Many Paths: "As-you-go"-publication system

Summary

To improve the way in which research is currently conducted and communicated, Hartgerink and van Zelst (2018) have recently suggested a new research communication infrastructure. In their vision, research output is communicated continuously “as-you-go” as opposed to the current system where research is only communicated after the entire cycle has been completed (i.e., “after-the-fact”). This “as-you-go” system offers a host of advantages, including more transparency and a more rapid dissemination of research output. To examine the viability of their system, I aim to build a functioning implementation of their proposed infrastructure to investigate the research question “Does power corrupt?”

Specifically, in this application I propose the *Many Paths* model, which starts with one research question and allows an emergent process to occur thereafter. Given that results are often path dependent and many paths can be taken in a research process, it is worthwhile to study which what paths a research project initiated, pruned, and merged.

The *Many Paths* model offers insight into how researchers from different disciplines approach and study the same research question in a different way, and how that may relate to different conclusions being reached. As such, the project offers insight into the value of the “as-you-go” form of research communication. Furthermore, by inviting researchers from various disciplines to collaboratively address the question “Does power corrupt?” the *Many Paths* project offers a collaborative and integrated approach to that age-old question.

The funding will be used primarily to set up the communication infrastructure that will allow the emergent collaborative project in the form of *Many Paths* to happen. Here, researchers communicate each step of the research process directly after it occurred, thereby linking each step to a previous one. This structure allows for the paths of the research process to be investigated. Moreover, the “as-you-go”-communication infrastructure allows collaborators to prune their own research progress into different areas, as they observe and get inspired by the other collaborators. The remainder of the funding will be used for a data scientist to analyze the paths via which researchers communicate on the *Many Paths* project, to support data collection (if needed) and for organizing meetings on the project.

Current state

The current scientific system is unsustainable for knowledge production. It is supposed to fulfill five key functions (de Sompel, Payette, Erickson, Lagoze, & Warner, 2004; Roosendaal & Geurts, 1998), but there are clear limitations: (1) Research needs to be registered, but retrospective communication is biased (e.g., publication bias; Franco, Malhotra, & Simonovits, 2014), (2) research needs to be certified, but peer review is inconsistent (Bornmann, Mutz, & Daniel, 2010) and subject to human biases, (3) research needs to be discoverable and accessible, but remains a pernicious issue in both over- and underdeveloped countries (Tennant, et al., 2016), (4) research needs to be archived, but control over distribution harms archival (De Domenico & Arenas, 2017), and (5) research needs to be incentivized, but the current incentive systems reward biased research, leading to a natural selection of bad science (Smaldino & McElreath, 2016).

The research process directly affects results, yet we fail to accurately and completely communicate and assess that process. Figure 1 depicts various ways the research process may influence results, with a combination of these leading to false positive rates of 60% (Simmons, Nelson, & Simonsohn, 2011). In a retrospective publication, the authors tell a story that may or may not be accurate or complete through external factors such as misunderstandings of statistics, pressures to publish, strong beliefs in theories, or lapses in memory. This storytelling is inherent to the retrospective nature of the publication, hence, we are unable to properly assess the veracity and credibility of research findings.

Figure 1. The empirical cycle (De Groot, 1969; blue) and systemic or individual issues that undermine it (red). Figure reused under CC-BY (Munafò et al., 2017)

Many efforts are being made to change the publishing landscape to reduce these issues, but these efforts take isolated approaches. Preregistration reintroduces chronology into the research

process. Study registries (e.g., ClinicalTrials.gov) aim to reduce publication bias. Open Access policies (e.g., Plan S) aim to facilitate access. However, these efforts remain external to the communication system that should register, certify, archive, make discoverable, and incentivize knowledge in the widest sense possible. There is a case to be made for piecemeal reform, but few researchers actually adopt new practices that aim to improve sustainable knowledge production (Hardwicke, Wallach, Kidwell, & Ioannidis, 2019). As such, many small changes apparently do not foster the desired result.

To move towards a sustainable system, it seems that a coherent alternative communication

system is needed. The issues are too large and interconnected to be addressed in isolation; reform no longer is a viable option when the system is too broken to reform.

A recent proposal provides a fundamental break from the current communication paradigm. This proposal calls the current system “after-the-fact” and suggests an “as-you-go” approach (Hartgerink & van Zelst, 2018). This system entails continuous public communication of the research process in a step-by-step manner, allowing for steps to be retraced to understand its origins (i.e., provenance). They argue that this will (1) help make registration more complete, (2) make research easily archivable and (3) completely accessible by design, (4) embed the empirical cycle in communication, and (5) allow for more precise research evaluation indicators to be developed. A technical proposal with a functional proof of concept shows it can be implemented immediately with appropriate resources (Hartgerink, 2019).

Project description

Goal 1: Software engineering

Resource restrictions currently obstruct the main engineer of the “as-you-go” infrastructure to further implement this paradigm altering model (personal communication, 2019). By providing financial resources from this fund, I will help the engineer free up time to implement the “as-you-go” communication infrastructure into practical and usable software. This is necessary to make Goal 2 possible.

Goal 2: Many Paths

I will initiate the first large scale meta-research project in work- and organization studies. To this end, I propose the *Many Paths* model, which allows me to study how a research process develops. When researchers use this “as-you-go” infrastructure, each path of the process is documented. The *Many Paths* project will investigate “Does power corrupt?” as its initial research question.

This research question is important for organizations as well as societies at large, but requires several layers to be answered rigorously, such as whether power is driven by nature or nurture, and under which conditions the potential corrupting influence of power can be dampened. A comprehensive answer requires input from diverse fields (e.g., management, philosophy, psychology), providing fruitful ground to test this collaborative stepwise public communication infrastructure.

The *Many Paths* model provides a new way of studying how the research process affects results. Figure 2 depicts the conceptual differences between the *Many Labs* (Klein et al., 2014), *Many Analysts* (Silberzahn et al., 2018), and *Reproducibility Project* (Open Science Collaboration, 2015). *Many Labs* varies only the data, *Many Analysts* varies the results and conclusions, and the *Reproducibility Project* varies the research questions, theories, and data. In the *Many Paths* model, the research question is fixed but theories, data, results, and conclusions can emerge.

Figure 2. Conceptual depiction of how various large scale meta-research projects vary the research process as a way of understanding how it affects the results (blue = previous; green = proposed). RQ = Research Question; Th = Theory; Da = Data; Re = Results; Co = Conclusion.

Methods Goal 1: Software engineering

The software engineer will implement four consecutive components: Component 1 creates the formal specifications for the “as-you-go” infrastructure that will serve as the basis for implementation. These standardize the base actions needed to implement the new infrastructure and will result in a text-based specification that anyone may implement.

Component 2 implements these formal text-based specifications in a NodeJS code library that can be used to build applications.

Component 3 uses the library from Component 2 to build a NodeJS based command line tool. With this, researchers can start communicating on the “as-you-go” infrastructure after some minor training.

Component 4 uses the library from Component 2 and reuses functionality from Component 3 to build a visual interface to create an easy to use application. With this, researchers can interact with the “as-you-go” infrastructure *without* additional training.

Methods Goal 2: Many Paths

Together with four committed other researchers (two organization scientists [Netherlands] and two meta-researchers [Netherlands, Germany]), I will leverage the “as-you-go” paradigm and infrastructure (Goal 1) to manage the first *Many Paths* project on the research question “Does power corrupt?”

First, we will invite researchers to participate in this public collaborative project. To this end we collect corresponding author e-mail addresses from peer-reviewed publications on power and corruption from the last three years, adding personal contacts. Participating researchers can contribute one or multiple steps, at any point, as befitting their specialization. We aim for a *minimum* of 30 participating researchers.

Second, while the software engineering is ongoing (Goal 1), we will invite the participating researchers to start working on theoretical approaches to “Does power corrupt?”

Third, when the command line tool is implemented, participating researchers are invited to a 90 minute online workshop. This workshop will train the participating researchers in using the command line tool.

Fourth, researchers are now able to continue at their own pace to further investigate this research question. This means that they can start to formulate predictions based on the theories, designs to test predictions, and so on. Some financial support for data collection will be made available (see Budget).

Fifth, we will monitor and evaluate the paths that emerge within the project. We will research how many paths are initiated, how many are pruned, and how many are merged. Additionally, we will produce indicators to evaluate the path structure using network analysis. These indicators can be used to evaluate the structure for critical (clusters) of actors, critical steps in the research process, interconnectedness of the process, and other potential valuable indicators to evaluate the process. To this end, we will contract a data scientist specialized in network analysis.

Approach

[illegible]

Goal	Part	09/19	10/19	11/19	12/19	01/20	02/20	03/20	04/20	05/20	06/20	07/20	08/20
2	2			x	x	x							
	3						x						
	4							x	x	x	x	x	x
	5					x	x	x	x	x	x	x	x

Outcomes

Goal 1: Software Development Kit (SDK), command line tool, and a desktop application (all MIT licensed).

Goal 2: Many Paths meta-research model, network indicators, ongoing large scale collaborative project.

Based on these outcomes, we also intend to write two joint papers. The first will be a paper addressing the question “Does power corrupt?” based on various perspectives and datasets (corresponding Goal 2); the second a meta-research paper addressing the value of the “as-you-go” research communication infrastructure is (corresponding Goal 1).

Risks and gains

The software engineer has committed in writing to build the infrastructure if this proposal is funded. I therefore consider the main risks to be that (1) technical difficulties arise during software development that cause non-trivial delays and (2) the pace of the emergent research process is too slow to have any meaningful process emerge within a year.

Gains include: (1) A new and reusable meta-research model to study the development of the research process, (2) open source implementations of the “as-you-go” infrastructure, (3) network-based indicators to evaluate research, (4) contributorship based project management.

Budget

What	Tasks	Amount
Software engineer	160 days at 300EUR p/day	53 280CHF
Data scientist	60 days at 300EUR p/day	19 980CHF
Research costs	Data collection funds	16 650CHF
Additional costs	Meetings	8 880CHF
Total	1EUR = 1.11CHF (12/07/19)	98 790CHF

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