Analysis of the occurrence of *applications/replications* in ten published papers

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Abstract

Application or *replication* research, already rare, is diminishing in both quantity and quality, for a variety of reasons ("How science goes wrong," 2013; "For my next trick," 2016). In this study of *replications* and *applications*, 351 papers that included a reference to any one of ten of the author's papers published between 2001 and 2007 (the "child" papers) were examined. A total of seventeen instances of *application/replication* by other researchers (the relative rarity already a finding) of some element, processes, procedures, instruments, or findings, of one of the author's "parent" papers were found, about 5% of the total 351 original parent papers. No self-replications by the author were studied.

The findings showed that, of the small number of replications, three (less than 18% of the total) were *exact* replications, five (about 29%) were *partial*, and nine (about 53%) were *conceptual* only ("investigating the same construct but with different methods and measures"; Jones, Derby, & Schmidlin, 2010). All of the replications reported were based on *positive* or *neutral* views of the parent paper, none were based on a *negative* view, potentially problematic, it was concluded, if one of the goals of replication is to identify weaknesses or mistakes in previous work. Another finding was that, after publishing in this area, a minority of authors published another paper on a related topic in the same area at least once in the future. The paper concluded with a call for greater acceptance and valuing of *application/replication* research in general, and of disagreements (and therefore corrections of concepts) among practitioners, by researchers, publishers, editors, reviewers, and authors.

Keywords

Replication research; research; editors, journals, reviewers; parent/child research, publications.

Introduction

Published research may be used in various ways by others – or may be ignored altogether. In a previous paper (Fahy, 2013), the author examined how ten of his papers (the *parent* papers) were, after publication, replicated or applied by others. In that paper, it was previously reported that:

1) usage was general, but appeared to be very time-sensitive (all ten of the parent papers had been referenced at least twice in the published research of others; maximum usage of one paper was 72, and the mean number of citations was 33.7, but the older papers were referenced considerably more often);

2) *single references* (citing just the author's paper) were far more common than *multiple references* (citing the paper is a list);

3) *applications/replications* were the least common type of usage, followed by *contrasts/elaborations*, and *quotations*;

4) unlike publications in the "hard" (laboratory) sciences, whether a parent paper was *solo-* or *co-authored* did not appear to affect usage;

5) publication of a parent in a *non-prestige journal*, as defined in the literature, was actually associated with more usage than publication in a *prestige journal*; and,

6) a large majority of uses of the parent papers (over 80%) were in heavily scrutinized or closely supervised sources (*journal articles,* or *theses* and *dissertations*).

The present paper continues the previous work, examining the same corpus of publications further, focusing specifically on *applications/replications* of elements of the parent papers.

Background

Previous work on the uses and value of published research in the social sciences, including open and distance learning (ODL), is not extensive, but the existing literature suggests that ODL publications are in a poor state: the research is often poorly designed, conducted, or described (Keegan, 1985; Moore, 1985; Holdaway, 1986; Cannell, 1999; Saba, 2000; Gibson, 2003; Zawicki-Richter, Backer, & Vogt, 2009); academic papers as a class are often ignored by other scholars after publication (Lehrer, 2010); the conclusions can be rejected or proven wrong by subsequent research ("Publish and be wrong," 2008); papers may be retracted for a variety of reasons by their authors or publishers (Groopman, 2010); and published work may even be proven fraudulent ("Liar! Liar!", 2009). In the popular press, readers are warned that if they do not encounter further confirmation of published reports they might suspect the original findings "have fallen by the wayside" ("Journalistic deficit disorder," 2012; Kaku, 2014; "Let just try that again," 2016). It is also not unusual for effects initially reported to decline when examined later, the result of hindsight and the application of more powerful research tools (Ioannidis, 2005; Coyne, 2010). Even research widely considered valid and robust is typically only occasionally cited (Abbott, 2007), often because it cannot be replicated by others (Jones et al., 2010; "University challenge," 2011).

Retractions increased tenfold in the previous decade, and America's National Institutes of Health (NSH) reckon despairingly that researchers would find it hard to reproduce at least three-quarters of all published biomedical findings ("Trouble at the lab," 2013). Replication research is also viewed suspiciously by young researchers, who believe that "verification … does little to advance a researcher's career" ("How science goes wrong," 2013, p. 13).

In its defense, the ideal of replication research is to refine and correct research concepts and perceptions through further examination, inquiry, and consideration (Jones et al., 2010; "A far from dismal outcome," 2016). It has long been recognized that *replications* and *applications* are an important way of assuring that good quality research is recognized, circulated, updated, corroborated, and applied (Jones & Charnley, 1978; Wilson, 2001, p. 38). Moonesinghe, Khoury, and Janssens (2007) observe, "… replication of research findings enhances the positive predictive value of research…." (p. 220). Adams et al. (2005, p. 56) acknowledge the power of further research/replications, and, given how common lack of corroboration in research is (p. 590), approvingly comment: "Replication is the test for objectivity and is at the very heart of any scientific discipline." They observe that empirical findings should not be widely accepted until they are retested and confirmed by multiple occurrences (p. 58). Adams and colleagues comment, "We have greater confidence in the replication effort when the same 'effects' are observed across samples by different observers" (p. 64). (A similar point is made by Carlson and Ji [2011, p. 711].)

The role of replications in providing contrasting views is also recognized, often by focusing attention on contentious findings or issues. Derby et al. (2008,

p. 672), for example, report that papers with more "children" were more likely to be replicated.

There are a variety of reasons why adaptations/replications are so rare in the social sciences (Gopnik, 2015). Adams et al. (2005) blame these causes:

1. Corroboration of previous research is not a priority among agencies and individuals that fund research (Jones et al., 2010). National funding agencies routinely announce that they fund only "fundamental new knowledge," "cutting-edge" research, and "development of innovative methods and models," in proposals "that offer unique approaches." Generally, agencies (and publications – see #2, below) appear to regard replication research – which can be seen as a form of sober second thought – as derivative and therefore not worthy of funding.

2. Reviewer and editor bias about replications in many social science journals is common, with the result that application research is rarely accepted for publication (Weisman, 2011; Jones et al., 2010, p. 587).

3. As a consequence of the above, social scientific research is dominated by, and researchers are used to seeing printed, poor research: "stories, anecdotes, cross-sectional, and 'one-shot' studies" (Adams et al., 2005, p. 62).

Well thought-out remedies that might provide for more replications, and rationales for the publication of contrasting views in research, do exist in the literature, however. Bell, DiStefano, and Morgan (2010) argue that "transparency and replication are essential features of scientific inquiry"; they offer no fewer than ten suggestions on replication and revision, intended to produce more

accurate social science research over time. Conroy, Dunlap, Clarke, and Alter (2005) first observe in relation to social science research that "without replication across participants and researchers, the findings can be limited," then suggest that, to assure accuracy, before findings are accepted, "at least five single subject design studies [should be] conducted, across 20 participants with researchers across the country" (p. 164). Derby et al. (2008) suggest that application "demonstrates that a given finding can or cannot be repeated," which allows revision, correction, and the gradual accumulation of sound research knowledge. Freese (2007) agrees, stating that, because the credibility of quantitative social science rests on the belief that results reported by one researcher will be verified by others, concerns about replicability and contrasting views have increased (p. 153). (Freese goes on to suggest the interesting notion that graduate students consider publishing such studies to increase useful publications at the start of careers, and to increase awareness and scrutiny of a range of published research findings.)

Despite its importance, however, Helmig, Spraul, and Tremp (2012) note that replication research is still "largely missing" (p. 361) from the social sciences, and the reporting and publication of contrasting or contradictory findings is rare. (Jones et al., 2010 disagree in relation to their own field, concluding that "replications seem to be common in the human factors literature" [p. 587]. They voice some criticisms of the research that has been reported, however.) Finally, Henson, Hull, and Williams (2010) also deplore "one-shot" studies as a way of establishing or corroborating any theory (p. 122).

Researchers have recently become more critical of views or practices disparaging replication research, advocating the potential usefulness of this kind of research, especially for an audience of academic novices. A previously

mentioned article ("How science goes wrong," 2013) notes that it is an accepted rule of thumb among biotechnology venture capitalists that a huge plurality (up to half of the research published in academic journals) cannot be replicated (p. 13). Leithwood and Sun (2012) approvingly refer to those who argue that dissertations and other unpublished works are good sources of the 95% of research that produces noteworthy, potentially interesting and important, but non-statistically-significant results. Abbott (2007) identifies a variety of problems that he believes might slow the progression of *application/replication* research (pp. 215 – 216), causing this type of research to spread (if at all) only fitfully through the discipline (p. 210). Weiner, Halle, Lund, and Shoou-Yih (2011) note that the "publication outlet" is significant to the reception accorded qualitative research, making the views of journal editors and reviewers even more significant to researchers (especially the younger and newer ones), if they are negative toward replication research.

To summarize: while *applications/replications* do occur in the social sciences, they are widely thought not to occur often enough; at the same time, researchers regard this type of work as potentially improving the validity, predictability, and consistency of concepts, methods, tools, and findings, and therefore of the confidence others have in published results; without revisiting and revising beliefs, some important research findings of a discipline may come to be based upon anecdotal or "one-shot" observations; replication research, though often resisted by editors and reviewers, is regarded as fundamental to the growth of the scientific elements of disciplines.

The study

Google Scholar (http://scholar.google.ca/) often provides direct links to published research (the exception is books and book chapters, which at the time of this study were usually not available in full-text format through *Google Scholar*), as well as providing specifics about usage by other researchers. The author was able to retrieve full-text copies of over 98% of the publications (parent and child) used in this study, through the various Athabasca University library subscription services. When full-text versions of the child papers were not available, they were removed from the analysis, since this situation was rare.

The procedure used was as follows. First, the ten "parent" papers were identified, then *Google Scholar* was used to identify the 351 "child" papers that referred to one of these, originally published between 2000 and 2007. Of these, this study focused on the 17 child papers that contained at least one instance of application or replication (these 17 papers were about 5% of the 351 total child papers).

The following questions were asked in relation to the total number of child papers:

1. How often were *applications/replications* of parent paper materials observed in the child papers?
2. What were the proportions in the *applications/replications* of *complementary, parallel, null set, or antagonistic* assessments, as determined by the researcher?
3. When an *application* or *replication* of some element of the original parent paper was conducted, was the *application/replication* an *exact,*

partial, or *conceptual application/replication* of the original research (using definitions from the literature)*?*

4. How often did conducting and reporting research in this area lead a researcher to publish further in the same area?

For manageability, the original literature searches were limited to the research databases *EDITLib*, *ERIC*, *SAGE*, *Education Research Complete*, and *ProQuest Education Journals*; consultation with Athabasca University library staff led to the conclusion that these five databases constituted the main sources for papers on open and distance learning (ODL).

For a study to be considered a replication, it had to meet the requirements of the definition provided by Jones et al. (2010, p. 586): "When a study is methodologically or conceptually similar to an earlier one, then the later study is considered a replication." More is said about the various possible types of replications below.

Findings

1: Frequency *of applications/replications*

The first question was the frequency of the various types of *applications/replications* in the child papers, related to the definitions used by Jones et al. (2010). (Similar definitions and language are used by Adams et al. [2005]).

Figure 1: Jones et al.'s (2010) definitions of *types* of application/replications
- Exact *applications/replications*: "strive to find the same results with the same instruments"
- Partial *applications/replications*: "investigate the same construct" and are "an extension of previous research, … retaining most of the original

measures"
- Conceptual *applications/replications*: "investigate the same construct, with different methods and measures"

The frequency of each of the above is shown in Figure 2:

Figure 2: Frequencies of *types* of replications in the present study

Type of *replication/application*	Occurrences of *applications* or *replications*	
	#	%
Exact	3	18
Partial	5	29
Conceptual	9	53
TOTAL	**17**	

Figure 2 shows that *applications/replications* were rare – less than 5% of the child papers. Figure 2 also shows that *conceptual replications/applications* were the most common among the child papers (more than half), and, at about a third, *partial replications/applications* were next most common. *Exact replications/applications* were the least common among the child papers. One interpretation is that the researchers in this study usually used the parent paper as a developmental springboard for their own thoughts and work, but only rarely engaged in exact replications/applications in the form of duplications where the original thinking was borrowed and applied exactly. A positive conclusion was that the work done by most of the researchers included in this survey was more creative and original than imitative.

On the other hand, while creativity might be laudable, and evidence of a lively curiosity, the rarity of exact *applications/replications* meant, for purposes of this study of *replications*, that original research findings were not usually

subjected to careful reexamination and reevaluation through the process of exact replication of approaches and instruments. For whatever reason, this study found that most child papers were not exact replications/applications of parent papers, and that the parent papers and their findings thus still remained to be duplicated precisely.

2: Positive, neutral, and negative endorsements of parent papers

Do appliers of previous research follow the path that was reported/deplored in the literature, endorsing only studies with which they agree? Do researchers correct studies they feel are in error? An examination of the papers by the researcher was done to determine the answer; Figure 3 shows the results.

Figure 3: Reaction to parent papers by users (Bloome, Carter, Christian, Madrid, Otto,Shuart-Faris, and Smith, 2008)

Reactions		
Positive	**Neutral**	**Negative**
9 (53%)	8 (47%)	0

The above indicates strongly that the most common type of endorsement of the parent papers by researchers was *positive*, consistent with the literature finding that, often because of the preferences of editors and reviewers, the vast majority of published literature contains only positive findings (Ioannidis, 2005; Lehrer, 2010). Neutral views in this study consisted of simple recounting of what was done or found in the parent research, without a positive or negative viewpoint. As can be seen from Figure 2, overtly negative judgments of parent elements (processes, procedures, instruments, or findings) did not occur at all. Lack of adoption may be seen as reflecting a negative view, just as adoption may

be seen as a positive endorsement. These findings should be considered preliminary until, in the spirit of replication, additional study corroborates or further explains them.

Besides other positive observations, it is noteworthy here that none of the user *applications/replications* resulted in the rejection of a finding or a process from a parent paper, and that none of the researchers reported a negative view about a parent paper. While this might be an instance of journal or reviewer bias in favour of positive results, as noted earlier, it may also be an indication that the parent papers were completely useful to users, or that the findings of the parent work completely passed scrutiny by subsequent researchers. (This question might profitably be further researched.)

Research is usually based on a positive (or at least a neutral) view of the research being cited ("Trouble at the lab," 2013); researchers rarely cite material with which they disagree, or in which they see problems. However, Bloome et al. (2008, p. 129) identify four stances research can take toward its predecessors, beyond the perhaps simplistic categorization used here: *complementary, parallel, null set*, and *antagonistic*. In *complementary* research, according to these authors, there is "compatibility with regard to the underlying theoretical assumptions about language, people, and knowledge"; *parallel* research uses "similar dimensions or aspects but not necessarily complementarity of underlying theoretical assumptions"; *null set* research perspectives "appear on the surface to have some relationships to each other, but upon deeper inspection are not at all about the same thing; upon deeper reading they are so different that they are not at all studying the same thing or using similar approaches"; and *antagonistic* research contains "mutually exclusive theoretical constructs across research

perspectives" (p. 129). This typology should be applied with a larger sample in future research to determine the suitability of the categories, and to explore the question further.

Two findings in this area are of particular note, because they reflect on what the literature had predicted: 1) none of the user *applications/replications* resulted in questioning – much less rejection – of a finding or a process of a parent paper; and, 2) none of the follow-up research focused precisely on an aspect of the original parent research that was deemed deficient in some way. As noted earlier, while this might be another instance of the bias of journal editors and reviewers it may also be an indication that the parent papers were in fact consistently and uniformly useful, were regarded positively by users, and that the findings of the original parent work met its objectives and subsequently passed careful scrutiny. Here, as noted earlier, the conclusion was reached that researchers who wrote the child papers consistently and uniformly did so only if they regarded elements of the original parent paper positively (they endorsed the results) or, at worst, were neutral about or in parallel with them (they mentioned some of the parent papers' results, but did not explicitly refute or endorse them).

Citations, however, imply an endorsement, even if a neutral or parallel one, in the terms used here (and of the concept of *complementarity* found in Bloome et al., 2008), and the endorsement is definite if the results cited are positive. For example:

> "As Fahy et al. (2001, p. 2) state: 'Practitioners and researchers must be able to describe online interaction more than impressionistically and measure them more effectively than anecdotally.'" [Cook & Ralson, 2003, p. 361]

"This study adopted TAT (Fahy, 2001) as the analysis technique to analyze students' patterns of interaction and online supportive behaviours." [Lin, Yueh, Liu, Shoji, Kakusho, & Minoh, 2007, p. 2]

Neutral expressions made no judgment about what they reported:

"In addition, researchers have already reported moderate inter-rater reliabilities for the TAT with Cohen kappa's ranging from 0.45 to 0.65 (Fahy, Crawford, & Ally, 2001)." [de Leng, 2009, p. 98]

"Gender appears to influence the way in which individuals interact and communicate in virtual environments (Fahy, 2001; Yates, 1996; Herring, 1996)." [Lawlor, 2004, p. 2]

As noted above, reasons for the lack in the child papers of negative interpretations of anything in the parent papers remains to be studied and explained further.

3: Further research in the area of replication/application

In relation to the third question, five online Athabasca University library databases listed above were consulted to determine whether *conducting and reporting research in any area led to further research in the same area by the author, as indicated by further publication on the same or a related topic.* To be recognized as further publishing in the same area, a subsequent paper had to meet completely the following three standards:

1. The title or abstract had to indicate that a subsequent child paper was in the same area or in an area closely related to the *application/replication* research.

2. The subsequent child paper had to cite at least one of the parent papers.

3. The original author had to be the primary author of both the original *application/replication* paper, and of further published papers in the same or similar area as the *application/replication*.

A search of the five databases showed that 13 authors were associated with publishing a total of 17 additional papers, as solo or lead author; four of these example authors subsequently published in the same area more than once. Figure 4 shows the most prolific authors.

Figure 4: Further research by the study's four most published authors

Solo/primary authors (total *application/replication* authors: 13)	References to parent papers (total references: 959)		Subsequent papers authored/co-authored in the same or similar areas (total papers: 17)	
	References	**% of total**	**Papers**	**% of total**
Murphy, E.	28	2.9%	6	35%
Oriogun, P.	70	7.3	5	29
Schellens, T.	53	5.5	2	12
Valcke, M.	53	5.5	2	12
TOTAL	**204**	**21.3%**	**15**	**88%**

Based on the above it was concluded that, while only a minority continued to work in the field of *application/replication* research, those who did contributed extensively (the mean number of subsequent publications was 3.75 per researcher, the median was 3.5 papers).

Regarding applications/replications

As noted earlier, there is consensus among science researchers that *applications* and *replications* are at the heart of the field's research, providing confirmation of objectivity and the lack of obvious bias or error in the reported results, therefore predicting the likely enduring validity and applicability of published papers (Neuliep & Crandall, 1993; Adams et al., 2005; Conroy et al., 2005; Brandon & Singh, 2009; Chrisman, Kellermanns, Chan, & Liano, 2009; Jones et al., 2010; Carlson & Ji, 2011; "For my next trick," 2016). *Replication/application* studies may not be identified as such in the published literature (Jones et al., 2010, p. 588, 594), a tendency confirmed here. As noted earlier, s*elf-replications* of the author's own previous research, thought to be more common, are also often not identified, to the frustration and detriment of some (Adams et al., 2005, p. 55; Jones et al., 2010, p. 186; McDonnell, Stanton, & Burgess, 2011).

On exact replications/applications. Though these were rare (at 17.6%) they were not particularly unusual in this study (the number was 3 of 17, of a very small sample). Clearly, the occurrence of *replications/applications* in other situations deserves further study. *Partial* and *conceptual replications/applications* are "more prevalent" in the literature (Jones et al., 2010), and were more common here (82%). The relative rarity of *exact* or *literal applications/replications* may be due to the lack of identical research circumstances that would permit exact replications, or to the desire of researchers to put their individual stamp on uses of research tools and methods. Both of these are potentially valid reasons for conducting partial or conceptual research; confirmation of their existence, and the reasons for exact applications and replications in ODL, deserve further examination in future studies.

The finding that a great majority of *applications* and *replications* were based on positive, or at worst neutral, views of the parent paper's processes, procedures, instruments, or findings, may confirm one of the literature's warnings, that publication often assumes positive (or at least not negative) results from *applications* and *replications* (Conroy et al., 2005; Ioannidis, 2005; Lehrer, 2010). Among the reasons for this phenomenon, as noted previously, may be the preferences – or requirements – of editors, reviewers, and funding agents (Patton, 1975; Abbott, 2007; Derby et al., 2008; Jones et al., 2010; Weiner et al., 2011; Weisman, 2011), as well as the predominance of genuinely positive outcomes noted in *replication/application* research. This finding also deserves further examination in further work.

It also appeared that, while the types of *replications/applications* ranged from *conceptual* to *full/exact*, ODL researchers who replicated previous work did not do so slavishly here. As noted earlier, the tendency to adapt previous elements when they replicated them, and to be creative in the role of replicator, can be seen as a sign that ODL researchers used previous work more as a starting point (described earlier as a "springboard") than as a limitation to their research. In this study, researchers who engaged in replications or applications only occasionally borrowed the processes, procedures, and instruments of the parent researcher *in toto*; more often, they made adjustments of various kinds (*partial* implementation), or merely used the previous work for further development (*conceptual application/replication*). This last case suggests that researchers were quite sensitive to differences in what the parent paper had examined, and the focus of their own work, a positive development – and, ironically, contrary to the purposes and concerns of replication research.

A final word needs to be said to researchers, as a result of these findings: Researchers should consider using the work of others more often in their own research, and when they do they should look for corroboration that previous findings are valid, or remain valid, in any new or untried circumstances, in the spirit of a genuine replication. Practitioners apparently recognized that, as circumstances change, tools and media should, too. The assumption that changed realities do not invalidate previous knowledge needs to be confirmed, or at least tested, as one of the roles of research and researchers.

Conclusions and implications

In this study, applications and replications occurred only about 5% of the time. (Freese's [2007, p. 168] definition of *replication* was applied: "… using the same data and procedures with the goal of verifying results"; "attempting to see if the same findings are observed in a fully repeated study …."). That such a small percentage of the elements of previously published papers was subjected to further scrutiny through *application/replication* may be regarded as perplexing, since this means that more than 95% of the papers, from a range of published sources, had been un-replicated, un-duplicated, and un-tested, in the average 7.4 years since their initial appearance. It appears that the complaint expressed in the research literature about the rarity of replication and application research is valid – an important finding of this work.

Also potentially problematic was the finding that most of the *applications/replications* studied here proceeded from a positive endorsement of the original work, fewer from a neutral view, and none at all from a negative one. Again as noted (and deplored) in the literature, this finding suggests that

replicators identified work consistent with their own objectives or expectations, and did not address less compliant issues. It is a question for further research whether this finding is general, and whether one of the interpretations is that researchers exhibited too slavish an acceptance of, and agreement with, the work of others.

Researchers have addressed the problem of lack of replication with suggestions of varying insight and feasibility. Freese;s (2007) suggestion is that young academics and graduate students might engage in replication research as a way to augment their publications, while testing and presumably becoming more familiar with the received wisdom of the field. Doing so could, in fact, be enriching, as well as meeting a requirement for more replication research; Molina-Azorin (2012) sees replication (using both qualitative and quantitative elements, whether produced by new academics or not) as potentially leading to more mixed-methods approaches, which in turn could result in stronger inferences, and more references than mono-method inquiries typically produce (p. 33). The likelihood and feasibility of these processes and outcomes remains to be debated and further researched in the field.

There is continued concern that journal editors may not seek out or encourage *application/replication* research. The literature contains many warnings and complaints about this alleged state of affairs. To the degree the charge is true it is unfortunate, for the reasons mentioned above. ODL requires examination of its roots and assumptions; *application/replication* research is one way to accomplish that objective. Simply said, journal editors and reviewers (and funding agents) should be more open to the conduct and reporting of *application/replication* studies, and to contrary, negative, or null findings (which

can be a form of rejection). Researchers, for their part, should be – or become –
better writers and presenters of their work (Holdaway, 1986; Zawicki-Richter et
al., 2009).

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