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Abstract

Existing literature provides insight into the nature and extent of plagiarism amongst undergraduate students (e.g., Ellery, 2008; Parameswaran & Devi, 2006; Selwyn, 2008). Plagiarism amongst graduate students is relatively unstudied, however, and the existing data are largely based on self-reports. This study investigated the rates and potential causes of plagiarism amongst graduate students in master's and doctoral programmes in science, technology, engineering, mathematics, and science or mathematics education by examining actual research proposals written by graduate students. Results indicate that plagiarism is a prevalent issue at each of the three university sites sampled and across all of the investigated disciplines. Fine grained analyses suggest that this plagiarism may be largely unintentional and due to a lack of disciplinary enculturation. Specifically, participants that plagiarised had approximately one less semester of research experience than graduate students who did not plagiarise. Furthermore, participants who lacked primary literature in their

research proposals were significantly more likely to plagiarise and often used inappropriate citation styles. Follow-up correspondence with participants indicates that participants plagiarised, in part, because they lacked an awareness of the role of primary literature in the research process. This suggests that explicit training in the role and use of primary literature may provide an opportunity for programmes or mentors to accelerate the development of graduate students' research skills. This study also revealed that plagiarism was more common amongst English as a Second Language (ESL) participants. Potential causes of plagiarism and solutions to address plagiarism among the ESL population will be discussed.

Introduction

Researchers have noted the occurrence of plagiarism, or theft of another's words or ideas, amongst undergraduate college students (Franklyn-Stokes & Newstead, 1995; McCabe, Trevino, & Butterfield, 2001; Pickard, 2006). In contrast, investigations into graduate student plagiarism are, until recently, relatively limited. However, recognition of the occurrence and meaning of plagiarism amongst graduate students is beginning to capture scholars' attention (e.g., McCullough & Holmberg, 2005; Pecorari, 2003).

At all levels of education, researchers are increasingly realising that plagiarism is a complex and nuanced phenomenon (Abasi & Graves, 2008; Chanock, 2008). Students, however, may fail to understand its "many subtleties" (Power, 2009; Marshall & Garry, 2006). Those engaging in "unwitting plagiarism" (McGowen, 2005) may sincerely believe they are following correct procedures (Chanock, 2008).

Confusion about the nature and extent of plagiarism may be heightened given that most investigations into its occurrence and nature are based on self-report (e.g., McCabe, 2005; Scanlon & Neumann, 2002). As noted by previous researchers, whilst self-reports of plagiarism can provide valuable information, this method raises issues of response bias due to the sensitive nature of the topic (McCabe, 2005) as well as the variability in students' definitions of what constitutes plagiarism (Marshall & Garry, 2006). Thus, more objective analyses of graduate student plagiarism may provide additional insights. This study investigates the occurrence and contributing factors to graduate student plagiarism using a performance-based measure of graduate students' research skills.

Factors contributing to intentional plagiarism

Several factors are implicated in the occurrence of intentional plagiarism amongst students such as technological advances and lack of consequences. Technological advances, including the relative ease of cutting and pasting text, the availability of information on the Internet, and the proliferation of websites selling student papers all may facilitate the occurrence of plagiarism (Auer & Krupar, 2001; Bartlett, 2009). Inconsistency in citing Internet-based resources across citation styles may also contribute to improper citation (see Auer & Krupar, 2001 for a discussion).

In addition to technological advances, a lack of consequences for committing plagiarism as well as a lack of motivation to complete one's work may contribute to intentional plagiarism. In terms of a lack of consequences, previous research suggests that instructors may be reluctant to pursue charges of plagiarism when they discover it (Barnett & Cox, 2005) often due to limited time (Remler & Pema, 2009). Even if instructors use software that detects word matches, students can readily obtain, for a price, highly customised essays, reports, and even dissertations. Their tailored specificity likely pushes them beyond the bounds of detection by plagiarism software (Bartlett, 2009). Students may also intentionally plagiarise, in part, because they lack the motivation necessary to do their own work. Increasingly, students attend college to secure a job, rather than to deepen their education (Cohen & Brawer,

2008). Thus, they may see plagiarism as a type of academic outsourcing, comparative in practice to a business outsourcing administrative tasks (Bartlett, 2009). With this career focus, students may be less invested in their studies (Auer & Krupar, 2001) and more likely to plagiarise.

Factors contributing to unintentional plagiarism

Though intentional plagiarism undoubtedly occurs amongst the graduate student population (e.g., Bartlett, 2009), Pecorari (2003) suggested that the majority of graduate students do not *intentionally* plagiarise based on observing students' forthrightness. As the name implies, unintentional or "unwitting" (McGowen, 2005) plagiarism refers to plagiarism that results through no intent to deceive. It is important to distinguish between intentional and unintentional plagiarism, because the causes and potential solutions are different. However, as Pecorari noted, intention is "notoriously difficult to prove or disprove, since the only conclusive evidence exists within the head of the perpetrator" (2003, p. 334).

Unintentional plagiarism has been shown to occur at the high school and undergraduate level. For example, almost half of high school students in one study believed that they could borrow others' ideas or language without using an in-text reference or footnote, as long as the author's name appeared in the reference list (Dant, 1986). Similarly, in a later study, as many as half of undergraduate students surveyed were unable to identify instances of inadequate paraphrasing (Roig, 1997). Unintentional plagiarism has been linked to unawareness of appropriate citation and paraphrasing which may stem from instructional deficits. Cultural differences have also been considered in explaining student plagiarism.

High school students and, to some extent, their undergraduate counterparts, are still learning rules and conventions to help them avoid plagiarism. One might assume that graduate students, with their advanced years of education, might be familiar with these rules and conventions. However, as Pecorari (2003) noted, this assumption is unfounded. Unfortunately, there is evidence that teachers and professors may not explicitly instruct students on how to avoid plagiarism. Instructional deficits can occur for several reasons. Instructors may believe that students arrive on campus with sufficient knowledge of how to avoid plagiarism (Chanock, 2008). Further, higher education institutions may provide student orientations in which a common topic is campus codes of ethics (McCabe, Travino, & Butterfield, 2001). Thus, instructors may assume that this orientation provides students with adequate guidance to avoid plagiarism. Other instructors may have no clear and commonly shared definition of plagiarism (Macdonald & Carroll, 2006). Intriguingly, even if they do, assumptions of how to write – including how to write in a way that facilitates unique blending of ideas whilst avoiding plagiarism – may be difficult for some instructors to articulate to their students (Abasi & Graves, 2008).

Unintentional plagiarism may result when graduate students, who may not have received explicit instruction on paraphrasing, lack an understanding of what constitutes plagiarism or are unaware of proper citation methods. These may be markers of a lack of enculturation at the graduate level. Enculturation is defined as the process of acquiring the values and behaviours of a group (Corcoran & Clark, 1984). In terms of writing, one important skill for students in the sciences is the ability to locate, critique, and synthesise primary literature (peer-reviewed papers that present original results or theories (Janick-Buckner, 1997)) and this skill is of utmost importance for graduate students who conduct their own dissertation research.

Researchers have also found that plagiarism is more commonly reported amongst ESL students (Marshall & Garry, 2006). Cultural differences in conceptions of what constitutes plagiarism may contribute to its occurrence amongst ESL students (Currie,

1998; Matalene, 1985; Marshall & Garry, 2006; Pennycook, 1996; Sherman, 1992). In Italy, where rote learning is strongly emphasised, students were found to identify plagiarism as desirable (Sherman, 1992). As Sherman explained, the students

> were virtually unanimous that it was a good idea to reproduce large tracts from source material when dealing with an academic subject. They found my requirements for 'own work' rather quaint…They pointed out that the opinion or the facts could not be better expressed than they were by the source writer, and that they themselves could hardly presume to improve on a publicly acknowledged expert. Taking over his words was thus necessary in order to cover the subject, and also a mark of respect for the originator. (1992, p. 191)

In contrast, graduate students in English-speaking countries are typically expected to critically evaluate published research and to develop their own authorial position in synthesising research to add a new voice to the literature (Abasi & Graves, 2008; Boote & Beile, 2005). Unfortunately, many international students may have limited experience with this type of writing (Abasi & Graves, 2008; Ninnes, Aitchison, & Kalos, 1999).

Cultural differences may also be compounded by ESL language barriers. Specifically, ESL students may lack the linguistic skills necessary to read and comprehend academic writing in English and to summarise those ideas in their own words (Currie, 1998). Stated differently, they may experience an overwhelming level of cognitive load which prevents them from representing ideas in their own words (Kirkland & Saunders, 1991). Perhaps due to these perceived difficulties, conventional wisdom has suggested that ESL students may be more susceptible to plagiarism (Pecorari, 2003). However, as Pecorari notes, "While explanations involving cultural differences often resonate….the only evidence for them is anecdotal" (2003, p. 319). In addition to cultural differences in students' definitions of plagiarism and language barriers, researchers have identified several additional factors which may contribute to plagiarism amongst international graduate students such as the drive to succeed financially, lack of a support network, or fear of failure (see Marshall & Garry, 2006 for a comprehensive list).

Study purpose

The researchers in this study did not set out to design a study on graduate student plagiarism, because they assumed that graduate students had already developed proper paraphrasing and citation skills. Whilst examining research skills, however, the researchers discovered that plagiarism was occurring at a substantial rate.

The extant literature on graduate student plagiarism uses student and faculty perceptions to investigate the extent of and reasons underlying graduate student plagiarism (Anderson, Louis, & Earle, 1994; Swazey, Anderson, & Louis, 1993), and little is known about actual rates of plagiarism or its causes in this population. Thus, this study serves multiple purposes. First, in an attempt to bypass reliance on self-reported occurrence of plagiarism, the study seeks to document the rate at which plagiarism actually occurs amongst graduate students using research proposals written by students in their area of study. Second, the study examines plagiarism rates across a spectrum of contexts: three institutions, six disciplines, and two degree-levels. Third, the study examines the association between markers of enculturation, operationally defined as prior research experience and inclusion of primary literature in research proposals, and the occurrence of graduate student plagiarism. Finally, the study examines the relationship between ESL status and the occurrence of graduate student plagiarism and uses Test of English as a Foreign Language (TOEFL) scores to tease apart whether ESL students plagiarise due to enculturation issues versus language barriers.

Method

This research was conducted as part of a larger National Science Foundation (NSF) study investigating the influence of engagement in inquiry-based teaching on graduate students' research skill development. As part of the larger study, data from each graduate student participant was collected including demographic information, whether English is their first language, single-authored research proposals, and responses to semi-structured interviews. These data were collected at the beginning and end of academic years 2007–2008, 2008–2009, and at the beginning of the 2009 academic year. Scores from the TOEFL were obtained from university records for ESL participants and used to triangulate students' self-reported ESL status.

Data collection sites

Graduate student participants were recruited from programmes at three universities. To provide contextual background to the reader, universities are referred to by their Carnegie classifications (Carnegie Foundation for the Advancement of Teaching, 2010). Two universities were located in the Southeastern United States, including a research-extensive university ("University 1") and a primarily baccalaureate college of arts and sciences ("University 2"). The third, a larger master's-granting university ("University 3") was located in the Northeastern United States.

Graduate student participants

Most of the 113 graduate student participants were in the first years of their graduate studies. Specifically, 73 (64.6%) were in their first year, 24 (21.2%) were in their second year, 9 (8.0%) were in their third year, and 7 (6.2%) were in or beyond their fourth year of graduate study. All were seeking their master's degree (n=46, 40.7%) or PhD (n=67, 59.3%) in science, technology, engineering, mathematics, or mathematics or science education (STEM-ED) fields. In the United States (US), the distinguishing feature of a master's degree is the shorter degree duration and more constrained scope of the thesis, the culminating research project. Doctoral degrees are typically longer and involve a broader scope of research investigation. Sixty-five (57.5%) participants pursued a science related degree (e.g., biology, chemistry), 10 (8.8%) pursued a technology degree (e.g., biotechnology, computer science), 24 participants (21.2%) pursued an engineering degree (e.g., mechanical engineering, chemical engineering), 6 (5.3%) pursued degrees in mathematics or science education, and 8 (7.1%) pursued a mathematics or statistics degree. Forty-six (40.7%) participants self-identified as an ESL student. All participants were paid $500 for their participation in the larger NSF project.

Research proposal development and collection

Each fall for three consecutive years, graduate students were recruited for participation. Shortly after recruitment, participants received detailed directions to develop their research proposals in their field of study. Section headings (Introduction, Methods, Results, Discussion, Literature Cited), descriptions, and criteria were explicitly delineated. Students were strongly encouraged to use resources and citations styles typical for their field. Students at University 3 submitted proposals as a requirement of their graduate fellowships. For other participants, the proposal was framed as an effort that could be directly applicable to NSF Graduate Fellowship applications and/or grant proposals.

Participants submitted their research proposal in mid to late September and revised and resubmitted their proposals in early May. Because many participants (73 of 113) were in their first year of their current graduate programmes, their conception of their proposed research may have been very naïve. However, very few students (10 out of 55 participants for whom both pre- and post-proposals were available) changed their post-proposal topics, indicating that students originally chose proposal topics relevant to their graduate research.

A chi-square analysis was conducted to identify extant differences in the rate of plagiarism observed in proposals during each year of the study. Results revealed no significant differences between the rate of plagiarism on the pre-proposal ($X^2[2]$ = 0.397, p=0.827) or the post-proposal ($X^2[1]$ = 0.003, p=0.957) across years of the study. Thus, all three years of proposal data were pooled for further analyses.

Proposal evaluation
Proposals were evaluated using a modified version of the Universal Lab Rubric (ULR) that assesses the quality of scientific writing (Timmerman, 2008; Timmerman, Strickland et al. in review). The rubric includes a component that assesses the presence of primary literature and the extent to which it is used effectively. To ensure that rubric ratings were valid (i.e., they accurately reflected each student's academic writing skills), each research proposal was submitted to *SafeAssign™* plagiarism detection software. This software produces a report that details the percentage of sentences matching other available sources such as websites, journal articles, and conference proceedings. *SafeAssign™* also provides the original source material for the matched text, allowing assessment of the nature of the plagiarism.

SafeAssign™ reports were evaluated and each instance of plagiarism was examined within the context of the larger paper. All proposals were then coded to indicate the presence or absence of plagiarised text. Examples of plagiarism ranged from inadequate paraphrasing of a limited number of sentences to instances of cutting and pasting large chunks of text without quotation or citation. Participants whose proposals included plagiarised text were notified by email and provided with the SafeAssign™ report. Although no explanation was required – or even anticipated – surprisingly, some participants chose to respond to these emails and explain why they plagiarised.

Sample sizes
As shown in Table 1, sample sizes varied between analyses, as not all data were available from each participant. In total, 113 pre-proposals and 54 post-proposals were examined for this study. More pre-proposals were available because post-proposals have not yet been collected for participants who are involved in the third year of the study and some participants left the study prior to submitting a post-proposal. Amongst the 113 pre-proposals, at the time of this study, 109 have been rated for primary literature. The remaining 4 proposals require raters with specialised knowledge in order to evaluate the inclusion and quality of primary literature. All 54 post-proposals were evaluated using the ULR. Data regarding degree pursuit and ESL status were available for all participants. Participants self-reported ESL status on a brief demographic questionnaire. TOEFL scores were available for 34 participants (out of 46 self-reported ESL participants). Participants for whom TOEFL scores were not available included native English speakers and ESL students who received a degree from a university in the US or became a US citizen prior to enrolling in their current degree programme. Information regarding participants' amount of research experience were available for 112 participants. One participant did not take part in the semi-structured interview.

Table 1:
Details about sample sizes

	Sample Size	
	Pre-proposal	Post-proposal
Total Proposals Received	113	54*
Proposals Rated for Primary Literature	109**	54
ESL Participants	46	24
TOEFL Scores	34	-***
Duration of Prior Research Experience	112	53

* When the current study was conducted, the larger three-year project was in Year 3 of data collection; thus, post-proposal data were unavailable for Year 3 participants.
** Four research proposals have not yet been rated using the URL because they require a rater with highly specialised knowledge of their discipline.
*** Collected prior to the study.

Semi-structured interviews

In addition to submitting research proposals, participants completed semi-structured interviews to provide information on their teaching and research experiences, views on teaching and research, and support received for their teaching and research. Interview data used in this study included participants' descriptions of their prior research experience. Specifically, researchers coded the number of semesters of prior research experience for all participants. These data allowed researchers to investigate the hypothesis that graduate students' amount of prior research experience is related to the likelihood that they plagiarise.

Results

Rate of plagiarism

Instances of plagiarism were commonly identified in participants' proposals. For the pre-proposal, 41 (36.3%) of the proposals included instances of plagiarism. The rate of plagiarism was similar for post-proposals. Twenty-three (42.6%) included occurrence of plagiarism. Occurrences ranged in severity with some participants insufficiently paraphrasing a few findings to participants who copied and pasted major chunks of text without any citation. The majority of text was plagiarised from websites and journals. Participants generally indicated in follow-up emails that they were unaware that they had committed plagiarism. For example, one participant noted, "The highlighted phrase [plagiarised passage] was about the symptoms of the disease. Symptoms for a disease never change." Thus, this graduate student did not recognise the effort that the author put forth to synthesise the symptoms of a disease and that this synthesised information represents intellectual property. Further analysis amongst participants who submitted both pre- and post-proposals revealed that 18 participants plagiarised on both the pre- and post-proposal, five participants plagiarised only on the pre-proposal, and three participants plagiarised only on the post-proposal.

Contextual factors

Analyses of rates of graduate student plagiarism across the three sites sampled are presented in Table 2. As shown, substantial rates of plagiarism were identified at all three universities. A chi-square analysis revealed that the rate of plagiarism between the universities was not statistically different for the pre-proposal, $X^2(2) = 1.316$, $p=0.518$, or the post-proposal, $X^2(1) = 0.742$, $p=0.389$.

Table 2:
Rates of graduate student plagiarism at three universities sampled

	Pre-proposal				Post-proposal			
	No Plagiarism		**Plagiarised**		**No Plagiarism**		**Plagiarised**	
University Classification**	N	%	N	%	N	%	N	%
University 1 (Research Extensive)	53	61.6%	33	38.4%	27	60.0%	18	40.0%
University 2 (Master's Colleges and Universities – Larger Programmes)	11	64.7%	6	35.3%	4	44.4%	5	55.6%
University 3 (Baccalaureate Colleges – Arts and Sciences)	8	80.0%	2	20.0%	-*	-*	-*	-*

Note: no statistically significant differences.

* Post-proposal scores not yet collected from this university.

** Developed by the Carnegie Foundation for the Advancement of Teaching, 2010.

Differences in the rate of plagiarism between master's and PhD level students were also examined. Table 3 suggests higher rates of plagiarism amongst masters students for both pre- and post-proposals, but these differences were not significant for the pre-proposal, $X^2(1) = 0.015$, $p=0.902$, or the post-proposal, $X^2(1) = 0.124$, $p=0.724$. Table 4 presents the rate of plagiarism across programme areas (science, technology, engineering, mathematics, and science and mathematics education). It shows that plagiarism was spread across all degree programme areas sampled. Sample sizes for some programme areas were not adequate for statistical analysis.

Table 3:
Participants who plagiarised and participants who did not plagiarise by degree level

	Pre-proposal				Post-proposal			
	No Plagiarism		**Plagiarised**		**No Plagiarism**		**Plagiarised**	
Degree	N	%	N	%	N	%	N	%
Master's	28	62.2%	17	37.8%	12	54.5%	10	45.5%
PhD	43	64.2%	24	35.8%	19	59.4%	13	40.6%

Note: no statistically significant differences.

Table 4:
Participants who plagiarised and participants who did not plagiarise by degree programme area

	Pre-proposal				Post-proposal			
	No Plagiarism		Plagiarised		No Plagiarism		Plagiarised	
Programme Area	N	%	N	%	N	%	N	%
Science	42	64.6%	23	35.4%	16	55.2%	13	44.8%
Technology	5	50.0%	5	50.0%	2	40.0%	3	60.0%
Engineering	18	75.0%	6	25.0%	11	78.6%	3	21.4%
Mathematics	4	50.0%	4	50.0%	0	0.0%	2	100.0%
Science and Mathematics Education	3	50.0%	3	50.0%	2	50.0%	2	50.0%

Note: sample sizes not adequate for statistical analysis.

Enculturation issues

Over 20% (25 out of 109) of the pre-proposals did not include any primary literature. Instead, these participants cut and pasted text from websites that also generally lacked any primary literature references. This suggests that at the time of pre-proposal submission, a sizable number of participants either did not know how to locate high quality or reputable sources to support their writing, or they simply failed to realise the importance of primary literature. Most (50 out of 54) post-proposals included at least one primary literature reference.

Table 5 compares the rate of plagiarism amongst participants who did and did not have any primary literature. A chi-square revealed that significantly more plagiarism was identified amongst participants who lacked any original text describing primary literature in their pre-research proposals, $X^2(1) = 10.410$, p=0.001. Sample sizes were not adequate, however, to conduct this analysis on post-proposal data as there were few instances in which graduate students did not include primary literature on the post-proposal.

Table 5.
Inclusion of primary literature by plagiarism status

	Pre-proposal				Post-proposal			
	No Plagiarism		Plagiarised		No Plagiarism		Plagiarised	
	N	%	N	%	N	%	N	%
Lacked Primary Literature	9	36.0%	16	64.0%	3	75.0%	1	25.0%
Included Primary Literature	60	71.4%	24	28.6%	28	56.0%	22	44.0%

Note: *p* $\leq$ 0.001 only for the pre-proposal. Post-proposal sample sizes not adequate for statistical analysis.

The extent of plagiarism with respect to prior research experience was also examined. Table 6 shows that participants who plagiarised on the pre-proposal had about one less semester of research experience at the time of the pre-proposal than participants who did not plagiarise. Participants who plagiarised on the post-proposal had about one and a half less semesters of prior research experience at the time of the post-proposal than participants who did not plagiarise.

A Mann-Whitney test was conducted to determine if students who did not plagiarise had significantly more research experience than did participants who plagiarised. On average, participants who did not plagiarise had about one more semester of research experience as compared with participants who plagiarised. Significant differences were detected at the $p=0.10$ level in median number of semesters of research experience between students who committed plagiarism versus those who did not for both the pre- and post-proposal (pre-proposal, $Z = -1.930$, $p = 0.054$; post-proposal, $Z = -1.690$, $p = 0.091$).

Table 6:
Semesters of prior research experience for participants who plagiarised and participants who did not plagiarise

	No Plagiarism		Plagiarised	
	N	Mean (Median) Semesters of Research Experience	N	Mean (Median) Semesters of Research Experience
Pre-proposal	71	3.94 (3.00)	41	3.15 (2.00)
Post-proposal	30	6.03 (6.00)	23	4.56 (4.00)

Note: $p \leq 0.05$ for the pre- and post-proposal.

English as a Second Language
The rate of plagiarism amongst ESL participants was compared with the rate observed amongst native English speakers. Table 7 shows that, overall, higher rates of plagiarism were found amongst ESL students. This trend was observed for both pre- and post-proposals. A chi-square test revealed that these differences were significant for the pre-proposal, $X^2(2) =6.314$, $p=0.012$, but not for the post-proposal, $X^2(1) = 0.969$, $p=0.325$. Analysis of TOEFL scores with respect to whether or not participants plagiarised on the pre-proposal, however, did not support this trend. Specifically, as depicted in Table 8, participants who plagiarised earned scores that were, on average, 18 points higher on the TOEFL. A Mann-Whitney test revealed, however, that the difference between the median TOEFL score of participants who plagiarised versus those that did not was not statistically significant, $Z = -1.226$, $p = 0.224$.

Table 7:
ESL status for participants who plagiarised and participants who did not plagiarise

	Pre-proposal				Post-proposal			
	No Plagiarism		Plagiarised		No Plagiarism		Plagiarised	
ESL Status	N	%	N	%	N	%	N	%
ESL	23	50.0%	23	50.0%	12	50.0%	12	50.0%
Native English Speaker	49	73.1%	18	28.9%	19	63.3%	11	36.7%

Note: $p \leq 0.05$ only for the pre-proposal. No significant differences were found for the post-proposal.

Table 8:
Average and median TOEFL scores for participants who plagiarised and participants who did not plagiarise on the pre-proposal

	No Plagiarism		Plagiarised	
	N	Mean (Median)	N	Mean (Median)
Average TOEFL score	18	587.56 (588.50)	16	605.25 (603.00)

Note: no statistically significant differences.

Discussion

Perhaps the most striking result of this study is that almost 40% of the proposals submitted by graduate students contained notable plagiarism, including copying and pasting of text from websites, failure to paraphrase, and failure to put quotation marks around direct quotes. The only other study that used performance data to examine plagiarism rates amongst graduate students (McCullough & Holmberg, 2005) found a 27% plagiarism rate in a sample of master's theses (n = 210 theses at 22 institutions). McCullough and Holmberg's study was similar to this study in that text matches were defined by expert reviewers who determined which matches constituted plagiarism and which were coincidental (e.g., matches in reference section). The types of plagiarism observed in this study were also similar to McCullough and Holmberg's finding that plagiarised sources ranged from websites to published work.

McCullough and Holmberg, however, restricted their study to master's theses. The current study confirms that approximately one third of master's students in our sample engage in inappropriate attribution and extends that finding to doctoral students as well. McCullough and Holmberg did not directly address potential causes of the plagiarism except in their discussion of the challenge in distinguishing between when graduate students were unattributed co-authors versus when they plagiarised from colleagues. Given that much of our sample plagiarised from popular or secondary rather than primary sources, this issue, whilst worth considering, is unlikely to explain most of the plagiarism observed in our sample. Additionally, this study provides significant context for the instances of plagiarism, suggesting that the source may be lack of awareness or enculturation rather than intentional deception.

Other research on plagiarism at the graduate level is based on self-report or perceptions of misconduct by others. Performance data used in this study suggests that actual plagiarism rates may be higher than perceived rates. Swazey et al. (1993) found that approximately 10–40% of both graduate students and faculty from a cross-section of STEM (science, technology, engineering and mathematics) disciplines reported plagiarism amongst their peers. Because their sample is confounded (multiple respondents may have reported the same instance), they can not provide an exact percentage of students or faculty reported to engage in plagiarism. Additionally, it should be noted that their definition of plagiarism was much broader and included multiple kinds of unethical behaviour such as keeping inadequate records of data collection or engaging in sexual harassment in the research context. Our data are more narrowly focused and address only students' compliance with the norms for attribution and writing conventions.

Influence of enculturation on rates of plagiarism
Academic maturity may play a large role in the occurrence of plagiarism. Close to one-third of graduate students in this study failed to include any primary literature references in their pre-research proposals. This in and of itself is surprising and

suggests a lack of enculturation. If students were aware of the role of primary literature in research, but simply uncomfortable with the content area, they would be expected to plagiarise from primary or at least secondary sources rather than popular web pages. The complete lack of primary literature in a sizable proportion of the pre-proposals suggests that graduate students are entering graduate school largely unaware of one of the underlying foundations of research. A year in a gradate programme did improve this situation with the proportion lacking primary literature dropping to 7.4% in the post-proposals. This change provides some evidence that over time participants may become more aware of the role of primary literature or became better able to locate these resources in their field.

Analyses also showed that participants who lacked primary literature on their pre-proposals were significantly more likely to plagiarise. This finding suggests that graduate students who plagiarise may do so, in part, because they lack important knowledge about their disciplines and lack an awareness of the role of primary literature in research. Examination of participants' research experience supports this contention. Specifically, results showed that graduate students who committed plagiarism had, on average, about one less semester of research experience which further suggests that lack of awareness rather than intentional deception may be the source of much graduate plagiarism. This finding was significant at the $p=0.10$ level. The relationship between prior research experience and plagiarism rates may be even more robust once researchers account for the quality of graduate students' prior research experiences. Future research should be conducted in this area.

Influence of institutional context on rates of plagiarism
Instances of graduate student plagiarism were dispersed across all three types of academic institutions, both doctoral and masters' level programmes, and multiple academic disciplines. The fact that the plagiarism occurred regardless of institutional size, geography, graduate programme type or discipline suggests that this issue is widespread. Our sample included only American graduate institutions so we cannot assert that this finding would extend to universities outside of the US. Given, however, that 40.7% of the sample were students who received undergraduate degrees from non-American institutions suggests that this is not a uniquely American problem.

Plagiarism and ESL
The finding that plagiarism was significantly more common amongst ESL participants at the time of the pre-proposal may reflect cultural differences in conceptions of plagiarism, inadequate English language skills, or a variety of other factors. Analysis of TOEFL scores, however, suggests that language skills may not be the primary problem. Inferences made from analysis of TOEFL scores are limited, however, because TOEFL scores were collected at differing times as participants enrolled in their graduate studies in differing years. Thus TOEFL scores may have been somewhat dated for some participants which may have distorted results. The difference between the rate of plagiarism amongst ESL participants and native English speakers was not statistically significant for the post-proposal. This may indicate that ESL participants have acquired language skills and/or Western conceptions of plagiarism by the end of their first or second years in graduate school.

Limitations

It should be noted that a considerable limitation of this study was that the research proposals represented a low-stakes assessment for participants at Universities 1 and 2, as these proposals did not influence graduate students' progress nor were they required to be shared with their advisors, although many students chose to do so. Future research should examine graduate student plagiarism issues using additional examples of student work, such as second-year projects or dissertation proposals.

Additionally, this study exclusively sampled graduate students in STEM fields; thus, the generalisability of these findings should be examined in future studies with graduate students from other disciplines. The rate of plagiarism observed in this study, however, is consistent with that of Swazey et al. (1993) who examined graduate student plagiarism issues in chemistry, civil engineering, microbiology, and sociology. Coupled with existing research, these findings indicate that graduate student plagiarism is common across disciplines and institutions.

Opportunities for future research

This study explored plagiarism amongst beginning graduate students. Additional research is warranted to determine if plagiarism rates differ amongst advanced graduate students. Future research that identifies the underlying cause of high rates of plagiarism observed amongst international students in this study is also warranted. The literature could benefit from an analysis of international graduate students' written work coupled with methods that will allow researchers to tease apart enculturation issues versus language barriers.

Further, the finding that lack of enculturation may be a significant contributor to graduate student plagiarism suggests an initial foundation for a conceptual framework to guide research in this area. A better understanding of the link between graduate student plagiarism and students' coursework and research experience, including their introduction to primary literature, can provide insight into the antecedents of graduate student plagiarism.

Recommendations and conclusion

This study, coupled with previous research, indicates that graduate student plagiarism is a prevalent issue. University-wide initiatives represent one approach to combating graduate student plagiarism. Specifically, universities should, with the input of faculty, staff, and students, establish a comprehensive definition of plagiarism, provide mechanisms for identifying and addressing student plagiarism, and raise awareness about plagiarism issues by engaging faculty and staff in discussions potentially through staff workshops or electronic discussion boards (Pickard, 2006; Thompson, 2006). Ideally this would be done in a non-pejorative manner as graduate student plagiarism seems symptomatic of a lack of enculturation into one's academic discipline rather than intentional deception. Thus, programmatic efforts to introduce graduate students to the culture of research in their discipline would also likely reduce plagiarism rates. For example, graduate programmes could focus explicitly on conveying the importance of primary literature to graduate students. Librarians may also be pivotal in disseminating information about how to avoid plagiarism (Auer & Krupar, 2001). Findings of this study also indicate that universities need to provide additional training to ESL students which may include assistance with developing English language skills, appropriate paraphrasing and citation methods, and identifying and locating high-quality resources in one's discipline including primary literature. Universities may also combat plagiarism amongst ESL students by educating faculty on instructional strategies to use with ESL students (Bretag, Horrocks, & Smith, 2002).

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