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Article:

CONCEPTUAL REVIEW ARTICLE

(Why) Are Open Research Practices the Future for the Study of Language Learning?

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Abstract: Open research practices are relevant to all stages of research, from conceptualization through dissemination. Here, we discuss key facets of open research, highlighting its rationales, infrastructures, behaviors, and challenges. Part I conceptualizes open research and its rationales. Part II identifies challenges such as the speed and cost of open research, the usability of open data and materials, the difficulties of conducting replication research, and the economics and sustainability of open access and open research generally. In discussing these challenges, we have sought to provide examples of good practice, describe and evaluate emerging innovations, and envision change. Part III considers ongoing coevolutions of culture, infrastructure, and behaviors and acknowledges the limitations of our review and of open research practices. We argue that open research is indeed a large part of our future, and most—if not all—challenges

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are surmountable, but doing so requires significant changes for many aspects of the research process.

Conceptualizing Open Research and Its Rationales

Discussion about open research seems to have hit the mainstream in language learning research: Books and conference proceedings have chapters on the topic (Handley & Marsden, 2014; Marsden, 2019a; 2020); special issues of journals feature articles on open practices (Bolibaugh et al., 2021; Saito et al., 2020); methodological syntheses argue that open research is an important way forward (Gass et al., 2021; Marsden, Thompson, & Plonsky, 2018); a burgeoning metascience is examining the extent of transparency (Derrick, 2016) and has flagged the benefits to researchers of doing open research both within (Marsden, 2019b; Plonsky & Derrick, 2016) and outside (McKiernan et al., 2016) the field of language learning; infrastructure has been established (IRIS in 2011, Marsden & Mackey, 2014; the Tromsø Repository of Language and Linguistics, https://site.uit.no/trolling); a small but increasing number of journals ask for materials and data to be made open and award open science badges, with editorials announcing open practice innovations (Gerrig & Rastle, 2019; Marsden, Crossley, et al., 2019); and social media can sizzle with advocacy.

The breadth of this activity in language learning research reflects the breadth of the term open research itself. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has defined open as consisting of four attributes: discoverable, accessible, reusable, and transparent (Hampson et al., 2020), and this definition applies to all open research[1] endeavors. Talking about and operationalizing these attributes require highly complex and multifaceted domains of activity, captured by the Framework for Open and Reproducible Research Training (FORRT) taxonomy of terminology and definitions (Azevedo et al., 2019; FORTT, n.d.). The taxonomy in Figure 1 clearly demonstrates that one article, including this one, cannot do justice to the vast topic of open research. The term defies easy definition, but we are broadly content with Vicente-Saez and Martinez-Fuentes's (2018) definition (for which we have included our suggested additions in square brackets): Open research is "transparent and [freely] accessible knowledge that is shared and developed through [freely accessible] collaborative networks, [infrastructures, and methods]" (p. 428).

Indeed, open research arguably represents seismic changes in all aspects of the research endeavor. In some disciplines, the open research movement
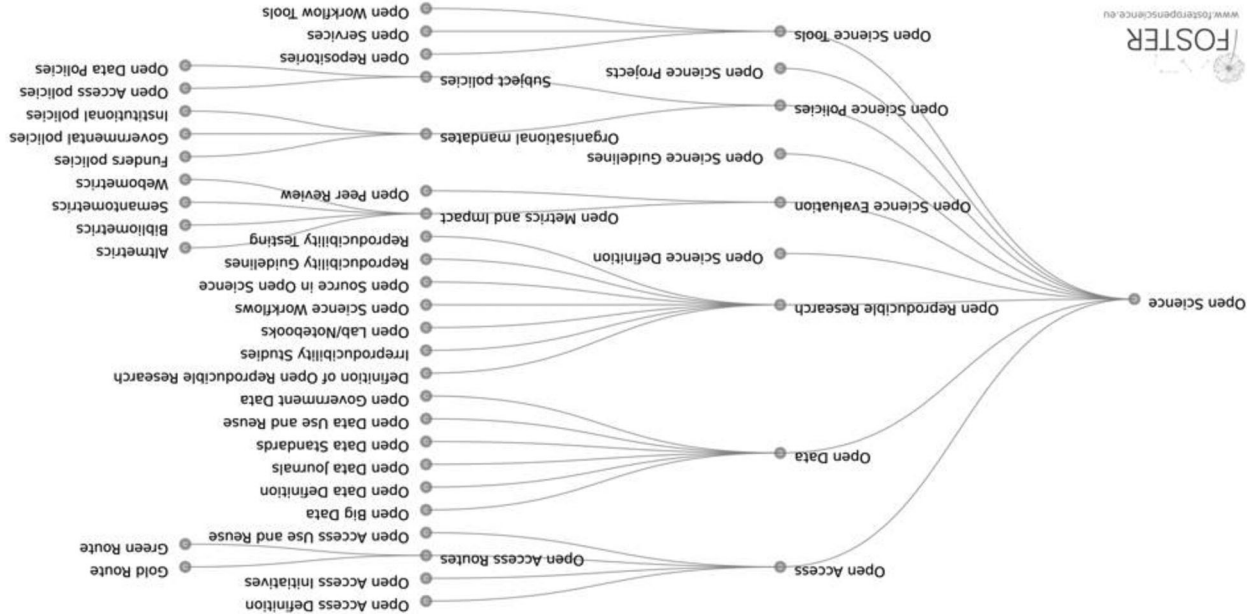
Figure 1 Open science taxonomy adapted from Pontika et al. (2015, p. 3).

has even been hailed a renaissance (Nelson et al., 2018), and some aspects of the movement could summon shifts akin to those of democratization in the sociopolitical sphere. It has parallels in other step changes that have defined eras in the development of human knowledge, such as the enlightenment or the digital age, and in social spheres, such as disruptive innovations like Uber or Airbnb. All of these step changes have deranged established ways of operating, shifting balances of power and knowledge from smaller to larger groups.

But why all this activity, which ultimately strives to change deeply rooted research traditions, cultures, infrastructures, and communities of practice? The different rationales for open research have been evolving for many years (for an overview, see Bartling & Friesike, 2014). An exceptionally broad range of rationales have been used to advocate open research practices, including economic arguments (e.g., improving efficiency), ambitions for social justice (e.g., improving global equity in the knowledge economy), achieving better inclusivity and diversity (of researchers, participants, and research questions), moral arguments (e.g., fulfilling researchers' sense of epistemic responsibility to share their knowledge), and personal incentivization (e.g., improved visibility, impact, and status of individual researchers).

Perhaps the most persuasive arguments for many researchers and for a wide range of open research behaviors emanate from *scientific* rationales: that science (at least, hypothesis-testing approaches) needs to create evidence that is observable across multiple instances and, therefore, should be self-correcting (Popper, 1959) and that for this to happen properly, researchers' behaviors and data should be fully transparent and reusable by others to permit open challenge by anyone. These views align with Mertonian norms and values that underpin and conceptualize the scientific endeavor (Merton, 1942/1973). The argument is that open research practices are expected to improve the quality of the scientific endeavor by improving research reliability and validity and by facilitating scrutiny (see Appendix S1 in the Supporting Information online for further discussion; also available on the OSF [Open Science Framework] at https://osf.io/ru5n4). These scientific rationales suggest that many open research practices have emerged from the needs of epistemologies that demand confirmatory approaches that seek generalizability (such as formal experimentation, hypothesis testing, quantitative data collection, random sampling, and inferential statistics). Indeed, these epistemological roots are reflected in the (largely quantitative) focus of many of our arguments and examples in this article. However, several practices and resources, a few of which we mention throughout, are emerging for improving qualitative research with open research practices.

These scientific rationales seem comprehensive and persuasive, with a view to making research less biased, more replicable and representative, and more accessible. Indeed, the need for such improvements to the scientific and dissemination processes has already been demonstrated through much meta-scientific work (e.g., Isbell et al., 2022). In Appendix S1, we describe in full how open research practices and infrastructure—such as open access publication, registered reports (i.e., an article type that undergoes peer review before any data are collected, with high quality protocols receiving provisional acceptance as long as researchers adhere to the registered protocols), open materials and data repositories, and multisite research endeavors—present opportunities to improve the validity, reliability, replicability, and reproducibility of research, directly or indirectly improving research quality over time. In addition, Appendix S1 describes how making materials, data, tools, and peer-reviewed reports available can broaden the scope of researchers' work along multiple dimensions: the participants (increasing the size and breadth of our sampling), the producers (diversifying the researchers and coproducers of research), and the consumers (allowing more and more diverse readers and users of research).

Taken together, all of the rationales could appear to coalesce in one macrophilosophy. But we believe that in reality, researchers who adopt open research thinking and behaviors will be motivated by these different rationales in different proportions and at different times, with specific motivations inspiring change in specific behaviors. For example, a strong philosophy of epistemic responsibility—the idea that "[s]cientists must learn to communicate with the public, be willing to do so, and indeed consider it their duty to do so" (The Royal Society, 1985, p. 6)—may drive some academics to make their findings openly available and conceptually accessible (see also Chubb & Reed, 2018). For others, this same behavior may (also) be driven by the potential for influencing social and economic change (Bastow et al., 2014). For others, the scientific rationales will provide the main impetus for changing one or more behaviors.

The respective roles and impacts of these different rationales themselves merit empirical scrutiny, perhaps through interviews and surveys to improve understanding of drivers and affective variables that might (better) underpin and shape the open research movement. However, until quite recently there has not, in fact, been an obvious need for an empirical evidence base to justify open research because relatively few voices have overtly challenged any of the rationales behind open research. Nevertheless, more recently, a few questioning voices have been heard (Herb & Schöpfel, 2018). For example, some critique open research as reflecting an epistemological stance that prioritizes

(only) narrowly perceived overall efficiency, acceleration, value accumulation, and growth rather than useful new understanding (Haider, 2018). Others argue that the open research movement will impede research and constrain the thinking and behavior of active researchers (Baumeister, 2016; Stroebe & Strack, 2014). Osborne (2013), expressing the only such viewpoint that we located, has even argued that open access publication is not necessary or helpful and that it could indeed be harmful because only those who currently have access to research publications are capable and need to understand their content. A further argument against an open collaborative etic is that fostering competition between researchers is, in fact, beneficial for progressing knowledge (see Fang & Casadevall, 2015, for discussion).

For most, however, the question "Why open research?" is not the problem. But, rather, "How do we get there?" is the primary concern. For example, researchers express the need for caution to ensure nonintimidating (Derksen & Field, 2022) and incremental (Liu et al., 2022) approaches to change. We agree that seismic change does not happen overnight, and only very few succumb to epiphanies. For most individuals, the open research movement will consist of gradual changes in thinking and behaviors for clearly identifiable components within the research process, from conceptualization to engagement with those beyond the academe. And it is this conceptualization of open research that inspired the current article. Rather than espousing a grand philosophy, we have broken down the open research movement into tangible constructs, practices, mechanisms, infrastructures, and incentives (see Appendix S1 for a full discussion establishing why open research practices are expected to improve the quality and scope of the scientific endeavor in the first place). Below, we continue our discussion with a forward-thinking perspective (a) to consider the challenges of open research practices and how to address them and then (b) to envisage coevolutions of culture, infrastructure, and behaviors for the future of open research. The totality of these changes will no doubt emerge with the feel of a new philosophy, a new way of being and doing—and with hindsight, this is what researchers in the field of language learning may observe in the future. But, while getting there, most researchers in the field will experience individual starlings, not a flock.

The Challenges of Some Key Open Research Practices and How the Field Might Address Them

Many benefits for open research practices have been proposed, some of which have been evidenced (see Appendix S1). However, engaging in them has not always been straightforward and many open research ideals pose serious

challenges. Here we highlight some of these challenges, discuss initiatives that are available to combat them, and consider their likely uptake and impact on the field of language learning.

The Speed and Cost of Open Research
Challenges
Although attitudes to open research may be largely positive, substantial barriers may impede the adoption of these practices (Liu & De Cat, in press). One concern is the time needed to implement (some of) the practices. At a minimum, making materials, data, and code open requires authors to upload this information to a repository, although a small number of repositories such as IRIS (Instruments and Data for Research in Language Studies) actually help authors to upload materials, data, and code (Marsden et al., 2016). However, in order to make the sharing of materials, data, and code most effective, authors may need to reformat, annotate, and organize their files. For example, data may not be usable if column headers are not labeled such that an independent researcher can understand what data are in each column, or if several files are uploaded to one webpage (e.g., a component page on the OSF), researchers may need to provide a readme document to describe each file. Naming, describing, annotating, and organizing such files takes time. Although the benefits of such open research practices are expected to positively impact the validity, reliability, and replicability of research, the impact of the time commitment on researchers cannot be ignored (LeBel et al., 2017), particularly for graduate students and early career researchers who have limited time for completing milestones upon which their careers depend (Allen & Mehler, 2019; Hui & Huntley, 2020).

Open research practices might also contribute to increased time during the review and publication process. When materials, data, and analysis scripts are submitted, the information that can be reviewed expands beyond the manuscript itself. Even though it is probably unrealistic to think that all reviewers could examine all details (at least, not without a significant shift to recognize the burden of such work), these files do add to the time needed by those reviewers. The timelines for registered reports may also pose challenges as peer review is needed before data collection and after the final manuscript is submitted. Although the overall length of the research process—from starting a project to publication—is not substantially longer, researchers are unable to control when they can begin data collection because the time needed for the first peer review process cannot be predicted, as revisions are usually required, as with any regular article type. There are multiple benefits of peer review before data collection, which may be particularly useful for students and early

career researchers. However, students or grant recipients may not have flexibility around their data collection timeline.

Although most open research practices do not involve a direct financial cost, open research does not come free to researchers or to the field. Publishing open access can represent a significant cost for individual researchers due to the article processing charges that many publishers impose. For example, the article processing charge for *Language Learning*, published by Wiley, is $3,350 USD, £2,250 GBP, €2,800 (for further discussion about issues with article processing charges, see the Open Access section below). There are also costs in providing the platforms and mechanisms that support open research publishing. For example, the platinum open access journal *Studies in Second Language Learning and Teaching* (published by the Department of English Studies, Faculty of Pedagogy and Fine Arts, Adam Mickiewicz University, Kalisz, Poland) does not receive article processing charges (to publish) or library subscriptions or payments (to read). Yet, there is a cost to run the journal, both in time as the editorial team undertakes copyediting and proofreading and in money as the faculty and university pay for editorial support, typesetting and printing copies, and maintaining the platform and service for processing submissions (M. Pawlak, personal communication, May 27, 2022). Similarly, repositories such as IRIS and OASIS (Open Accessible Summaries in Language Studies; Marsden, Alferink, et al., 2018) require funding for the maintenance and development of the webpages and databases and services to authors. For these and other open research resources, their availability is contingent on the time that their leaders spend seeking grant and/or institutional support (for further discussion, see Envisioning Ways Forward for Open Materials section).

Envisioning Ways Forward to Address Speed and Cost Barriers

These time and cost challenges are significant but not insurmountable. Individual researchers can manage the time commitment by leveraging the many resources and templates that support open research that they decide are most effective. Guidance is available for such decisions, particularly for early career researchers (e.g., Allen & Mehler, 2019). It has been argued that "early adoption of open and reproducible methods is an investment in the future and can put researchers ahead of the curve" (Allen & Mehler, 2019, p. 11). For example, early career researchers may benefit particularly from registered reports because they might "reduce the chances of… work going unpublished" (Allen & Mehler, 2019, p. 6).

The onus of addressing speed and cost barriers, however, should not primarily lie with individuals. Hui and Huntly (2020) have provided many

suggestions about what graduate programs can do to support students by, for example, (a) adding a preregistration requirement for qualification milestones, (b) using open materials and data in training, and (c) incorporating open research teaching into the curriculum, supported by the rich materials available through the FORRT (FORRT, n.d.; Azevedo et al., 2019). Journals can also promote open research by enabling open access publication and by encouraging or requiring certain practices. Evidence has suggested that open practices can be encouraged by awarding open science badges. For example, the open data badge was found to be associated with increased data sharing in psychology (Giofrè et al., 2022), at least in conjunction with guidelines that encouraged data sharing (cf. Rowhani-Farid et al., 2020, for evidence that open data badges themselves did not increase data sharing in biology). Also, by offering the registered report article type, preregistration, open materials, and open data all become part of the publication process. By incorporating open research practices into publication processes or graduate programs, such practices would not impose additional time commitments beyond the publishing and program requirements.

However, adjustments may still be needed as it may take longer to reach graduate program milestones or submit an article. In other words, these steps do not reduce the time commitment for researchers, but rather they ensure that the time is integral to the research process itself. Thus, researchers might have to choose between somewhat longer routes to publication involving open research practices versus shorter routes that may not require such practices. Given the fact that current systems reward quantity (along with quality) of research in hiring, promotions, and funding, it may be rational for certain researchers to choose routes that do not involve open research in order to produce more research in the same amount of time. Thus, it is critical that the system changes so that rational choices related to quality, including adopting open research practices, are more strongly rewarded. But, how can this be achieved?

There is a movement toward slow research (Frith, 2020; Stengers, 2018), in which the focus is on less but better research. Realistically though, the whole field would have to slow down as one, otherwise some researchers would be hurt by engaging in slower practices. Therefore, incentivizing practices that enhance quality—as indexed by certain open research practices—even at the expense of quantity, is critical. One approach is to create award structures that prioritize open research practices, for example, the Replication Award (IRIS, n.d.) and the Registered Reports by Early Career Researchers Grant Program (*Language Learning*, 2021; Marsden, Morgan-Short, Trofimovich, & Ellis, 2018). Researchers can also create standards for documenting open research

undertakings on curricula vitae (CVs), such as the United Kingdom funder's (UKRI) narrative CV format and the Royal Society's Résumé for Researchers, thereby rewarding open materials, datasets, open science badges, and knowledge exchange and deprioritizing a focus on quantity of publications and journal impact factors so as to refocus attention on the merit (quality and impact) of individual articles. These have the potential to change the way institutions and society conceptualize an academic career, allowing institutions to adopt hiring and evaluation frameworks that are not (as) centered on bibliographic metrics (e.g., Benedictus et al., 2016; for wider discussions about incentivization, see McKiernan et al., 2016; Nosek et al., 2012). Crucially, the field must maintain equity as a central goal in implementing any such reconceptualizations and changes to incentivization (for further discussion, see Cole et al., 2022; Ross-Hellauer, 2022).

Open Data
Challenges
Access to data can improve validity and reliability and increase the range of researchers participating in the field of language learning (Marsden & Plonsky, 2018; see Appendix S1). Although incentivizing open data has increased the researchers' practice of making their data available, encouragement and requirements do not seem to be as effective as one might have hoped. For example, one journal editor noted that when they requested that authors submit data to accompany their submission, almost half of the authors withdrew their manuscripts (Miyakawa, 2020). For published articles, the rates at which data are provided when requested range from 0.07% to 44% (Gabelica et al., 2022; Stodden et al., 2018), even when the journal policy requires that data be made available upon request. When data are available, they may not be sufficiently transparent to allow reuse (Hardwicke et al., 2022; Obels et al., 2020; Stodden et al., 2018). For example, Stodden et al. (2018) found that they could only reproduce the findings from 26% of articles for which they had obtained data and code. Buck (2021) warned against performative reproducibility, in which researchers take actions like making data available but not in a way that is truly useful to reproducibility. Ideally, researchers would strive for the highest level of the TOP (Transparency and Openness Promotion) Guidelines that state that "[d]ata must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication" (Center for Open Science, n.d.-a). But, who does the work to ensure that accessible data are complete and reusable or that analyses are reproducible prior to publication? Should authors be required to have their data double checked independently to

confirm that the analyses can be reproduced? It seems onerous for reviewers to check for the availability and usability of data. Does the responsibility fall into editors' hands prior to review or publication? Should professional societies in the field provide structure and process for curating data and code?

The challenge of making data available and reusable partly stems from barriers that individuals encounter in a system that does not facilitate or reward this process. Although researchers have been found to consider data sharing profitable for their field (Houtkoop et al., 2018; Marsden, 2019b), they have reported practical and fear-related barriers. For example, Houtkoop et al. (2018) reported that researchers considered preparing data for sharing to be excessively time consuming and feared misinterpretation of the data as well as the possibility of being scooped. Individuals may also have to seek permission to share data through institutional review boards, and indeed, data sharing may not be possible or ethical in some cases (e.g., research with vulnerable participants). Relatedly, providing open data may not be appropriate for all research. For example, although important benefits and exemplary reuses of qualitative data have been observed (Bishop & Kuula-Luumi, 2017; DuBois et al., 2018), challenges have also been acknowledged with the suggestion that some qualitative research data should not be reused in secondary analysis (Chauvette et al., 2019) due to, for example, its context dependency. In all, there are real and perceived barriers to open data sharing that must be addressed before researchers can maximize its possible benefits.

Envisioning Ways Forward for Open Data
So, how does the field of language learning move forward with open data practices? There are several recommendations and resources available, with the FAIR Guidelines providing principled recommendations that data are findable, accessible, interoperable, and reusable in the long term (Wilkinson et al., 2016). Towse et al. (2021) have provided specific recommendations and resources for each of these guidelines including a checklist (see also the Open Scholarship Knowledge Base, n.d.). SPARC (Scholarly Publishing and Academic Resources Coalition), an organization that promotes open and equitable systems for research, provides policy (SPARC, n.d.) and resources, including a Data Management Plan tool (https://dmptool.org/plans). Guidance on sharing data (and materials) openly can also be found in a recent tutorial from the founders of Databrary (Gilmore et al., 2018). European funding guidelines (H2020 Programme, European Commission, 2016) introduced the concept that data should be as "open as possible and as closed as necessary"

(p. 4), allowing for the fact that authorization procedures may be needed to gain access to some kinds of data.

Such a plethora of resources may be more used if journals and organizations (e.g., professional associations and funders) encouraged or required data sharing. Indeed, the American Psychological Association's (n.d.) ethical principles state that researchers should freely share published data in public repositories and, as mentioned above, the COS (Center for Open Science) awards the open data badge (Center for Open Science, n.d.-b). Within the language sciences, journals may also consider offering registered reports, as the rate of data sharing and its reusability are greater in registered reports than in the standard literature (Obels et al., 2020). Although journals seem hesitant to require data sharing (even with caveats for when data cannot be ethically shared), there may be untapped will among the researcher community, as researchers have indicated that mandates would be most effective in leading them to share data (Houtkoop et al., 2018), a sentiment borne out by evidence that mandatory open data policies do indeed increase the frequency and quality of data sharing (Hardwicke et al., 2018). Together then, support for researchers along with structural changes to encourage or mandate data sharing should lead to more FAIR data sharing.

Importantly, we need to consider discipline-specific ways to increase data sharing. Some initial work has advanced the understanding of practices, benefits, and challenges relevant to the field of language learning (e.g., Berez-Kroeker et al., 2018; Bolibaugh et al., 2021), but to our knowledge, metascience has not yet specifically addressed this aspect of open research. We need (more) field-specific training and resources to facilitate data sharing. Local initiatives are valuable, such as department-level workshops addressing issues such as open data ethics, data readability by humans and machines, and assigning metadata, digital object identifiers (DOIs), and licenses (e.g., Bolibaugh, 2022). For widening reach, however, the proactivity of professional organizations and groups will be essential, such as the new network Open Applied Linguistics (n.d.) and the Linguistics Data Interest Group (Research Data Alliance, n.d.) that provide policy, education, training, and resources including a handbook featuring principles, methods, and case studies for linguistic data management (Berez-Kroeker et al., 2022; for educational networks in psychology, see Blincoe & Buchert, 2020; Hawkins et al., 2018). Critically, such education will also promote awareness and use of the growing sets of open data. For example, the Linguistic Data Consortium (n.d.) hosts numerous corpora and data-related resources, though accessible only by members. Fully open resources include The TalkBank (TalkBank, n.d.) with repositories in

14 research areas, including child language and multilingual corpora. In 2016, IRIS began hosting any type of dataset—including both qualitative and quantitative data—from peer-reviewed or dissertation research and now has over 240 datasets (as of the time of writing).

Ideally, the combination of general and field-specific metascience, training, and resources will move our field beyond individual examples of making data open (e.g., Saito et al., 2020) and advocacy for creative solutions (e.g., Berez-Kroeker et al., 2022) to a more systematic approach that will lead to increased computational reproducibility in the field as well as innovative uses of the data, such as through secondary data analysis (Weston et al., 2019) and multiverse analyses (Steegen et al., 2016).

Open Materials

Challenges

The most obvious challenge for making the field's research materials openly available seems to be a very slow pace of change. For example, IRIS colleagues have been supporting and encouraging journal editors to ask their authors to make their materials open for over a decade, but so far, only three journals seem to achieve this with regularity—*Language Learning*, *Studies in Second Language Acquisition*, and *The Modern Language Journal*—although 36 journals in applied linguistics report that they routinely invite their authors to upload their materials upon acceptance of a manuscript. Marsden (2019b) examined the 10 journals that have published research with the most materials on IRIS and yet found that between 2013 and 2017 only approximately 13.6% of instruments were available on IRIS out of those that could be available, with a low rate of change: from 10.3% in 2013 to 15.2% in 2017. Whether authors in the field upload materials to repositories other than IRIS is unknown, but they would be expected to also do so at a low percentage rate.

Another associated obstacle relates to individuals' concerns about being scooped or, more simply, a sense of personal ownership over their materials. This concern is perhaps not strongly evidenced in general, and indeed Marsden (2019b) found that researchers did not strongly agree with the statements "I am worried that others will use materials/data that I spent a lot of time and effort developing/collecting" or "I still might use my materials (or data), and I don't think that others should be able to use them before I am certain I have finished with them," but there were nevertheless large standard deviations around the mean ratings of concern ($M = 17/100$, $SD = 28$; $M = 28/100$, $SD = 35$, respectively). These findings suggested that, for some people, these are important issues. Another hurdle for open materials is their commercial

sensitivity. A key manifestation of this problem for the language sciences relates to measuring proficiency. The use and reporting of valid and reliable proficiency measures have long been identified as problematic, threatening replication and reproducibility (Park et al., 2022). Many proficiency measures are commercially sensitive, thus restricting their availability and reuse. For example, *Language Learning* had to seek special dispensation from the COS to allow open material badges to be awarded even if the proficiency measure used by the researchers (e.g., TOEFL, IELTS) had not been made openly available. The directors of COS eventually agreed on the condition that any such material be clearly flagged in the article. This, however, is not a desirable situation, as replicating researchers should be able to use the same proficiency measure as those used in the initial study.

A further barrier to open materials is the rapid pace of technological change. At the start of IRIS, in 2011, one challenge was how to archive analogue recordings (audio and video cassettes) and paper materials (photographs and hand drawn pictures). Now, other concerns face the field, such as software code not always being future proof, broken urls, and updating the architecture and interface in pace with the ever-changing digital landscape. Open archiving of digital artefacts clearly requires serious public investment and personal effort.

Another challenge is ensuring the searchability of materials. For this, researchers need ontological systematicity: clear and consistent systems for classifying materials and tagging them with searchable metadata. Yet good practice for materials metadata has been slow to emerge and metadata must change in pace with our methodological advancements, thus posing challenges for the searchability and stability (i.e., version control) of materials. An illustration of the issue is that categories of material or research areas are not easily found on the OSF. This is because key terms are supplied by the uploaders, without external control, resulting in overlap, underuse, and redundancy of metadata, and ultimately poor searchability. In contrast, on IRIS, materials are associated with rich, searchable metadata that are based on a priori ontological categories, for example, for research area, instrument type, data type, participant type, language feature. However, these IRIS dictionaries require maintenance so that the metadata do not mushroom with synonyms, near-synonyms, hypernyms, and hyponyms, thus threatening the usefulness of the database. As anyone who has organized a conference knows, the labeling of subfields to define the conference submission parameters requires specific expertise in the field's ontologies, epistemologies, methodologies, and theories. Creating searchable ontologies involves decisions about where a construct or parameter

(e.g., "lexicon") might end and another might begin (e.g., "syntax") or which members (e.g., "feedback") belong to which superordinates (e.g., "interaction"). As an illustration of the importance of ontological control, searching for "working memory" on the OSF returns 167,676 files associated with this key term—a hit rate that is far too high to be functional. In contrast, on IRIS, 202 hits point to measures of working memory administered for a peer-reviewed publication in the language sciences, which could be further constrained by other descriptors such as "language" or "author." But this level of field specific metadata has a critical albeit small financial cost. Are researchers, as a community, sufficiently willing to invest in maintaining this systematic historical record of their methods, allowing them to be findable and searchable across time and space?

Envisioning Ways Forward for Open Materials

There are ways of incentivizing a culture that treats the process of research (including the materials) as a product in itself that should be available to all. Recently, *Applied Psycholinguistics* and *Language Testing* (following the *Journal of Memory and Language* in 2019) began to require open materials (which can be anonymized or under embargo at submission to allay fears of scooping). Such policies should result in a marked increase in open materials, demonstrating that systematic top-down editorial effort is required to ensure open materials. Additionally, in the future, more journals in the field may now require materials to be made available on IRIS (specifically) as the scope of IRIS was recently expanded to include research into first language learning and all domains of language use, thus opening up to the entire field of applied linguistics. In terms of addressing fears that sharing materials will lead to scooping, one counter-argument is that IRIS—as one type of repository—only accepts materials after publication, and so the fear of scooping prior to publication does not apply, at least for the concurrent study in question. More generally, Laine (2017) provided other counterarguments and strategies to address this type of concern, including the idea that open research can protect researchers from academic misconduct.

As further incentivization of open materials, materials need to be recognized on CVs and in promotion applications. For this, materials need a full reference and DOI; for example, TOP Guidelines (Nosek et al., 2015) include citation standards for this. However, this is far from common in the field of language learning, where materials, if provided at all, are often included as part of the article (supplementary materials or appendices behind a paywall), rather than identifiable objects in and of themselves. As an example of a way forward,

Language Learning now (since Nahatame, 2021) asks that materials (and data and code) be fully referenced with a DOI to the objects held on IRIS. We envision a related practice spreading so that more materials are open, citable, and recognized on CVs. That is, simply asking authors to reference their materials and obtain a DOI may concurrently promote open practices, as repositories (such as COS and IRIS) can assign DOIs. In contrast, if authors are only asked to put materials in supplementary material on the publishers' website or in appendices, this does not create a citable output. Thus, requiring that materials (and/or data and analysis scripts) be citable could achieve at least three goals: to make them findable, open, and rewardable.

Research materials also include tools, and open source tools are becoming increasingly available (such as text analysis software developed by Kyle and Crossley, https://www.linguisticanalysistools.org). Such tools reduce the total community work effort and, therefore, the cost of research. They can reduce human error and interstudy and intrastudy degrees of freedom, thereby enhancing validity. Just as referencing data collection instruments and data as research artefacts is important, it is also critical to recognize open source software as intellectual property. To address this, the Open Source Initiative, launched nearly 25 years ago, continues to defend the ethos inherent to open research by establishing many types of free and open source software (known as FOSS) licenses. While perhaps the least glamorous underbelly of open research, it is critical to recognize and sustain the digital technology that feeds it.

There is now a rich offering of platforms for open materials, organized by domain of interest (e.g., IRIS for language research), by medium (e.g., audio and transcriptions on CHILDES, https://childes.talkbank.or, or video data on Databrary, https://nyu.databrary.org), by instrument type (e.g., Engle's collection of working memory tests, https://englelab.gatech.edu/taskdownloads, or Meara's site housing vocabulary tests, https://www.lognostics.co.uk/tools/LLAMA_3), or by type of object (e.g., Tromsø is for data only, as is LDBase, https://www.ldbase.org; Hart et al., 2020). Finding field-wide consensus about one unified infrastructure may seem desirable, but we suspect that some redundancy and duplication will improve the chances of long-term accessibility. What the field of language learning chooses to engage with should, in our eyes, be driven by a repository's sustainability, breadth, and searchability. Searchability, along both general and specific parameters, is likely to help serve a wide range of purposes and so should, in turn, garner community support. However, sustainability is unlikely if a repository relies on short-lived funding or on one individual's staying in an institutional post or alive (Obels et al., 2020),

and if researchers want a reliable and comprehensive repository, more effort is necessary in the language sciences. Recently a little support has been forthcoming from publishers (e.g., for IRIS, $3,000 USD from Wiley and €500 from John Benjamins, in addition to £5,000 per year funding from the British Academy and support from the University of York). Fortunately, significant funding for open research is becoming more frequent from philanthropic societies. Professional associations are, we believe, in a strong position to apply for such funds to curate the discipline's materials.

Finally, we envision a coming together of open materials and data practices. The idea of gathering data using freely available instruments online is not new (e.g., see the much-used LLAMA tests, Meara & Rogers, 2019, and those discussed by MacWhinney, 2017). However, although these tools generate participants' overall scores, they do not output item level datapoints that would allow validity and reliability checks. In another kind of activity, researchers are beginning to conduct integrative data analyses—pooling related data collected by the same elicitation technique though not synchronously. Although not a new concept (Bauer & Hussong, 2009), it has rarely been used in the language sciences (cf., Isbell & Son, 2022). Bringing these endeavors together, we envisage freely available and accessible data collection tools (such as measures of individual differences) that output full datasets to facilitate the large-scale accumulation of ethically compliant open datasets that are tagged with metadata and analyzable by those who did not collect the data. We acknowledge that such a vision presents a chicken-and-egg conundrum, inherent in much of the open research movement: On the one hand, before making materials and data openly available, consensus about validity and reliability is desirable; on the other hand, in order to reach any consensus, open practices are critically needed to allow accumulation of knowledge over time and space.

Replication

Challenges

Increasing replication research is largely viewed as desirable, but it is not without its challenges, including decisions about what and how to replicate. Given researchers' limited resources, should they replicate studies soon after or even before publication, or should they replicate studies that have been most influential over time, to check their findings' validity and generalizability? One issue in replicating some highly influential (older) studies is that, having been conducted several years ago, they may not reflect current methods or analytical practices. So, researchers need to decide whether to conduct a direct replication for confirmation purposes accepting the initial study's limitations, or to

conduct a partial or conceptual replication that includes one or more revisions that may have fewer known limitations but may not speak as directly to the initial research questions. An illustration of the difficulty of these decisions can be found in the line of replication research of the influential VanPatten (1990) study that examined attention to form and meaning using a reading passage and comprehension test provided in an appendix. Whereas some replications retained methods close to those of the initial study (e.g., Greenslade et al., 1999), others used a different reading passage and comprehension test in order to address concerns about the validity of the initial materials (e.g., Leow et al., 2008, with materials available in appendices). However, the most valid and reliable way to replicate the initial VanPatten study and to address its central research question is still a matter of debate because (a) low reliability has been observed for the more recent (Leow et al., 2008) comprehension test (e.g., Morgan-Short et al., 2018, Cronbach's $\alpha = .197$; Son et al., 2021, Cronbach's $\alpha = .293$), compared to the reliability reported in the initial study (Leow et al., 2008, Cronbach's $\alpha = .915$) and (b) concerns about the more recently used reading passage have also been raised (Sanz & McCormick, 2021), even though those materials were introduced to address validity concerns about the passage used in the initial study. These details illustrate some of the tensions and difficulties in designing valid replication efforts.

The decisions about how to replicate become all the more challenging when materials from initial studies are not openly available. Marsden, Morgan-Short, Thompson, and Abugaber (2018) found that fewer than 1% of initial studies that had been replicated had provided full materials and that 17% of the initial studies had not provided any materials at all. Thus, in most cases, researchers must, at least partially, recreate materials based on descriptions provided within articles, materials that are often underspecified for the purpose of replication. This may make it harder to knowingly establish similarities and differences between initial and replication studies as well as to reproduce the initial study's findings. For example, Marsden, Morgan-Short, Thompson, and Abugaber found that replication results were less likely to support initial findings when materials were not provided in the initial study. Another problem is that a lack of availability of the initial materials probably increases the chances that a replication is co-authored with one or more of the initial authors, given that co-authorship can facilitate access to materials and/or data. However, Marsden, Morgan-Short, Thompson, and Abugaber found that co-authorship with the initial authors substantially increased the chances of a replication study supporting the findings of the initial study. An additional and perhaps related problem brought about by a lack of open practices is that having to

recreate materials increases the replication researcher's degrees of freedom. This leaves the process more vulnerable to (even unintentional) questionable research practices, such as a reverse publication bias, that is, a bias to publish findings that do not support the findings of the initial study.

Envisioning Ways Forward for Replication

To increase replication in the field of language learning, some journal initiatives solicit replication research itself (e.g., special issues of *Language Learning* and *Studies in Second Language Acquisition*) or encourage replication through articles highlighting specific replication recommendations (e.g., Arroyo & Yilmaz, 2018, in *Language Learning*). But how might open research help?

There are several ways that open research practices are essential to promoting replication efforts (Marsden, Morgan-Short, Thompson, & Abugaber, 2018; McManus, in press). First, open materials facilitate replications that are independent of the authors of the initial study, as researchers can be more confident about the extent to which the replication materials match (e.g., for a direct replication, see McManus & Liu, 2022) or differ systematically (e.g., for a partial or conceptual replication, see Leow et al., 2008) from the initial study materials. Second, preregistration supports replication efforts because it limits researcher degrees of freedom as researchers conduct the replication from the preregistered and open protocols and materials (Brandt et al., 2014; Zwaan et al., 2018). To this end, Brandt et al. (2014) have provided a preregistration template specifically designed for replication studies. Open multisite replication projects are another promising way forward for replication (Kobrock & Roettger, 2022), whereby groups of researchers agree on what to replicate and how to do so, preregister the protocol, and collect data at multiple sites. Transparency and open practices are essential and inherent to such endeavors, and free infrastructure and tools are available to facilitate large-teams working. For example, StudySwap (Chartier et al., 2018), established in 2017, has 62 registrations at the time of writing expressing either a need for collaboration or a have (i.e., a resource for collaboration such as a dataset posted for analysis). For authorship accreditation decisions when researchers work in large teams, the CRediT taxonomy (Brand et al. 2015) and its free online tool can facilitate the assignment of credit (Holcombe et al., 2020).

None of these open research practices, however, addresses the issue of publication bias, which may be particularly strong for replication studies because null results may be refuted by reviewers due to (perceived) inconsistencies between the replication and the initial study. Fortunately though, registered

reports seem to mitigate publication bias (Chambers & Tzavella, 2021), and thus may be a particularly useful mechanism for replication. Indeed, replications are more common among registered reports than regular article types in psychology (Scheel et al., 2021), and within language learning research, a relatively high proportion of (the albeit small number of) registered reports are replications (e.g., Huensch & Nagle, 2021, and those in the *SLA for all?* initiative). An additional benefit of registered reports is that the peer review of the proposed study, which may include the author(s) of the initial study, can help researchers to conceive the most valid and reliable replication design, addressing the challenges illustrated above of deciding the methods for replicating a study (for an example from the *SLA for all?* initiative, see Ryan et al., 2023).

As the field adopts open research practices to enhance replication efforts, researchers should continue to dialogue about what to replicate and why. Several perspectives on these issues have been offered both within and outside the language sciences (e.g., Field et al., 2019; Isager et al., 2021; Kobrock & Roettger, 2022; Marsden, Morgan-Short, Thompson, & Abugaber, 2018). Central among these perspectives is the need for replication to be driven by the contribution and impact of the initial and replication studies, rather than by the availability of open materials per se. Ultimately though, best practices for transparency would be combined with replication to serve an epistemological strategy of theory pruning to yield theories with stronger explanatory power (Tierney et al., 2020). The call for this process is already seeing uptake in the field, for example, Al-Hoorie et al.'s (2021) consideration of replication in regard to dynamic systems theory. Understanding how open research can support replication to serve theoretical progress may help convert the relatively positive views of replication (McManus, 2022) into a more systematic approach to replication in the field of language learning.

Open Access
Challenges
There are many benefits of open access, and progress is being made toward widening access to research findings (e.g., via open accessible summaries of research at https://oasis-database.org; Alferink & Marsden, in press; Marsden, Trofimovich, & Ellis, 2019). However, many challenges lie ahead, as the high number of articles that are behind paywalls indicate (see Appendix S1). Indeed, new journals are still emerging that are not born as platinum open access ones and thus produce more research behind paywalls or have article processing charges, such as *International Journal of Learner Corpus Research* (started in 2015), *Instructed Second Language Acquisition* (2017), and *Journal*

of Research Methods in Applied Linguistics (2022). One consequence of not moving forward with open access is that global inequities in the knowledge economy are perpetuated. Even though publishers sometimes reduce subscription fees for certain countries, the reductions are very often small and do not fully address inequities in resources between and, even within, countries. Moreover, the big deals to publish and read freely are happening in wealthy economies (e.g., a recent deal made by Elsevier means that around 80% of the research output in the United Kingdom can be published open access),[2] and as such these deals are likely to increase global inequality. Indeed, open access fees are described as a "particularly pressing issue" in potentially compounding inequities in research (Ross-Hellauer, 2022, p. 363). For example, two consequences of these deals—the open access citation advantage (Tennant, 2022) and the fact that access is granted only to certain demographics (Ottaviani, 2016)—are likely to perpetuate vicious inequitable circles. For example, the open Psychological Science Accelerator initiative has "recruited large numbers of laboratories in North America and Europe but far fewer labs in Africa, South America, and Asia" (Moshontz et al., 2018, p. 509).[3] Similarly, out of the 19 articles published on the theme of social justice and applied linguistics in a recent issue of the *Annual Review of Applied Linguistics*, only six were open access—thus reducing the chances that these studies might reach those who live in the communities that the studies addressed and who provided some of the data. Change in this domain of open research is clearly slow and probably the hardest to effect because the stakes are so high for academics and the game involves governments and multinational corporations.

The large publishing houses have several aces stacked in their deck, making change toward open access even harder. One is that they can afford the use of large platforms, such as ScholarOne, facilitating the review and editorial process, whereas the cost of use of such sophisticated platforms is prohibitive for platinum journals. A second trump card is the deals that they can strike with governments or institutions, whereas smaller publishers do not attract such deals, a situation that is therefore thought to inhibit growth of born platinum journals. Yet another ace card is the existing market share that the journals produced by large publishing houses have over the most established journals, including the one for which we are now writing, and these journals tend to have relatively high citation indices. At the time of writing, only a few platinum access journals, including *Language Learning and Technology* (started in 1997) and *Studies in Second Language Learning and Teaching* (started in 2011), have made it on to Clarivate's *Social Science Citation Index*, which

provides rankings of citation counts (for full list, see Al-Hoorie, n.d.). Citation counts are used not just by publishers to sell a journal, but implicitly or explicitly, by authors, reviewers, editors, funders, and institutions when making decisions such as where to publish, whether to provide reviewing or editorial work, and whether to fund a project or to support a promotion. Thus, the value placed on citation indices presents challenges for increasing open access. In sum, weaning researchers off current funding and impact models and establishing new ones arguably represent the single biggest barrier for open access, and more critically, perhaps are the key to realizing the full potential of all other open research practices: Even if materials, data, and analyses are openly available, they cannot properly be used without the accompanying published peer-reviewed report.

One may argue that preprints as an open research practice (mentioned in Appendix S1) are one way to increase open access. However, they do not offer a reliable solution even though they are open. Their disadvantages include not displaying information to indicate credibility (see Soderberg et al., 2020); multiple versions circulating sometimes even with multiple DOIs; and compromising double anonymous peer review, still valued by many. The citation and altmetric (mentions on social media) advantages for articles posted as preprints (found by Fraser et al., 2020) cannot, we think, be interpreted as a quality index. Preprints may be useful where the rate of knowledge production can be life-critical and where the review workforce is large enough to validate preprints quickly. However, we do not consider preprints—at least, the early versions of articles before peer review and subsequent resubmission(s)—to constitute a route towards open access in the language sciences. However, preprints from later in the publication process (but prior to final acceptance) may offer one avenue towards greater availability of research findings.

A final but very substantial challenge is that open access, alone, does not directly improve knowledge transfer and coproduction—whether they are open access or not, academic publications are not read much beyond academia due to a complex mix of a lack of incentive, time, training, and shared goals among users or coproducers of research (Marsden & Kasprowicz, 2017). Thus, even if researchers in the field were to succeed in identifying a globally equitable business model for publishing, would open access really improve knowledge transfer? Making research available to those outside academia needs brokers to (co)select and (co)consider appropriately hedged implications, as open access alone does not make research understandable, relevant, or trustworthy. We therefore suspect that moving open access forward has greater potential

to improve inequalities in the knowledge economy than interfaces between researchers and stakeholders.

Envisioning Ways Forward for Open Access

On a practical level, journals need a platform on which to conduct the review and publication process, and so funders that value open research are commissioning free editing and publishing platforms, reviewed positively by Ross-Hellauer et al. (2018). One such platform is Open Journal Systems, an open source software application for managing and publishing used by over 25,000 journals. Originally developed by the Public Knowledge Project in 2001 (https://pkp.sfu.ca/ojs), it is now funded by South Florida University Library, a range of donors, development partners (including Canadian funding agencies), and research grants. The Linguistics Society of America uses Project Muse, another platform, to host their society journal. Project Muse contributes a small amount of money to the academic society for each download; such a contribution can help with journal running costs. We suspect and hope that such collaborative efforts will gradually gain traction and become self-sustaining, driven by community need.

Even with a move to these platforms, if researchers in the field are serious about achieving open access, a question that they must ask themselves is how much they value aesthetic uniformity over openness. In other words, do they value journal aesthetics enough to continue paying the cost of the typesetting that commercial publishers provide? Or perhaps, we would rather forgo this cost and be satisfied with publications broadly following style guides (e.g., American Psychological Association) but not with specific typesetting, as is currently true for preprints and postprints. However, in this case, more responsibility would fall to authors. For example, *Language Development Research* makes it clear that no anonymization checks or formatting will be undertaken and that authors must use an article template (prior to or after acceptance). From the first author's experience of publishing with this platinum journal (Bovolenta & Marsden, 2021), it can take a few hours to follow the guidelines to get the manuscript ready for production. Is this a price worth paying for a platinum model? We believe so, especially because the template can be used for future papers once an author has used it to format a paper. Moreover, if authors do want to maintain typeset documents, there are now free typesetting systems (e.g., CoLaTex), further permitting independence from commercial publishers. As for the more academic editorial responsibilities (e.g., initial desk triaging, arbitrating the review process, checking for rigor and clarity), in open access models this cost would no doubt simply continue

to be absorbed into academics' workloads (and is only very occasionally subsidized by publishers anyway). Whether the actual readability or scientific merit of platinum journals are somehow less than those of publisher-produced journals, empirical metascience into academic discourse and research quality is needed.

But how to move forward from researchers' professional reliance on journals with high impact factors? Possibly showing awareness of concerns that many subscription and hybrid journals dominate citation indices, many major publishers have signed the San Francisco Declaration on Research Assessment committing to de-emphasize the journal impact factor as a promotional tool and to make available a range of article level metrics (see Fraley & Vazire, 2014, for an entirely different kind of metric, the N-pact factor, based on statistical power). Perhaps the boldest and most efficient way to achieve open access publication is for the established journals to move their academic identity wholesale and adopt a platinum model (as *Glossa* did), thus potentially setting a new norm wherein high impact factors and open access can coexist. A fear is that moving away from big publishers' market networks would reduce findability of articles and, in turn, future citations. However, many university libraries are now ready to simply link directly to open access versions, given that they already use software (e.g., Unsub) to scrape the internet for free content to decide whether to unsubscribe from arrangements with commercial publishers.[4] Finally, posting postprints is one way of making an accepted version openly available and allows authors to still publish with established journals. To help searchability and visibility, a central repository can host the postprints, as IRIS now does. IRIS thus provides a one-stop metadata-rich repository for materials, data, analysis code, and the reports of findings.

Improving our understanding about all of these interventions to promote open access may gradually shift professional behaviors. For example, metascience is needed in the language sciences specifically (as citation practices differ across disciplines) to check the validity of different quality and impact metrics, including free indices like Google Scholar, which could provide evidence for established journals to move to platinum models.

A Coevolution of Open Cultures, Infrastructures, and Behaviors: Concluding Remarks With a Sight on the Future

In the previous section, we described particular challenges and our visions for ways forward for these specific challenges. We now comment more generally on the coevolution of open culture, infrastructure, process, and behaviors in shaping the future study of language learning and of research more widely,

and we acknowledge some limitations of our review and of open research itself. We end by providing a concluding response to the question asked in our title.

Infrastructure and Process

As should be clear from our review so far, shifts in ideologies and ambition are propelled by the emergence of new infrastructure and networks. For open research, networks continue to be established (e.g., the United Kingdom's multidisciplinary Reproducibility Network, Munafò et al., 2020; the International Association of Applied Linguistics Research Network on Open Scholarship in Applied Linguistics, https://openappliedlinguistics.org/about , in 2022), and new systems of systems are emerging. For example, an European Union-funded project (2021–2024) is developing the European Open Science Cloud, where researchers can find, share, and process interoperable datasets, publications, code, and other research outputs, as well as workflows to support the lifecycle of data including managing, discovering, and reusing datasets.

These infrastructural innovations suggest a serious investment in fundamental change. But one cornerstone of research infrastructure and process that we have not really touched upon yet in this article is that of peer review—a key mechanism that has not escaped the lens of transparency that has been used to scrutinize the other aspects of the research culture and process. Peer review has traditionally been double anonymous. This system does not seem to be broken, at least according to a survey of linguistics researchers that found that consistently over 80% of their academic respondents valued peer review (D'Arcy & Salmon, 2021). However, many alternate, more open models of review are emerging, such as signed, transparent, collaborative, crowdsourced, post publication, and dynamic review types. So, what might these alternative models offer to the quality—or to other dimensions—of the scientific endeavor? Transparent peer review, whereby signed (nonanonymized) reviews are made publicly available alongside the article, has been advocated as it may increase transparency and reduce bias. The argument is that how and why an article changed during the review process should be open, given that this discussion between reviewer and author(s) is an integral part of knowledge creation (see Besançon et al., 2021, for useful discussion and strong recommendations for medical research). The argument for reducing bias is that, if transparent reviews are signed, then any bias (e.g., conflicts of interest that would otherwise be concealed) becomes a matter for the reader to evaluate. However, counterarguments include that making signed reviews open would change the validity of the reviews such that only certain reviewers would agree

to review the manuscript or the review would be flavored by the knowledge that they would be signed and open. Indeed, in a metascientific analysis of a model whereby reviewers have a choice to sign or not sign, there was an observed tendency for positive reviews to be signed more often than negative reviews (van Sambeek & Lakens, 2020). Other concerns include that signed open peer reviews may incur retribution and an increased burden on reviewers by imposing public responsibility for endorsing the study. There are practical concerns too: Peer review in some disciplines, including our own, can produce highly intricate and lengthy documents; if made open, these could not be edited so would appear warts and all. Another development is crowdsourced (or portable) peer reviews. These are not solicited by an editor but posted spontaneously next to preprints through dedicated platforms such as Pubpeer, Zenodo, or Review Commons, or they can be done post publication, thus complementing the journal's internal reviewing process. Such reviews are available to all and can be signed or anonymous. More informal steps include community endorsement of preprints via Plaudit.pub (whereby readers click a button to applaud a work). Overall, it seems to us that transparent reviews have many benefits, and the key disadvantage stems from reviews being signed. We envisage that gradually, perhaps over a decade or two, the practice will filter—perhaps in a basic form—into the language sciences, but signing reviews will, and has to, remain optional.

Regardless of the transparency of the review that a publication undergoes, the knowledge conveyed in an article must still be subject to change, as per Merton's (1942/1973) scientific values discussed in the first section of this article. The drive for transparency increases our general sense of epistemological responsibility for pursuing and reporting true findings. So what is to be done about a researcher's own loss of confidence or new understandings of methods or analyses that render their own previous research questionable or invalid? Rohrer et al. (2021) suggested several mechanisms, such as author amendments to publication, that could facilitate researchers' making statements about loss of confidence related to validity and incentivize such behavior by formal publication. We look forward to seeing this debate enter discourse in the language learning sciences.

Community-Driven Ambitions

Reflecting the democratic and community-spirited values of the open research movement, practices seem to be increasingly driven by networks of researchers with an ambition to change a particular practice, including via grassroots action campaigns (see Uhlmann et al., 2019, for numerous examples [Table 2]

and discussion). For example, signatories to the Peer Reviewers' Openness Initiative (Morey et al., 2016) refuse to review papers that do not have open materials and data. Other community-driven practices draw on crowdsourcing, citizen science, and other types of collaborative and multisite working that can occur in a surprising number of stages of the entire research process, including research team building (e.g., Moshontz et al., 2018), design decisions (e.g., Landy et al., 2020), data collection (e.g., Paquot et al., 2022, validation of community judgements of proficiency), community augmented meta-analyses that accumulate multiple datasets (see Many Babies Metalab, https://langcog. github.io/metalab/documentation/using_ma_data/contribute_ma), and analysis (Aczel et al., 2021, to improve analytical robustness). Even the writing process itself has attracted an open community-driven approach (e.g., Tennant et al.'s, 2020, discussion of massively open online papers [MOOPs] that involve between 10 and 100 [partially] self-selecting authors in an openly participatory format). With clear editorial rights and authorship assignment, we think that MOOPs may help to diversify the producers of research, though perhaps only for certain genres of academic writing such as narrative syntheses or scoping reviews. A final grass-roots initiative is that of Peer Community in (https://peercommunityin.org), established in 2016, which reviews preprints held on repositories and then publishes them as licensed articles with the Creative Commons Attribution CC BY if the preprints are approved by two recommenders (akin to editors who seek reviews and then write a recommendation of 300–1,500 words). The authors of the peer-community approved preprints can then submit their recommended work to a specific set of journals that have committed to either accept the article with no further peer review or seek further review. Thematic communities of recommenders are entitled Peer Community in […], for example, Peer Community in Evolutionary Biology. One community that has emerged is that of Peer Community in Registered Reports (https://rr.peercommunityin.org), which operates as above except that participating journals do not retain the right to send the work for further review.

Perhaps the most striking indicator of the community-spirited ethos behind the open research movement is that of open grants, whereby researchers make their research proposals openly available (https://www.ogrants.org). This not only recognizes the effort invested, but also makes funding processes more transparent and potentially reduces inequities in understanding and accessing funding. If this infrastructure catches on in the field of language learning, this act of providing the intellectual property at the very core of the research process, would represent a very significant change in the research community's ethic.

The range and number of community-driven initiatives reveal a groundswell of interest in delivering open research practices in a collaborative manner. Which of these initiatives are sustained will depend, we think and hope, on the extent to which they can really address the scientific (i.e., quality-related) needs of the community. Most important, overall, these emerging practices reflect a changing culture whereby collaborative approaches involving open materials, data, analysis, quality-control, and dissemination are an inherent part of research. We prefer this vision to the rather bleaker view of open research as a mechanistic exercise in error-spotting or naming and shaming others within our communities (Rouder et al., 2019). In sum, the developments that we have reviewed suggest that open research practices could indeed feasibly be the future as innovation in infrastructure, process, and behavior coevolve with changes in culture.

Limitations of Our Conceptual Review

Despite the many different components of open research that we have covered, we have by no means covered all. For example, Hardwicke et al. (2022) considered additional practices such as funding disclosure and conflict-of-interest statements. Certainly, the movement is mature enough to no longer belong under one catch-all term of open research, and the metascience needed to examine and evaluate open research must focus on its individual components.

We have also noted a certain circularity to some of our metascientific argumentation. As we have observed in various places above, in order to demonstrate a need for a change towards more openness, more evidence is needed. Certainly, more discipline specific metascientific evidence is needed—though perhaps more so for some practices (e.g., materials, data usability) than others (e.g., open access). Indeed, we have had to draw on work from outside the language sciences. However, in order to create this evidence base, open research itself is needed to facilitate robust scrutiny of validity, reliability, scope, and generalizability. Thus, we acknowledge that we have, to some extent, relied upon somewhat piecemeal and nondiscipline specific data to describe and, in many places, advocate a need for change. But the circularity is perhaps inescapable—to do both better scientific and metascientific work, open research offers much potential.

We also acknowledge that open practices alone, and thus our review of them, are unlikely to comprehensively address some problems with research. For example, in terms of opening research to more producers, epistemological and linguistic biases against the work of scholars from contexts outside of an Anglophone-center have been observed, and numerous obstacles cause

uneven distribution of resources across contexts (Canagarajah, 2002; Salager-Meyer, 2014). Writing in English causes additional financial burdens (Hanauer & Englander, 2011), and journal practices (e.g., editing and reviewing) can also constrain (as well as enable) participation in knowledge production (Curry & Lillis, 2018; Salager-Meyer, 2014). Although pedagogies on writing for publication have emerged (Corcoran et al., 2019, interestingly, not an open-access book), their effect is yet to be seen on addressing underrepresentation of scholars from outside Anglophone western contexts.

Conclusion: Are Open Research Practices the Future?

And so, to the question posed by our esteemed colleagues: "(Why) are open practices the future?" We reply: "They are definitely *a* future, and it has to be so for many powerful reasons." We see the value of each one of UNESCO's recommendations for open research (Hampson et al., 2020), but for research in language learning to fully reflect these values, substantial steps are needed beyond a wait-and-see approach that rests on a belief that research is by definition self-correcting (Pashler & Harris, 2012; Smaldino & McElreath, 2016). We see that there is far to go. Even in psychology, where debate and initiatives have been more intense and proactive, Hardwicke et al. (2022) found only half of 250 articles published between 2014 and 2017 were openly available, and 14% of research materials, 0% of study protocols, 2% of raw data, and 1% of analysis scripts were shared. Preregistration and replication were also rare (3% and 5%, respectively). In the field of language learning, although the new journal *Research Methods in Applied Linguistics* became a very important addition to the stable in 2022, the introductory article and author guidelines (at the time of writing) barely mention open research despite the journal's focus on improving methods. Despite such bleak observations, we argue that "yes" for more of the time, for more researchers, and for more types of research, open research practices are the future.

In tandem, we also emphasize that open research is not the only future—other challenges also require attention! As Nosek et al. (2022) noted, "Other issues include measurement, causal inference, theory, generalizability, and applicability… Replicability does not guarantee validity of measurement or causal inference, nor that the knowledge is applicable" (pp. 738–739). For example, the usefulness and relevance of research cannot be improved by open research alone. Indeed, the challenges of achieving usefulness have been observed for decades in the field of language learning, for example, in relation to the links between language learning research and education (Hatch, 1979; Lightbown, 1985). However, open access and transfer of knowledge initiatives that promote

engagement with research consumers and coproducers may exert a drip-feed influence via a kind of washback into the relevance of research questions, designs, and dissemination. Better access should empower public critique that may enter into researchers' discourse, planning, and activities. Similarly, open research practices alone cannot increase the geographical, cultural, and social breadth of research producers, as noted in the limitations above, but open access and other open practices have the potential to play a significant emancipatory role in addressing at least some of these issues. Also sitting somewhat independently of open research is the quality of researchers' theorizing and hypotheses (as argued by Oberauer & Lewandowsky, 2019, and Muthukrishna & Henrich, 2019). Being more open will not, in and of itself, resolve the reproducibility crisis; having testable predictions that allow researchers to refute theories is, after all, the true driver. High standards of reporting cannot be replaced by open research either, and measurement error will not be corrected by open research alone, though we have argued that it is likely to help. And researchers cannot fully leverage open materials, data, or code without the training to understand them, but we have argued that research methods training can benefit from open research as more data and instruments are available. Finally, the future must also include maintaining and nurturing exploratory and qualitative work whose value and quality may not benefit from some of the elements of open research that we have discussed (though surely achieving open access publication is epistemologically neutral).

So, for many facets of research endeavors, open research is not sufficient, but it is necessary to achieve many of researchers' aspirations and highly beneficial for other aspirations. We are optimistic that in the long term, open research practices may washback into research to not only affect its reliability, validity, sampling, and scope, but also its very worth in society.

If pushed to recommend where to focus researchers' individual efforts and choices—as authors, reviewers, and editors—in order to improve the quality and scope of research, we would probably suggest that the focus should be on achieving open materials, data, and analyses. Adopting one or more of these practices is perhaps relatively low-hanging fruit for individuals. On the other hand, open access to findings that are free to be published and to be read is what is most urgently needed to achieve better equity in the global knowledge economy; however, open access publication, as things stand, involves a more complex set of professional and personal choices for authors, reviewers, and editors.

We foresee that the emerging metascience in the field of language learning will continue apace. Indeed, expectations about research quality change,

and so the metascientific endeavor will be ongoing: In 20 years, researchers will no doubt look back and observe how some practices that we consider to be acceptable now are in fact questionable. Endeavors to improve research are phenomena in themselves, worthy of systematic investigation. Interventions to promote open research—such as efforts to improve inclusivity of participants and researchers, error detection, large team approaches, or incentivization—may have gained momentum, but the field needs data about whether and how they are changing research for good or bad. We hope that language learning researchers will engage in this agenda so that field-specific challenges in language learning research can be accounted for and addressed.

<div align="right">Final revised version accepted 26 February 2023</div>

Notes

1 We prefer the term open research to open science to avoid any unintended epistemological biases—open research poses different challenges and affords different benefits for different types and approaches to research, which we discuss, albeit briefly, in the article. Others use open scholarship, often as an even wider term that also includes open educational resources. An even broader agenda is that of the (scientific) reform movement, a term that is increasingly used to refer to a wide range of subdomains of interest including not only open science but also metascience, and the history, theory, and philosophy of science. Much reform work is indeed concerned with openness (such as transparency and accessibility), but it is not solely defined by it, as the reforms might be driven by a primary focus on, for example, validity, bias, or inclusivity, which may be affected by or relate to (a lack of) open research (see Derksen & Field, 2022, for an example of metascience about the reform movement). We chose not to use the term reform here as it is too all encompassing for our purposes.

2 Such deals have been accused of causing double dipping; the public purse covers both university library subscriptions (to allow the research to be read) and article processing charges (to allow the same university academics to publish the research).

3 Some propose that professional bodies publish research. But, on the whole, this approach would still not provide open access (see the journals run by the American Psychological Association), as it would shift the cost to the membership of bodies and exclude those without membership (see Brysbaert & Rastle, 2020, for a history of relations between learned societies and journals).

4 At least one publisher's response to this has been to remove some of the free content in their journals (Wiley professional communication, November 27, 2020).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Accessible Summary
Appendix S1. Open Research and Its Role in Improving Research.