INTRODUCTION

Again, and Again, and Again …

REPLICATION—THE CONFIRMATION OF RESULTS AND CONCLUSIONS FROM ONE STUDY
obtained independently in another—is considered the scientific gold standard.
New tools and technologies, massive amounts of data, long-term studies, interdis-
ciplinary approaches, and the complexity of the questions being asked are compli-
cating replication efforts, as are increased pressures on scientists to advance their
research. The five Perspectives in this section (and associated News and Careers
stories, Readers' Poll, and Editorial) explore some of the issues associated with
replicating results across various fields.

Ryan (p. 1229) highlights the excitement and challenges that come with field-
based research. In particular, observing processes as they occur in nature allows
for discovery but makes replication difficult, because the precise conditions sur-
rounding the observations are unique. Further, although laboratory research allows
for the specification of experimental conditions, the conclusions may not apply to
the real world. Debate about the merits of lab-based and field-based studies has
been a persistent theme over time. Tomasello and Call (p. 1227) further contribute
to this debate in their discussion of some obvious barriers to replication in primate
cognition and behavior research (small numbers of subjects, expense, and ethics
issues) as well as more subtle ones, such as the nontrivial challenge of designing
tasks that elicit complex cognitive behaviors.

New technologies continue to produce a deluge of data of different varieties,
raising expectations for new knowledge that will translate into meaningful thera-
peutics and insights into health. Ioannidis and Khoury (p. 1230) outline multiple
steps for validating such large-scale data on the path to clinical utility and make
suggestions for incentives (and penalties) that could enhance the availability of
reliable data and analyses.

Peng (p. 1226) discusses the need for a minimum standard of reproducibility
in computer sciences, arguing that enough information about methods and code
should be available for independent researchers to reach consistent conclusions
using original raw data. Specifically, he describes a model that one journal has
used to make this a reality.

The need to convince the public that data are replicable has grown as science
and public policy-making intersect, an issue that has has beset climate change
studies. As Santer *et al.* (p. 1232) describe, having multiple groups examining the
same data and generating new data has led to robust conclusions.

The importance of replication and reproducibility for scientists is unquestioned.
Sometimes attempts to replicate reveal scientific uncertainties. This is one of the
main ways that science progresses (see associated News stories of faster-than-light
neutrinos and sirtuins, pp. 1200 and 1194). Unfortunately, in rare instances (com-
pared to the body of scientific work), it can also indicate fraud (see the Editorial by
Crocker and Cooper, p. 1182). How do we promote the publication of replicable
data? The authors in this section come up with possibilities that are targeted at
funders, journals, and the research culture itself. In the Readers' Poll, you can make
your views known as well.

– BARBARA R. JASNY, GILBERT CHIN, LISA CHONG, SACHA VIGNIERI

Data Replication & Reproducibility

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Perspectives

Science