-tracking or thermal data. As a relatively new approach to conducting research, large-scale collaborations require new rules to facilitate fair scientific practices (Moshontz et al., 2018). For example, large-scale collaborations are faced with the problem of free-riders because individual contributions can be difficult to track and verify, raising questions such as how much does one need to contribute to a project in order to be included as an author and how can that be verified (see Borenstein & Shamoo, 2015). Typically, individual research groups have their own authorship guidelines, which determine who qualifies as an author and why. Large-scale projects also have to develop authorship guidelines, which specify the minimal conditions that one person has to fulfill to qualify for authorship, such as the minimum amount of data collected or manuscript section writing. This is particularly challenging in the case of large-scale collaborations, in which researchers aim to maximise inclusivity, but workloads may differ greatly between individuals, although credit for the projects is shared equally by all. In other large-scale collaborations, such as the Psychological Science Accelerator, these issues have been solved using collaboration agreements and externally defined contributor roles (e.g., McNutt et al., 2018). The question of who should be recognized and how requires delicate balancing between the needs of individual researchers and the whole group. One solution to this issue is to have a consortium authorship like ManyPrimates, although we still do not know how tenure, hiring, and funding bodies will look at such authorship structure.

Large-scale projects also face coordination problems as they involve hundreds of collaborators and large administrative workloads (e.g., simultaneous work of many labs, overseeing adherence to established protocols, task designation, setting up deadlines and obtaining ethical approval). Scientists might be discouraged to take on such workloads without economic compensations. To our knowledge, none of the large-scale consortia in psychology have a steady source of financing, and many have only minimal funds. That means that most of the work is voluntary (which often involves diluted accountability) and in addition to the scientists' main research activity. Lack of funding also makes reaching labs and samples from non-WEIRD (Western, Educated, Industrialized, Rich and Democratic) countries harder as relying on crowdfunding rather than on institutional funding makes the future of these projects uncertain.

Another challenge facing large-scale collaboration involving multiple experiments is disagreement between authors or contributors on the interpretation of particular experiments. In the collaborative project the *Atlas of Comparative Cognition* (eds. Hanus and O'Madagain, acc.clld.org), systematic reviews are compiled to generate a 'map' of what we know about cognitive abilities across species. As part of this project, the curatorial team created a series of guidelines to follow in case parties disagreed on interpretations and implications of reported studies. Such disagreement typically concerns whether a particular paradigm really demonstrates a particular cognitive ability (for example, whether information-seeking demonstrates the presence of metacognition).

At the *Atlas of Comparative Cognition* it was decided that the best principle to invoke was to allow readers to draw their own conclusion – and therefore as curators, to err on the side of inclusiveness. This meant that if the authors of a study claimed their results illustrated a given ability, then it should be included in the review even if the reviewer (or other authors) disagreed – thereby leaving it to the reader to decide. In the context of large scale replication projects, the same principle can be applied: if a study is claimed by some authors, but not all, to illustrate a given cognitive ability, it can be included in a replication project as an illustration of that ability. Whether its replication really does illustrate the presence of that ability can be left to the reader to decide.

In addition to the abovementioned generic problems, large-scale collaborations in primatology face a set of specific issues. One particular problem surrounds ethical restrictions at different study sites. Primates included in scientific studies either live in the wild or are housed in laboratories, zoos and sanctuaries. Each study site has its own set of ethical guidelines that outlines what type of studies are allowed (Schoene & Brend, 2002). For example, invasive studies are often allowed in laboratories but not in wild or sanctuary-housed populations (Fedigan, 2010). To further complicate matters, there are often no shared definitions of key terms such as ‘invasive’ (see Conlee et al., 2004), meaning that what is considered to be invasive at one site might not be at another. Indeed, legal texts themselves routinely adopt the use of such ambiguous terminology (see Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010). This introduces a novel dimension to the challenge of developing generally applicable methodologies. The ethical restrictions at a given site may also extend beyond the studies that are conducted at that site. For instance, in our experience thus far in ManyPrimates, there are some sites where ‘invasive’ studies are not allowed, and researchers at those sites cannot collaborate with other scientists involved in invasive research, even if the collaborative study itself is not invasive. This is clearly a complex issue, and as the number of sites involved in a project increases, so too does the complexity of this problem.

Why large-scale and other research has to be open

The main assumption behind open science is simple: ideas and theories are a common good that should be shared freely. Openness should be one of the defining characteristics of modern science - the research process should be transparent, and the full methodology, tools, code and data should be accessible to everybody (with certain necessary restrictions, such as protecting the identity of human participants). Sharing studies’ documentation provides greater access to research outputs that can limit unnecessary duplication of data collection and promote a wider evaluation and scrutiny of ongoing research and existing findings. Furthermore, by making data and code publicly available, it is possible to flag potential cases of malpractice or errors. Moreover, taxpayers should not only be able to trust science, but they should also have access to publicly funded research.

Unfortunately, incentives to produce open, solid and thorough, rather than attractive and quick scientific results are low in modern day academia (see e.g. Pennycook & Thompson,

2018). Until a decade or so ago, it was uncommon in many disciplines to properly document and make available the stimuli, data, and analysis details underlying empirical publications (physics, for example, being a commendable exception). Wrong incentives and insufficient documentation habits open doors for more or less severe scientific mal-practice, ranging from blurred lines between confirmatory and exploratory data analysis to severe fraud involving data fabrication (prominent examples of severe misconduct are the cases of US based primate behavior researcher Marc Hauser and Dutch social psychologist Diederik Stapel: Stapel investigation, 2012; Bouter, 2015; Gross, 2016). Attempts at increasing research openness were to a large degree a consequence of the replication crisis permeating many scientific disciplines. The replication crisis resulted in the promotion of a range of practices aimed at making science more reliable such as code and data sharing as well as the creation of new publication formats. For example, study pre-registrations require hypotheses and analysis pipelines to be declared before data collection begins, thus limiting the pitfall of hypothesizing after the results are known to a minimum. Registered Reports go even further by reversing the traditional review process and having study proposals peer reviewed and accepted in principle prior to data collection. Registered Reports not only limit publication bias of hypotheses conforming findings (“file drawer problem”) but also help researchers to improve the quality of their methodology, design and analysis plan in time. Open science tools can also help in re-evaluating existing research. For example, *p-curve* software (Simonsohn et al., 2014) helped to address the overrepresentation of positive results in the literature, and *statcheck* (Epskamp & Nuijten, 2016) helped by reviewing the articles for inconsistencies in reported statistical values.

The spirit of ManyPrimates, in line with other collaborative initiatives, is that science needs to be open, independent, transparent, and adhering to good scientific practice. Moreover, large parts of the academic system are funded by public money and should thus be public and independent from any influences as to which results are desired by specific third parties. ManyPrimates and other large-scale collaborations, as well as an increasing number of individual researchers, commit to open science practices by pre-registering their studies, sharing their data and code and publishing without paywalls.

Large-scale collaborations

Large-scale collaboration in psychology

Failures to replicate high-profile psychological studies (i.e., Doyen et al., 2012), questionable research practices (John et al., 2012) and problems with generalizability of results led to a collective loss of trust in the reproducibility of research findings in psychology. One of the first steps needed to fix the problem was to identify its depth. To this end, numerous research groups initiated collaborative, highly powered replication efforts. One of the leading projects, the Open Science Collaboration, managed to replicate only 36% of the chosen studies (Open Science Collaboration, 2015). After a great deal of replications were conducted, it was possible to identify some of the causes leading to the low success rate observed by the Open

Science Collaboration. These included underpowered studies; small sample sizes; biased samples including mainly participants from WEIRD countries (Henrich et al., 2010); biased reporting of findings; publication bias; p-hacking; questionable research and methodological practices; researcher's degrees of freedom; "data torturing" (that is, if researchers use enough statistical tests they will always find some significant patterns and relations in their data; in other words: "if you torture the data long enough, it will confess" (Tullock, 2001, p. 205)) and defining hypotheses after the results are known.

Large-scale collaborations in psychology emerged as a response to the replication crisis and the problems identified by previous replication attempts. The Many Labs project for example, focused on meta-scientific questions. In their five iterations, they managed to pool resources from several hundred research groups and collect data from thousands of participants. Many Labs 1 tried to replicate 13 psychological effects in 36 different settings testing 6344 participants (Klein et al., 2014). The different Many Labs projects led to the creation of a comprehensive data set on human psychology of a magnitude without precedent in the field.

Another large-scale collaboration in psychology is the Many Smiles Collaboration, which focuses on human facial expressions with the goal of testing the facial feedback hypothesis (Coles et al., 2019). The ManyBabies consortium (Frank et al., 2017), another example of a large-scale collaboration in psychology, conducts replications of influential experiments in developmental psychology focusing on human infants. Much like ManyPrimates, each iteration of ManyBabies focuses on a specific problem: infant directed speech (ManyBabies Consortium, 2020), infants' social evaluations (ManyBabies Consortium, under review), infant theory of mind, infant rule learning and the Hunter and Ames model of infant looking preference (<https://manybabies.github.io>). In contrast to the collaborations described above, which gather for every iteration and can have completely different people involved in each project, ManyBabies is a standing collaboration. Other examples of standing collaborations in psychology are the Psychological Science Accelerator (a network of laboratories that conduct several different large-scale projects at the same time) and the Collaborative Replications and Education Project (CREP) that aids students and instructors in conducting replication studies.

Large-scale collaboration in primatology

Recent data reports the existence of more than 500 primate species distributed within almost 80 genera (Burgin et al., 2020). Unfortunately, almost 75% of these species show declining populations (Estrada et al., 2017). Large-scale collaborations are therefore crucial to pool extremely rare but valuable resources to better understand evolutionary and ecological factors shaping primate diversity but also to facilitate the maintenance of current captive populations and conservation *in situ*. So far, by sharing and collating their longterm data on diverse primate species, networks of researchers have created large databases on primate life history (the Primate Life History database, from 7 ongoing field studies of 7 wild primate taxa; Strier et al., 2010) and primate aging (Primate Aging Database, 40 species from 16 different research facilities, sanctuaries and zoos; Kemnitz, 2019). Such collaborations have thus resulted in long-lasting resources necessary to quantify existing diversity between and within

species as well as between wild and captive populations. However, such large databases necessitate complex logistics and constant data curation and are consequently time-consuming in the long term.

Large-scale collaborations have also enabled the maintenance of current captive populations under high ethical standards, allowing the creation of infrastructures for breeding and research such as EUPRIM-Net (European Primate Network, 9 primate centers in the EU). In line with this, the Pan African Sanctuary Alliance (PASA) represents the collaboration of 23 member organizations in 13 different countries. Altogether they house more than 3,000 rescued primates and share high standards for their operations (Stokes et al., 2018). This initiative also promotes institutional collaborations to enable impactful conservation efforts. PASA runs projects ranging from crisis response to international law enforcement. Other similar initiatives exist in North America with NAPSA (North American Primate Sanctuary Alliance) and in Europe with EARS (European Alliance of Rescue Centres and Sanctuaries). Scientifically, such collaborative work allows us to advance our knowledge on the existing variation in morphology, behavior, ecology and genetics, as well as taxonomy of primates. This is particularly true for cryptic (animals that look identical but are genetically distinct) or isolated species, as recently demonstrated with the description of a new species of orangutan, the Tapanuli orangutan (*Pongo tapanuliensis*: Nater et al., 2017).

Some large-scale collaborations in primatology have focused on promoting conservation of a single primate superfamily. For example, the Lemur Conservation Network (LCN) was founded by the Madagascar Section of the IUCN SSC Primate Specialist Group following their alarming article reporting that 94% of the lemur species (about 100 species) are threatened (Schwitzer et al., 2014). The LCN promotes collaboration between researchers, NGOs and charities to help protect the lemur populations which are all endemic to Madagascar (60 member organizations, Reuter & Venart, 2014). Another example is the A.P.E.S. Wiki, a recent collaborative effort to create an open-access platform that provides standardized research and conservation data at the study-site level for all ape taxa, with the aim of supporting collaborations across sites and promoting successful conservation decision-making (<https://apeswiki.eva.mpg.de/index.php>). There is already information for numerous chimpanzee study sites in the Wiki, including 59 in West Africa for the critically endangered *Pan troglodytes verus* at the time of writing this chapter (Heinicke et al., 2021).

Other large-scale collaborations in primatology have focused on a single species. For example, the Pan African Programme (PanAf) collected ecological and behavioral data using largely the same protocol in more than 50 different chimpanzee study sites across Africa, with the aim of identifying the evolutionary and ecological factors that have produced chimpanzee behavioral diversity (<http://panafrican.eva.mpg.de/index.php>). The publications that this project so far has produced have been able to answer questions regarding chimpanzee behavioral complexity and explore the implications of such complexity for understanding human evolution, in ways that would not have been possible without such large sample sizes (e.g., Boesch et al., 2020; Kalan et al., 2020).

The replicability problem has also been recognized in the primate neuroimaging community. The issue here has been that many laboratories, due to ethical sensitivities, complete their neuroscientific study with sometimes 2 or 3 animals, and until recently they did not commonly share data nor did they have platforms for doing so. The primate neuroimaging community has recently broken substantial ground by establishing a resource for primate neuroimaging data sharing called the PRIMatE Data Exchange (PRIME-DE). Hundreds of datasets across many institutions around the world were shared in the first round of data sharing on PRIME-DE (Milham et al., 2018). This initiative gained substantial ground following a meeting of the community with over 150 individuals (Milham et al., 2020). This has inspired a special issue with over 30 contributions from the community considering standards of data collection, acquisition, analysis, quality control and other developments to support secondary data analysis and the systematic analysis of the large datasets that are available. In addition, the primate neuroimaging community has recently created a platform to exchange information about scientific practices, data and methodology called the PRIMatE Research Exchange (PRIME-RE) platform (Messinger et al., 2021; <https://prime-re.github.io/>). This collaboration was inspired by the Human Connectome Project (Van Essen et al., 2013), which created a scalable open science for human neuroimaging. The footsteps that these communities have taken could also be useful for the behavioral and cognitive psychology primate community. For example, the primate neuroimaging community has suggested how behavioral and genetic fingerprints or metadata can follow each animal and may include brain imaging data, if available (Milham et al., 2020).

In primate cognition research, collaborative work has demonstrated to be fruitful (Amici et al., 2008; Amici et al., 2018; Burkart et al., 2014; Herrmann et al., 2007; Joly et al., 2017; MacLean et al., 2014). These collaborations have offered new theoretical approaches and important data to investigate the evolution of the primate mind. These projects have not only provided insights into the feasibility of large-scale collaborative work but also about its limitations (e.g., required long-term involvement of investigators, which is difficult without a permanent academic position and limited financial support).

ManyPrimates as a case study

Large-scale collaborative projects in primate cognition research have had a tremendous impact on the field. However, they were not long-lasting. Most of these projects were initiated by a single individual, often supported by a dedicated grant. As a consequence, the network and the associated infrastructure dissolved once the project was completed. The ManyPrimates project was initiated to address these shortcomings. Our goal is to build an enduring infrastructure for large-scale collaboration in primate cognition research, independent of a single individual and external funding. We envisioned the core of the project to be a platform that allows researchers to connect and collaboratively discuss, decide, and conduct studies. Furthermore, we hoped to spread open science practices in the field.

Since its beginning in 2017, ManyPrimates has mostly been a success. We established a network that includes a substantial proportion of researchers working on primate cognition in

captive settings. For example, in December 2020 our mailing list had more than 140 members. We are also reaching out to a wider community, for example with our Twitter account (@manyprimates), which is approaching 1000 followers. The network is diverse and includes a large number of early-career researchers. As part of building an infrastructure for data collection, we discussed and agreed on a list of ethical guidelines, which set the ethical ramifications of any ManyPrimates study. The project's large and diverse nature brought some unique challenges because our members work in very different research settings. After a lengthy discussion, we agreed on a set of minimal ethical guidelines, for example, that all ManyPrimates studies will be non-invasive in nature, which all contributing sites must confirm. In addition, each site obtains ethical approval from their respective oversight board. Similarly, we discussed and decided on criteria that specify the contributions that license authorship in a project. As part of this discussion, we decided that all ManyPrimates studies will be published in dedicated open access journals. The author list will be headed by a group author (ManyPrimates), followed by an alphabetical list of all researchers who contributed to the particular study. The two guidelines - ethics and authorship - can be found on the project's website: <https://manyprimates.github.io/>.

We put this infrastructure into action for a pilot study (ManyPrimates et al., 2019b). As a first step, the group proposed and discussed several topics via the mailing list and voted that short-term memory should be the focus. We modeled the study after a well-established paradigm used with several species in captivity. Task forces within the group prepared study protocols, coding sheets, and data hosting infrastructure. After pre-registering the experimental procedure and analysis, participating researchers collected the data in their respective institutions. They then uploaded the data to a central repository (https://github.com/ManyPrimates/mp_pilot), and another task force merged the datasets, implemented the pre-registered analysis, and visualized the results. All data files and analysis scripts were made publicly available in the repository mentioned above. With more than 170 individuals from a dozen species, the resulting dataset was one of the largest ever to be collected in primate cognition research. The results of the first project showed that primates across species were less likely to remember where food was hidden, the longer they had to wait between hiding the food and searching for it. As such, this finding replicated earlier studies. Interestingly, while the overall pattern (longer delay = poorer memory) was stable across species, the absolute level of performance varied substantially. For example, for Brown capuchin monkeys (*Sapajus apella*) the pattern was 80% correct with a short delay, 55% with a medium delay and 46 % with a long delay. For chimpanzees, it was 93% (short delay), 82% (medium delay) and 79% (long delay). A preliminary phylogenetic analysis showed that species with a long shared evolutionary history performed more similar to one another. . Multiple members presented these results at a variety of different conferences. Finally, the results - along with a description of the project infrastructure - were written up collectively and published (ManyPrimates 2019b). In the same collaborative spirit, we recently conducted two reviews of primate cognition studies with a focus on the species and samples being studied worldwide (ManyPrimates et al., 2019a) and in France (ManyPrimates et al., 2020). The three above mentioned publications show that ManyPrimates offers an

effective and productive infrastructure for conducting primate cognition research in a collaborative environment.

At the time of writing, we are beginning data analysis for the first ManyPrimates project (MP1). MP1 is a continuation of our pilot study for which we are collecting data from more species and individuals in the same short-term memory task. The final dataset will contain data from more than 400 individuals from over 40 species - by far, the largest experimental dataset on any aspect of primate cognition. As part of this project, we are also exploring a new approach to data analysis and theory testing: we launched a “modeling challenge” in which researchers can submit their favorite theory to be tested against the data as a statistical model. All submitted models will be compared to one another to determine which model (and theory) best explains the data. Because we consider all proposed theories, the project itself can remain theoretically neutral.

Two new ManyPrimates projects (MP2: delay of gratification; MP3: inference by exclusion) are currently in the planning phase. These projects followed along the path set by the pilot study: After soliciting potential study topics from the group, we conducted polls to decide on the topics (based on short proposals prepared by group members). The selected topics became projects and we formed coordination teams to lead them. Over the last years, the number of people who actively contributed to the project grew constantly. Early career researchers were particularly engaged at all levels of the project so far. For future projects, we hope to collaborate with field researchers to explore the possibility of conducting studies with both captive and wild animals. Furthermore, we started collaborating with other large-scale collaborative projects (ManyBabies, Psychological Science Accelerator, Open Science Framework) to build a “network of networks” where we plan to share and develop best practice guidelines and infrastructure common to all projects.

Future directions and conclusions

Future directions

Historically, most primate cognition research has been done on captive primates (Janmaat, 2019), and especially on great apes, neglecting monkeys and strepsirrhines. This phenomenon is known as “chimpanocentrism” (Beck, 1982; Miklósi, 2002) and it has been argued that it limits our understanding of the evolution of primate cognition (Meunier, 2017). In addition, little cognition research has been done on wild primates (see Girard-Buttoz et al., 2020; Janmaat et al., 2014 for recent approaches). Most field research is based on systematic observations. Field experiments face the intrinsic difficulties of introducing controlled experimental conditions in wild settings and, additionally, are often restrained from introducing novel objects and materials into the species' natural environments. Still, several research groups developed innovative field experiments in the past 15 years (e.g., Carter et al., 2012; Flombaum & Santos, 2005; Gunhold et al., 2014; van de Waal et al., 2013). In

contrast to the chimpocentrism of experiments in captive populations, such field experiments were mainly conducted on non-endangered monkey species for which ethical restrictions are sometimes less strict (but see e.g. Crockford et al., 2012; Gruber et al., 2009, for field experiments with chimpanzees). During the last two decades, an increasing number of cognitive experiments have been conducted with captive sanctuary populations of great apes, thus broadening the view of primate cognition to wild-born individuals (see Ross & Leinwand, 2020 for an overview). An important future direction in primate cognition research is to continue to find suitable experimental methods to compare primates in diverse living conditions, including the wild. Large-scale collaborations between researchers studying primate cognition in both captive and wild settings are an important tool to accomplish this goal. Such collaborative effort should be coupled with open science considerations to satisfy good and ethical conducts in research, to facilitate knowledge transfer and to reach broader audiences.

Conclusions

Open science innovations including pre-registration, registered reports, reproducible workflow, open materials and more, will improve primate research as they have improved scientific research across disciplines. In particular, large-scale collaborations such as ManyPrimates aim to push research in primate cognition and behavior beyond many of the impediments that have lingered in the field. Large-scale collaborations such as those described in this chapter allow researchers to combat pervasive problems across scientific fields like small sample sizes, homogeneous samples and lack of replications, while also allowing for novel cross-species comparisons and phylogenetic inferences, and promoting inclusivity in a diverse field. Perhaps most importantly, we and others have recently and repeatedly demonstrated that large-scale, open science driven collaboration in primate research is feasible, and can be very successful.

References

- Amici, F., Aureli, F., & Call, J. (2008). Fission-fusion dynamics, behavioral flexibility, and inhibitory control in primates. *Current Biology*, 18(18), 1415–1419. <https://doi.org/10.1016/j.cub.2008.08.020>
- Amici, F., Call, J., Watzek, J., Brosnan, S., & Aureli, F. (2018). Social inhibition and behavioural flexibility when the context changes: a comparison across six primate species. *Scientific Reports*, 8(1), 3067. <https://doi.org/10.1038/s41598-018-21496-6>
- Aristotle, & Hamlyn, D. W. (1968). *Aristotle's De Anima: Books II and III (with Certain Passages from Book I)*. Oxford: Clarendon Press.

- Beck, B. B. (1982). Chimpocentrism: Bias in cognitive ethology. *Journal of Human Evolution*, 11(1), 3–17. [https://doi.org/10.1016/S0047-2484\(82\)80027-4](https://doi.org/10.1016/S0047-2484(82)80027-4)
- Boesch, C., Kalan, A. K., Mundry, R., Arandjelovic, M., Pika, S., Dieguez, P., Ayimisin, E. A., Barciela, A., Coupland, C., Egbe, V. E., Eno-Nku, M., Michael Fay, J., Fine, D., Adriana Hernandez-Aguilar, R., Hermans, V., Kadam, P., Kambi, M., Llana, M., Maretti, G., ... Köhl, H. S. (2020). Chimpanzee ethnography reveals unexpected cultural diversity. *Nature Human Behaviour*, 4(9), 910–916. <https://doi.org/10.1038/s41562-020-0890-1>
- Borenstein, J., & Shamoo, A. E. (2015). Rethinking authorship in the era of collaborative research. *Accountability in Research*, 22(5), 267–283. <https://doi.org/10.1080/08989621.2014.968277>
- Bouter, L. M. (2015). Commentary: Perverse Incentives or Rotten Apples? *Accountability in Research*, 22(3), 148–161. <https://doi.org/10.1080/08989621.2014.950253>
- Burgin, C. J., Wilson, D. E., Mittermeier, R. A., Rylands, A. B., Lache, T. E., & Sechrest, W. (Eds.). (2020). *Illustrated checklist of the mammals of the world*. Bellaterra (Spain): Lynx Edicions.
- Burkart, J. M., Allon, O., Amici, F., Fichtel, C., Finkenwirth, C., Heschl, A., Huber, J., Isler, K., Kosonen, Z. K., Martins, E., Meulman, E. J., Richiger, R., Rueth, K., Spillmann, B., Wiesendanger, S., & van Schaik, C. P. (2014). The evolutionary origin of human hyper-cooperation. *Nature Communications*, 5, 4747. <https://doi.org/10.1038/ncomms5747>
- Call, J., Burghardt, G. M., Pepperberg, I. M., Snowdon, C. T., & Zentall, T. (2017). What is comparative psychology? In J. Call (Ed.), *APA Handbook of comparative psychology. Volume I: Basic concepts, methods, neural substrate, and behavior*. American Psychological Association.
- Call, J. and Carpenter, M. (2001). Do apes and children know what they have seen? *Animal Cognition* 3. 207–220.
- Call, J., & Tomasello, M. (2011). Does the Chimpanzee have a Theory of Mind? 30 years later. In S. Schleidgen, M. Jungert, R. Baue, & V. Sandow (Eds.), *Human nature and self design* (pp. 83–96). Leiden, The Netherlands: Mentis. https://doi.org/https://doi.org/10.30965/9783957438843_008
- Carter, A. J., Marshall, H. H., Heinsohn, R., & Cowlishaw, G. (2012). How not to measure boldness: Novel object and antipredator responses are not the same in wild

- baboons. *Animal Behaviour*, 84(3), 603–609.
<https://doi.org/10.1016/j.anbehav.2012.06.015>
- Coles, N. A., March, D. S., Marmolejo-Ramos, F., Arinze, N. C., Ndukaihe, I. L. G., Özdoğan, A. A., Aczel, B., Hajdu, N., Nagy, T., Som, B., Basnight-Brown, D., Zambrano, D., Grey Javela, L., Foroni, F., Willis, M., Pfuhl, G., Kaminski, G., Ehrengarth, T., Ijzerman, H., ..., & Liuzza, M. T. (2019). A multi-lab test of the facial feedback hypothesis by The Many Smiles Collaboration. *PsyArxiv*.
<https://doi.org/10.31234/osf.io/cvpuw>
- Conlee, K. M., Hoffeld, E. H., & Stephens, M. L. (2004). A demographic analysis of primate research in the United States. *Alternatives to Laboratory Animals*, 32 (Suppl 1A), 315–322. <https://doi.org/10.1177/026119290403201s52>
- Crockford, C., Wittig, R. M., Mundry, R., & Zuberbühler, K. (2012). Wild chimpanzees inform ignorant group members of danger. *Current Biology*, 22(2), 142–146.
<https://doi.org/10.1016/j.cub.2011.11.053>
- Czerny, P., & Thomas, R. K. (1975). Sameness-difference judgments in *Saimiri sciureus* based on volumetric cues. *Animal Learning & Behavior*, 3(4), 375–379.
<https://doi.org/10.3758/BF03213462>
- Darwin, C. (1859). *The origin of species by means of natural selection of the preservation of favoured races in the struggle for life*. London: John Murray.
- Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London: John Murray.
- Doyen, S., Klein, O., Pichon, C.-L., & Cleeremans, A. (2012). Behavioral priming: it's all in the mind, but whose mind? *PLOS ONE*, 7(1), e29081.
<https://doi.org/10.1371/journal.pone.0029081>
- Epskamp, S., & Nuijten, M. B. (2016). *Statcheck: Extract statistics from articles and recompute p values*. R package version 1.2.2. <http://CRAN.R-project.org/package=statcheck>.
- Estrada, A., Garber, P. A., Rylands, A. B., Roos, C., Fernandez-Duque, E., Di Fiore, A., Nekaris, K. A.-I., Nijman, V., Heymann, E. W., Lambert, J. E., Rovero, F., Barelli, C., Setchell, J. M., Gillespie, T. R., Mittermeier, R. A., Arregoitia, L. V., de Guinea, M., Gouveia, S., Dobrovolski, R., ... & Li, B. (2017). Impending extinction crisis of the world's primates: Why primates matter. *Science Advances*, 3(1).
<https://doi.org/10.1126/sciadv.1600946>
- European Parliament Council of the European Union. (2010). Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the

protection of animals used for scientific purposes. *Official Journal of the European Union*.

- Farrar, B. G., Boeckle, M., & Clayton, N. S. (2020a). Replications in comparative cognition: what should we expect and how can we improve? *Animal Behavior and Cognition*, 7(1), 1–22. <https://doi.org/10.26451/abc.07.01.02.2020>
- Farrar, B. G., Voudouris, K., & Clayton, N. (2020b). Comparisons, sampling and the problem of representativeness in animal behavior and cognition research. *PsyArXiv*. <https://doi.org/10.31234/osf.io/2vt4k>
- Fedigan, L. M. (2010). Ethical issues faced by field primatologists: asking the relevant questions. *American Journal of Primatology*, 72(9), 754–771. <https://doi.org/10.1002/ajp.20814>
- Fischer, J., & Price, T. (2017). Meaning, intention, and inference in primate vocal communication. *Neuroscience & Biobehavioral Reviews*, 82, 22–31. <https://doi.org/10.1016/j.neubiorev.2016.10.014>
- Flombaum, J. I., & Santos, L. R. (2005). Rhesus monkeys attribute perceptions to others. *Current Biology*, 15(5), 447–452. <https://doi.org/10.1016/j.cub.2004.12.076>
- Forss, S., Motes-Rodrigo, A., Hrubesch, C., & Tennie, C. (2020). Chimpanzees' (*Pan troglodytes*) problem-solving skills are influenced by housing facility and captive care duration. *PeerJ*, 8, e10263. <https://doi.org/10.7717/peerj.10263>
- Foster, E. D., & Deardorff, A. (2017). Open Science Framework (OSF). *Journal of the Medical Library Association : JMLA*, 105(2), 203–206. <https://doi.org/10.5195/jmla.2017.88>
- Frank, M. C., Bergelson, E., Bergmann, C., Cristia, A., Floccia, C., Gervain, J., Hamlin, J. K., Hannon, E. E., Kline, M., Levelt, C., Lew-Williams, C., Nazzi, T., Panneton, R., Rabagliati, H., Soderstrom, M., Sullivan, J., Waxman, S., & Yurovsky, D. (2017). A collaborative approach to infant research: promoting reproducibility, best practices, and theory-building. *Infancy*, 22(4), 421–435. <https://doi.org/https://doi.org/10.1111/infa.12182>
- Franz, S. I. (1913). Observations of the preferential use of the right and left hands by monkeys. *Journal of Animal Behavior*, 3(2), 140–144. <https://doi.org/10.1037/h0075149>
- Freckleton, R. P., Harvey, P. H., & Pagel, M. (2002). Phylogenetic analysis and comparative data: A test and review of evidence. *The American Naturalist*, 160(6), 712–726. <https://doi.org/10.1086/343873>

- Friston, K. (2012). Ten ironic rules for non-statistical reviewers. *NeuroImage*, 61(4), 1300–1310. <https://doi.org/10.1016/j.neuroimage.2012.04.018>
- Gallup, G. G. (1970). Chimpanzees: self-recognition. *Science*, 167(3914), 86-87. <https://doi.org/10.1126/science.167.3914.86>
- Gardner, R. A. & Gardner, B. T. (1969). Teaching sign language to a chimpanzee. *Science*, 165, 664-672. <https://doi.org/10.1126/science.165.3894.664>
- Girard-Buttoz, C., Surbeck, M., Samuni, L., Tkaczynski, P., Boesch, C., Fruth, B., Wittig, R. M., Hohmann, G., & Crockford, C. (2020). Information transfer efficiency differs in wild chimpanzees and bonobos, but not social cognition. *Proceedings of the Royal Society B: Biological Sciences*, 287(1929), 20200523. <https://doi.org/10.1098/rspb.2020.0523>
- Goodall, J. (1964). Tool-using and aimed throwing in a community of free-living chimpanzees. *Nature*, 201(4926), 1264–1266. <https://doi.org/10.1038/2011264a0>
- Gross, C. (2016). Scientific Misconduct. *Annual Review of Psychology*, 67(1), 693–711. <https://doi.org/10.1146/annurev-psych-122414-033437>
- Gruber, T., Muller, M. N., Strimling, P., Wrangham, R., & Zuberbühler, K. (2009). Wild chimpanzees rely on cultural knowledge to solve an experimental honey acquisition task. *Current Biology*, 19(21), 1806–1810. <https://doi.org/10.1016/j.cub.2009.08.060>
- Gunhold, T., Whiten, A., & Bugnyar, T. (2014). Video demonstrations seed alternative problem-solving techniques in wild common marmosets. *Biology Letters*, 10(9), 20140439. <https://doi.org/10.1098/rsbl.2014.0439>
- Haggerty, M. E. (1909). Imitation in monkeys. *Journal of Comparative Neurology and Psychology*, 19(4), 337–455. <https://doi.org/https://doi.org/10.1002/cne.920190402>
- Hanus D and O'Madagain. D. (eds.) (2020). *The Atlas of Comparative Cognition*. <https://acc.clld.org/>
- Heinicke, S., Ordaz-Németh, I., Junker, J., Bachmann, M. E., Marrocoli, S., Wessling, E. G., Byler, D., Cheyne, S. M., Desmond, J., Dowd, D., Fitzgerald, M., Fourier, M., Goedmakers, A., Hernandez-Aguilar, R. A., Hillers, A., Hockings, K. J., Jones, S., Kaiser, M., Koops, K., ...& Köhl, H. S. (2021). Open-access platform to synthesize knowledge of ape conservation across sites. *American Journal of Primatology*, 83(1), e23213. <https://doi.org/https://doi.org/10.1002/ajp.23213>
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *The Behavioral and Brain Sciences*, 33(2–3), 61–135. <https://doi.org/10.1017/S0140525X0999152X>

- Herrmann, E., Call, J., Hernández-Lloreda, M. V., Hare, B., & Tomasello, M. (2007). Humans have evolved specialized skills of social cognition: the cultural intelligence hypothesis. *Science*, 317(5843), 1360–1366. <https://doi.org/10.1126/science.1146282>
- Hirata, S., Watanabe, K., & Masao, K. (2008). “Sweet-potato washing” revisited. In T. Matsuzawa (Ed.), *Primate origins of human cognition and behavior* (pp. 487–508). Tokyo: Springer Japan. https://doi.org/10.1007/978-4-431-09423-4_24
- Huxley, T. H. (1863). *Evidence as to man’s place in nature*. New York: Williams & Norgate.
- Janmaat, K. R. L. (2019). What animals do not do or fail to find: A novel observational approach for studying cognition in the wild. *Evolutionary Anthropology: Issues, News, and Reviews*, 28(6), 303–320. <https://doi.org/https://doi.org/10.1002/evan.21794>
- Janmaat, K. R., Polansky, L., Ban, S. D., & Boesch, C. (2014). Wild chimpanzees plan their breakfast time, type, and location. *Proceedings of the National Academy of Sciences of the United States of America*, 111(46), 16343–16348. <https://doi.org/10.1073/pnas.1407524111>
- John, L. K., Loewenstein, G., & Prelec, D. (2012). Measuring the prevalence of questionable research practices with incentives for truth telling. *Psychological Science*, 23(5), 524–532. <https://doi.org/10.1177/0956797611430953>
- Joly, M., Micheletta, J., De Marco, A., Langermans, J. A., Sterck, E. H. M., & Waller, B. M. (2017). Comparing physical and social cognitive skills in macaque species with different degrees of social tolerance. *Proceedings of the Royal Society B: Biological Sciences*, 284(1862), 20162738. <https://doi.org/10.1098/rspb.2016.2738>
- Jones, C., & Sabater Pi, J. (1969). Sticks used by chimpanzees in Rio Muni, West Africa. *Nature*, 223, 100–101. <https://doi.org/10.1038/223100a0>
- Kalan, A. K., Kulik, L., Arandjelovic, M., Boesch, C., Haas, F., Dieguez, P., Barratt, C. D., Abwe, E. E., Agbor, A., Angedakin, S., Aubert, F., Ayimisin, E. A., Bailey, E., Bessone, M., Brazzola, G., Buh, V. E., Chancellor, R., Cohen, H., Coupland, C., ... & Köhl, H. S. (2020). Environmental variability supports chimpanzee behavioural diversity. *Nature Communications*, 11(1), 4451. <https://doi.org/10.1038/s41467-020-18176-3>
- Kellogg, W. N., & Kellogg, L. A. (1933). *The ape and the child: A study of environmental influence upon early behavior*. New York: Whittlesey House.
- Kemnitz, J. W. (2019). Database for indices of aging in nonhuman primates. *Innovation in Aging*, 3(Suppl 1), S957–S957. <https://doi.org/10.1093/geroni/igz038.3472>

- Kinnaman, A. J. (1902). Mental life of two *Macacus Rhesus* monkeys in captivity. I. *The American Journal of Psychology*, 13(1), 98–148.
<https://doi.org/10.2307/1412207>
- Klein, R. A., Ratliff, K. A., Vianello, M., Adams, R. B., Bahník, Š., Bernstein, M. J., Bocian, K., Brandt, M. J., Brooks, B., Brumbaugh, C. C., Cemalcilar, Z., Chandler, J., Cheong, W., Davis, W. E., Devos, T., Eisner, M., Frankowska, N., Furrow, D., Galliani, E. M., ... & Nosek, B. A. (2014). Investigating variation in replicability. A “many labs” replication project. *Social Psychology*, 45(3), 142–152.
<https://doi.org/10.1027/1864-9335/a000178>
- Köhler, W. (1925). *The mentality of apes*. Kegan Paul, Trench, Trubner [Original work published: *Intelligenzprüfungen an Anthropoiden* (1917). Berlin: Königliche Akademie der Wissenschaften.
- MacLean, E. L., Hare, B., Nunn, C. L., Addessi, E., Amici, F., Anderson, R. C., Aureli, F., Baker, J. M., Bania, A. E., Barnard, A. M., Boogert, N. J., Brannon, E. M., Bray, E. E., Bray, J., Brent, L. J. N., Burkart, J. M., Call, J., Cantlon, J. F., Cheke, L. G., ... & Zhao, Y. (2014). The evolution of self-control. *Proceedings of the National Academy of Sciences*, 111(20), E2140 LP-E2148.
<https://doi.org/10.1073/pnas.1323533111>
- ManyBabies Consortium. (2020). Quantifying sources of variability in infancy research using the infant-directed-speech preference. *Advances in Methods and Practices in Psychological Science*, 3(1), 24–52. <https://doi.org/10.1177/2515245919900809>
- ManyBabies Consortium (under review). Infants’ social evaluation of helpers and hinderers: a large-scale, multi-lab, coordinated replication study.
- ManyPrimates, Altschul, D.M.; Beran, M.J.; Bohn, M.; Caspar, K.R.; Fichtel, C.; Försterling, M.; Grebe, N.M.; Hernandez-Aguilar, R.A.; Kwok, S.C.; Llorente, M.; Motes-Rodrigo, A.; Proctor, D.; Sánchez-Amaro, A.; Simpson, E.A.; Szabelska, A.; Taylor, D, J., van der Mescht, J., ... & Watzek, J. (2019a). Collaborative open science as a way to reproducibility and new insights in primate cognition research. *Japanese Psychological Review*, 62(3), 205–220.
- ManyPrimates, Altschul, D. M., Beran, M. J., Bohn, M., Call, J., DeTroy, S., Duguid, S. J., Egelkamp, C. L., Fitchel, C., Fischer, J., Flessert, M., Hanus, D., Haun, D. B. M., Haux, L. M., Hernandez-Aguilar, A., Herrmann, E., Hopper, L. M., Joly, M., Kano, F., ... & Watzek, J. (2019b). Establishing an infrastructure for collaboration in primate cognition research. *PLOS ONE*, 14(10), e0223675.
<https://doi.org/10.1371/journal.pone.0223675>
- ManyPrimates, Aguenounou Sèmèvo, G., Ballesta, S., Beaud, A., Bustamante, L., Canteloup, C., Joly, M., Loyant, L., Meunier, H., Roig, A., Troisi, C.A. & Zablocki-Thomas, P. (2020). ManyPrimates: une infrastructure de collaboration

internationale dans la recherche en cognition des primates. *Revue de Primatologie*, 11. <https://doi.org/10.4000/primatologie.8808>

Marriott, J. G., & Abelson, J. S. (1980). Age differences in short-term memory of test-sophisticated rhesus monkeys. *AGE*, 3(1), 7–9.

<https://doi.org/10.1007/BF02434999>

Matsuzawa, T. (1985). Use of numbers by a chimpanzee. *Nature*, 15(6014), 57-59.

<https://doi.org/10.1038/315057a0>

Matsuzawa, T., & McGrew, W. C. (2008). Kinji Imanishi and 60 years of Japanese primatology. *Current Biology*, 18(14), R587-R591.

<https://doi.org/https://doi.org/10.1016/j.cub.2008.05.040>

McNutt, M. K., Bradford, M., Drazen, J. M., Hanson, B., Howard, B., Jamieson, K. H., Kiermer, V., Marcus, E., Pope, B. K., Stang, R. S. S. P. J., & Verma, I. M.

(2018). Transparency in authors' contributions and responsibilities to promote integrity in scientific publication. *Proceedings of the National Academy of Sciences*, 115(11), 2557–2560. <https://doi.org/10.1073/pnas.1715374115>

Messinger, A., Sirmipilatz, N., Heuer, K., Loh, K. K., Mars, R. B., Sein, J., Xu, T., Glen, D., Jung, B., Seidlitz, J., Taylor, P., Toro, R., Garza-Villarreal, E. A., Sponheim, C., Wang, X., Benn, R. A., Cagna, B., Dadarwal, R., Evrard, H. C., ... & Klink, P. C. (2021). A collaborative resource platform for non-human primate neuroimaging. *NeuroImage*, 226, 117519.

<https://doi.org/https://doi.org/10.1016/j.neuroimage.2020.117519>

Meunier, H. (2017). Do monkeys have a theory of mind? How to answer the question?

Neuroscience and Biobehavioral Reviews, 82, 110-123. <https://doi.org/10.1016/j.neubiorev.2016.11.007>

<https://doi.org/10.1016/j.neubiorev.2016.11.007>

Miklósi, A. (2002). Can dancing replace scientific approach: Lost (again) in chimpancentrism. *Behavioral and Brain Sciences*, 25(5), 633–634.

<https://doi.org/10.1017/S0140525X02360114>

Milham, M. P., Ai, L., Koo, B., Xu, T., Amiez, C., Balezeau, F., Baxter, M. G., Blezer, E. L. A., Brochier, T., Chen, A., Croxson, P. L., Damatac, C. G., Dehaene, S.,

Everling, S., Fair, D. A., Fleysher, L., Freiwald, W., Froudust-Walsh, S., Griffiths, T. D., ... & Schroeder, C. E. (2018). An open resource for non-human primate

imaging. *Neuron*, 100(1), 61-74.e2.

<https://doi.org/https://doi.org/10.1016/j.neuron.2018.08.039>

Milham, M., Petkov, C. I., Margulies, D. S., Schroeder, C. E., Basso, M. A., Belin, P.,

Fair, D. A., Fox, A., Kastner, S., Mars, R. B., Messinger, A., Poirier, C., Vanduffel, W., Van Essen, D. C., Alvand, A., Becker, Y., Ben Hamed, S., Benn, A., Bodin, C.,

... & Zhou, Y. (2020). Accelerating the evolution of nonhuman primate

- neuroimaging. *Neuron*, 105(4), 600–603.
<https://doi.org/https://doi.org/10.1016/j.neuron.2019.12.023>
- Miller, G. A. (2003). The cognitive revolution: A historical perspective. *Trends in Cognitive Sciences*, 7(3), 141–144. [https://doi.org/https://doi.org/10.1016/S1364-6613\(03\)00029-9](https://doi.org/https://doi.org/10.1016/S1364-6613(03)00029-9)
- Morange, M. (2000). *A history of molecular biology*. Harvard: Harvard University Press.
- Moreno, C. B., & Muñoz-Delgado, J. (2007). An account on the history of ethology. *Suma Psicológica*, 14(2), 213–224. <https://doi.org/10.14349/SUMAPSI2007.29>
- Morgan, C. L. (1894). *Contemporary science series. An introduction to comparative psychology*. London: Walter Scott Publishing Company.
- Moshontz, H., Campbell, L., Ebersole, C. R., IJzerman, H., Urry, H. L., Forscher, P. S., Grahe, J. E., McCarthy, R. J., Musser, E. D., Antfolk, J., Castille, C. M., Rhys, Evans, T., Fielder, S., Kay Flake, J., Forero, D. A., Janssen, S. M. J., Keene, J. R., Protzko, J., Aczel, B., ... & Chartier, C. R. (2018). The Psychological Science Accelerator: Advancing Psychology through a distributed collaborative network. *Advances in Methods and Practices in Psychological Science*, 1(4), 501–515.
<https://doi.org/10.1177/2515245918797607>
- Motes-Rodrigo, A., Mundry, R., Call, J., & Tennie, C. (2021). Evaluating the influence of action- and subject-specific factors on chimpanzee action copying. *Royal Society Open Science*, 8:200228. <https://doi.org/10.1098/rsos.200228>
- Nater, A., Mattle-Greminger, M. P., Nurcahyo, A., Nowak, M. G., de Manuel, M., Desai, T., Groves, C., Pybus, M., Sonay, T., Roos, C., Lameira, A. R., Wich, S. A., Askew, J., Davila-Ross, M., Fredriksson, G., de Valles, G., Casals, F., Prado-Martinez, J., Goossens, B., ... & Krützen, M. (2017). Morphometric, Behavioral, and Genomic Evidence for a New Orangutan Species. *Current Biology*, 27(22), 3487–1786341376. <https://doi.org/10.1016/j.cub.2017.09.047>
- Nishida, T. (2011). *Chimpanzees of the lakeshore: natural history and culture at Mahale*. Cambridge: Cambridge University Press.
- Nissen, H. W., & Crawford, M. P. (1936). A preliminary study of food-sharing behavior in young chimpanzees. *Journal of Comparative Psychology*, 22(3), 383–419.
<https://doi.org/10.1037/h0062234>
- Open Science Collaboration (2015). Estimating the reproducibility of psychological science. *Science*, 349(6251), aac4716. <https://doi.org/10.1126/science.aac4716>

- Pasnak, R. (1979). Acquisition of prerequisites to conservation by macaques. *Journal of Experimental Psychology: Animal Behavior Processes*, 5(2), 194–210.
<https://doi.org/10.1037/0097-7403.5.2.194>
- Pennycook, G., & Thompson, V. A. (2018). An analysis of the Canadian cognitive psychology job market (2006–2016). *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, 72(2), 71.
<https://doi.org/10.1037/cep0000149>
- J. Perner, (2012). MiniMeta: In search of minimal criteria for metacognition. In M. J. Beran, J. Brandl, J. Perner, & J. Proust (Eds.), *The foundations of metacognition* (pp. 94- 118). Oxford, UK: Oxford University Press
- Persson, T., Sauciuc, G.A., & Madsen, E.A. (2017). Spontaneous cross-species imitation in interactions between chimpanzees and zoo visitors. *Primates*, 59, 19–29.
<https://doi:10.1007/s10329-017-0624-9>
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1(4), 515-526.
<https://doi.org/10.1017/S0140525X00076512>
- Popper, K. R. (2002a). *The logic of scientific discovery* (2nd edition). London, UK: Taylor & Francis.
- Popper, K. R. (2002b). *The open society and its enemies* (7th edition). London, UK: Taylor & Francis.
- Povinelli, D. J. (2000). *Folk physics for apes*. New York: Oxford University Press.
- Reuter, K., & Venart, L. (2014). Announcing the Lemur Conservation Network: working together to save lemurs from extinction. *Primate Conservation*, 28(1), 37–38. <https://doi.org/0.1896/052.028.0111>
- Richter, S. H., Garner, J. P., & Würbel, H. (2009). Environmental standardization: cure or cause of poor reproducibility in animal experiments? *Nature Methods*, 6(4), 257–261. <https://doi.org/10.1038/nmeth.1312>
- Ross, S.R., & Leinwand, J.G. (2020). A review of research in primate sanctuaries. *Biology Letters*, 16, 20200033. <http://dx.doi.org/10.1098/rsbl.2020.0033>
- Rumbaugh, D. M., & Gill, T. V. (1973). The learning skills of great apes. *Journal of Human Evolution*, 2(3), 171–179. [https://doi.org/10.1016/0047-2484\(73\)90073-0](https://doi.org/10.1016/0047-2484(73)90073-0)
- Savage-Rumbaugh, S., & Fields, W. M. (2006). Rules and tools: Beyond Anthropomorphism. In N. Toth & K. D. Schick (Eds.), *The Oldowan: Case studies into the earliest Stone Age* (pp. 223-241). Stone Age Institute Press.

- Savage-Rumbaugh, E. S., Rumbaugh, D. M., Smith, S. T., & Lawson, J. (1980). Reference: The linguistic essential. *Science*, 210(4472), 922-925.
<https://doi.org/10.1126/science.7434008>
- Schoene, C. U. R., & Brend, S. (2002). Primate sanctuaries - a delicate conservation approach. *South African Journal of Wildlife Research*, 32, 109–113.
- Schwitzer, C., Mittermeier, R. A., Johnson, S. E., Donati, G., Irwin, M., Peacock, H., Ratsimbazafy, J., Razafindramanana, J., Louis, E. E., Chikhi, L., Colquhoun, I. C., Tinsman, J., Dolch, R., LaFleur, M., Nash, S., Patel, E., Randrianambinina, B., Rasolofoharivelo, T., & Wright, P. C. (2014). Averting lemur extinctions amid Madagascar's political crisis. *Science*, 343(6173), 842 LP – 843.
<https://doi.org/10.1126/science.1245783>
- Seed, A. M., Hanus, D., & Call, J. (2011). Causal knowledge in corvids, primates, and children. In T. McCormack, C. Hoerl, & S. Butterfill (Eds.), *Tool use and causal cognition* (pp. 89–110). Oxford: Oxford University Press.
- Seed, A., & Tomasello, M. (2010). Primate cognition. *Topics in Cognitive Science*, 2(3), 407-419. <https://doi.org/10.1111/j.1756-8765.2010.01099.x>
- Setchell, J. M., Fernandez-Duque, E., Higham, J. P., Rothman, J. M., & Shülke, O. (2016). Editorial: Changes and clarifications to the policies of the *International Journal of Primatology* to promote transparency and open communication. *International Journal of Primatology*, 37(6), 617–627.
<https://doi.org/10.1007/s10764-016-9925-x>
- Seyfarth, R.M., Cheney, D.L. (2017). Precursors to language: Social cognition and pragmatic inference in primates. *Psychonomic Bulletin and Review*, 24, 79–84.
<https://doi.org/10.3758/s13423-016-1059-9>
- Seyfarth, R. M., Cheney, D. L., & Marler, P. (1980). Vervet monkey alarm calls: Semantic communication in a free-ranging primate. *Animal Behaviour*, 28(4), 1070–1094. [https://doi.org/10.1016/S0003-3472\(80\)80097-2](https://doi.org/10.1016/S0003-3472(80)80097-2)
- Simonsohn, U., Nelson, L. D., & Simmons, J. P. (2014). P-curve: A key to the file-drawer. *Journal of Experimental Psychology: General*, 143(2), 534–547.
<https://doi.org/10.1037/a0033242>
- [Stapel Investigation. \(2012\). Flawed science: The fraudulent research practices of social psychologist Diederik Stapel. Available at https://www.commissielevelt.nl.](https://www.commissielevelt.nl)
- Stokes, R., Tully, G., & Rosati, A. G. (2018). Pan African Sanctuary Alliance: securing a future for the African great apes. *International Zoo Yearbook*, 52(1), 173–181.
<https://doi.org/10.1111/izy.12174>

- Striedter, G. F. (2016). *Neurobiology: A functional approach*. Oxford: Oxford University Press.
- Strier, K. B., Altmann, J., Brockman, D. K., Bronikowski, A. M., Cords, M., Fedigan, L. M., Lapp, H., Liu, X., Morris, W. F., Pusey, A. E., Stoinski, T. S., & Alberts, S. C. (2010). The Primate Life History Database: A unique shared ecological data resource. *Methods in Ecology and Evolution*, 1(2), 199–211. <https://doi.org/10.1111/j.2041-210X.2010.00023.x>
- Suzuki, A. (1966). On the insect-eating habits among wild chimpanzees living in the savanna woodland of western Tanzania. *Primates*, 7(4), 481–487. <https://doi.org/10.1007/BF01730244>
- Thompson, R. K., & Oden, D. L. (2000). Categorical perception and conceptual judgments by nonhuman primates: The paleological monkey and the analogical ape. *Cognitive Science*, 24(3), 363–396. https://doi.org/10.1207/s15516709cog2403_2
- Thorndike, E. L. (1901). The mental life of the monkeys. *The Psychological Review: Monograph Supplements*, 3(5), i–57. <https://doi.org/10.1037/h0092994>
- Tomasello, M., & Call, J. (1997). *Primate cognition*. Oxford: Oxford University Press.
- Toth, N., Schick, K. D., Savage-Rumbaugh, E. S., Sevcik, R. A., & Rumbaugh, D. M. (1993). *Pan* the tool-maker: Investigations into the stone tool-making and tool-using capabilities of a bonobo (*Pan paniscus*). *Journal of Archaeological Science*, 20(1), 81–91. <https://doi.org/10.1006/jasc.1993.1006>
- [Tullock, G. \(2001\). A Comment on Daniel Klein's "A Plea to Economists Who Favor Liberty". Eastern Economic Journal, 27\(2\), 203-207.](#)
- van de Waal, E., Borgeaud, C., & Whiten, A. (2013). Potent social learning and conformity shape a wild primate's foraging decisions. *Science*, 340(6131), 483 LP – 485. <https://doi.org/10.1126/science.1232769>
- van de Waal, E., Claidière, N., & Whiten, A. (2015). Wild vervet monkeys copy alternative methods for opening an artificial fruit. *Animal Cognition*, 18(3), 617–627. <https://doi.org/10.1007/s10071-014-0830-4>
- Van Essen, D. C., Smith, S. M., Barch, D. M., Behrens, T. E. J., Yacoub, E., & Ugurbil, K. (2013). The WU-Minn Human Connectome Project: An overview. *NeuroImage*, 80, 62–79. <https://doi.org/https://doi.org/10.1016/j.neuroimage.2013.05.041>
- van 't Veer, A. E., & Giner-Sorolla, R. (2016). Pre-registration in social psychology—A discussion and suggested template. *Journal of Experimental Social Psychology*, 67, 2–12. <https://doi.org/10.1016/j.jesp.2016.03.004>

- Vazire, S. (2018). Implications of the credibility revolution for productivity, creativity, and progress. *Perspectives on Psychological Science*, 13(4), 411–417.
<https://doi.org/10.1177/1745691617751884>
- Visalberghi, E., Addessi, E., Truppa, V., Spagnoletti, N., Ottoni, E., Izar, P., & Frigaszy, D. (2009). Selection of effective stone tools by wild bearded capuchin monkeys. *Current Biology*, 19(3), 213-217.
<https://doi.org/10.1016/j.cub.2008.11.064>
- Vostal, F. (2016). *Accelerating academia. The changing structure of academic time*. Basingstoke, UK: Palgrave Macmillan.
- Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review*, 20(2), 158-177. <https://doi.org/10.1037/h0074428>
- Whiten, A. & van de Waal, E. (2017). Social learning, culture and the ‘socio-cultural brain’ of human and non-human primates. *Neuroscience & Biobehavioral Reviews*, 82, 58-75. <https://doi.org/10.1016/j.neubiorev.2016.12.018>
- Witmer, L. (1910). Intelligent imitation and curiosity in a monkey. *The Psychological Clinic*, 3, 225–227.
- Yerkes, R. M. (1916). The mental life of monkeys and apes: A study of ideational behavior. In J.B. Watson (Ed.), *Behavior Monographs*, 3(1). Cambridge, MA: Henry Holt and Company.
- Yerkes, R. M., & Yerkes, A. W. (1929). *The great apes*. Yale: Yale University Press.
- Zeise, M. L. (Ed.). (2021). *Neuroscience for psychologists: an introduction*. Cham: Springer Nature Switzerland AG.