Effects of a Video-Based Teacher Observation Program on the De-privatization of Instruction: Evidence from a Randomized Experiment

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ABSTRACT

US schools have traditionally been characterized by teacher privacy and independence, yet theory and empirical work suggest that peer observation and support – or "de-privatized instruction" – can help improve pedagogical practice. In this randomized controlled trial, we investigate whether the introduction of video technology into a school, through a video-based teacher evaluation system called Best Foot Forward (BFF), led to instructional de-privatization. We find that BFF caused administrators to broker more peer support among teachers, made teachers more likely to share lesson videos with colleagues, led teachers to have more of their lessons seen by other teachers, and redistributed which teachers were providing instructional support to colleagues (with relatively newer teachers taking on a larger role in providing peer support). Results suggest that video technology may be an effective tool for efforts to improve instruction by increasing peer observation and support.

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US schools have traditionally been characterized by teacher privacy and independence (Lortie, 1975), yet higher levels of teacher peer support and collaboration have been linked to greater student achievement, innovative climate, and improved reform implementation and sustainability (Coburn, Mata, & Choi, 2013; Frank, Zhao, & Borman, 2004; Leana & Pil, 2006; Pil & Leana, 2009). Reformers have therefore argued for the "de-privatization of instruction," or for increasing teachers' engagement with peer observation, feedback, and support (Supovitz, 2002). However, school systems have struggled to achieve that goal.

Schools often face organizational barriers to instructional de-privatization. In-person peer observation is difficult, given that teachers are responsible for instructing their own students during the school day. The introduction of video technology can help schools overcome this challenge by enabling teachers to observe their colleagues' lessons at their convenience (Borko, Koellner, Jacobs, & Seago, 2011;

Calandra & Rich, 2015). The availability of video could lead to instructional de-privatization through at least two channels: 1) teachers may independently take the initiative to share lesson videos with colleagues, or 2) administrators may seize the opportunity of more easily facilitating teacher peer support. Past research shows that administrators often arrange for peer observation and support (Hawley, Rosenholtz, Goodstein, & Hasselbring, 1984; Youngs & Kings, 2002). With lesson videos, it is easier for an administrator to organize peer observation.

Much of the research on lesson video, however, has focused on how video can be used as a professional development tool. Little is known about whether using video for a required activity—such as classroom observations—can help facilitate the de-privatization of instruction.

In this study, we use data from a randomized controlled trial of Best Foot Forward (BFF), a video-based teacher evaluation system, to investigate the potential of video technology to facilitate instructional de-privatization. While BFF required that participating teachers record their lessons for the purpose of formal review by their administrators, the program did not include components designed to encourage instructional de-privatization.

Even though participants were not required to share video as part of the program, we hypothesized that the availability of video technology through BFF would increase the frequency with which administrators brokered peer support among teachers, contributing to an increase in peer observation and professional support. Results indicate partial confirmation of our hypotheses.

Using self-report data, we find that BFF increased the amount of teacher peer support that school administrators brokered among teachers. BFF made teachers more likely to show their colleagues a video of themselves teaching, and increased the number of teachers' lessons that were observed by their colleagues (either in person or through video), with a particularly strong effect for teachers who had used lesson video prior to participating in BFF (compared to teachers who had not used video in the past). BFF did not lead participating teachers to receive more peer support, but did redistribute who provided support, with newer teachers providing support otherwise provided by more experienced teachers. As discussed below, one potential reason for this redistribution may be that viewing colleagues' lesson videos enables teachers to seek peer support from their colleagues who are the most skilled, as opposed to seeking support from their most experienced colleagues by default.

We begin this paper by providing background on the theoretical and empirical basis underlying efforts to improve teaching practice by de-privatizing instruction, and discussing the role that administrators play in this process. We then describe the potential that video holds to facilitate instructional de-privatization and foster teacher learning, before describing our study setting and the Best Foot Forward system. Finally, we outline our analytic methods, present our results, and offer explanations for the findings.

BACKGROUND

De-privatization of Instruction and the Situated Perspective on Learning

Lortie (1975) described the process of socialization into the teaching profession as one of "self-socialization," (p. 79) in which teachers developed their instructional skills mainly through solitary trial and error. This stands in contrast to other skilled professions, in which new entrants are initiated into some common body of professional knowledge and continually hone their practice over the course of their careers by comparing their performance to some common benchmark of expertise. The professional isolation experienced by teachers, Lortie argued, made the field of education poorly suited for the development of "commonly held, empirically derived, and rigorously grounded practices and principles of pedagogy" (p. 79). To the extent that teachers did support one another's professional learning, it was usually limited to the sharing of brief and idiosyncratic tricks of the trade.

The "situated perspective" on teacher learning (Putnam & Borko, 2000; Borko, 2004) offers a theoretical framework for understanding how self-socialization in teaching can inhibit instructional improvement. Unlike traditional perspectives on learning that focus on the individual, the situated perspective emphasizes the "interactive systems that include individuals as participants, interacting with each other as well as materials and representational systems" (Putnam & Borko, 2000, p. 4). Central to this perspective are the assumptions that learning is social in nature and that "discourse communities" play an important role in learning. Such communities "provide the cognitive tools—ideas, theories, and concepts—that individuals appropriate as their own through their personal efforts to make sense of experiences" (Putnam & Borko, 2000, p. 5). The atomized nature of the teaching force described by Lortie (1975), with its limited peer observation and feedback, offers no process by which teachers are enculturated into a community's shared dispositions and ways of thinking.

Scholars have theorized that breaking the norms of privacy among educators—or "de-privatizing instruction" —will help improve teaching and ultimately student learning (Little, 1982). Supovitz (2002) operationalized instructional de-privatization as "the extent to which teachers observe each other and receive suggestions or other feedback from colleagues" (p. 1602). By observing colleagues teach, being observed teaching, exchanging

feedback, and discussing practice, teachers develop common professional standards of excellence and are able to continually improve their instruction (Little, 982).

Empirical evidence has begun to accumulate that de-privatizing instruction can lead to instructional improvement. Changes in teachers' pedagogical practices have been shown to be predicted by the extent to which teachers engage in collaborative discussion, interact with more expert colleagues, and seek instructional advice from colleagues (Parise & Spillane, 2010; Sun, Wilhelm, Larsen, & Frank, 2014; Supovitz, Sirinides, & May, 2010). Perhaps most importantly, the amount of information-sharing and interaction around instruction that teachers engage in have been shown to predict student achievement (Leana & Pil, 2006; Pil & Leana, 2009).

The administrator's role in de-privatizing instruction. In the traditional public school in the U.S., in which teachers' instructional interactions are limited, administrators could play an important role in de-privatizing instruction (Smylie, 1988). Administrators can help make instruction public through organizational means such as establishing cooperative work structures, or by encouraging individual teachers to share resources and techniques, coach less expert peers, and observe other teachers' instruction (Hawley et al., 1984; Youngs & Kings, 2002). Because administrators generally do not lead their own classrooms and are expected to perform classroom observations as part of their supervisorial duties, they are well-positioned to identify teachers whose strengths match other teachers' weaknesses, enabling them to broker mentoring relationships and match teachers with one another for collaborative endeavors.

The Potential of Video to Facilitate Instructional De-privatization

One common barrier to instructional de-privatization is that teacher peer observation requires either the coordination of teachers' free periods or the hiring of a substitute teacher to cover the observer's classroom. The use of lesson video has become an increasingly popular means of overcoming this challenge because it allows teachers to examine their peers' practice without being physically present to observe a teacher's lesson in real time (Borko et al., 2011; Calandra & Rich, 2015).

Lesson video is a potentially powerful tool for teacher learning because many of its uses are well-aligned with key principles of the situated perspective on teacher learning. The situated perspective stresses the value of identifying learning opportunities within everyday practice, of recognizing teachers' classrooms and schools as powerful contexts for teachers' learning (Putnam & Borko, 2000), and of using classroom artifacts as vehicles for teacher learning (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Putnam & Borko, 2000). Classroom videos are "ecologically valid" classroom artifacts (van Es, Tunney, Seago, & Goldsmith, 2015)—that is, they offer teachers the opportunity to engage with an authentic representation of actual teaching practice. Furthermore, video enables teachers to be removed from the immediacy of the classroom, thus facilitating reflection (Lampert & Ball, 1998, as cited by van Es et al., 2015). In studies of the use of lesson video for teacher PD, teachers have reported that the process of observing colleagues' lesson videos as part of an organized learning community helped them learn new instructional strategies and better understand students' thinking (Borko et al., 2008). Consistent with the theoretical importance of authentic classroom artifacts to teachers' learning, teachers in one study reported that watching videos of themselves or of colleagues was more helpful than watching published videos (Zhang, Koehler, & Lundeberg, 2015), and that watching videos of colleagues' lessons was as helpful as watching videos of their own lessons (Sherin & Han, 2004; Zhang et al. 2015).

Professional development programs that rely on classroom video all introduce some formal structure through which teachers engage with video. Such structures range from the highly specified, in which external PD providers prescribe the PD goals and procedures, to the highly adaptive, in which the PD goals grow from the local context, and in which general guidelines—rather than strict procedures—are followed during meetings (Borko et al., 2011). Nevertheless, existing video-based PD programs all have some organizing structure, even if that structure consists simply of scheduling time for teachers to meet routinely to review lesson videos in a highly adaptive manner. Much less is known about whether simply introducing video technology to a school, without the express purpose of establishing a video club, can help de-privatize instruction.

In many school districts, teachers must have a formal classroom observation one to three times per year. We hypothesize that by granting teachers the opportunity to submit lesson videos in lieu of in-person observations, one could increase the share of teachers collecting video and, thereby, expand the use of video for other purposes, such as de-privatized instruction.

How, and for whom, video might affect de-privatization. Making video technology available in schools, and incentivizing teachers to record themselves by allowing them to submit lesson videos in lieu of required in-person classroom observations, may help de-privatize instruction for two main reasons. First, teachers may, through their own initiative, seize the opportunity to share lesson videos with their colleagues. However, not all teachers are comfortable opening themselves up to scrutiny in this way (Sherin & Han, 2004). Teachers with certain dispositions or prior experiences—for example, those who have used video to record themselves teaching in the past—may be more likely to take advantage of an opportunity to de-privatize through video. Second, administrators – in their role as support brokers—might encourage teachers to share recorded lessons with colleagues. This may occur if the principal wants the teacher to share an example of effective instruction, if the principal wants the teacher to receive feedback on the video, or if the principal is encouraging a collaborative lesson study process. With the encouragement of an administrator, some teachers who may have otherwise not been inclined to share lesson videos may decide to do so.

Because the purpose of lesson observation is to initiate discussion about instruction, video technology may lead to an increase in the amount of instructional support that teachers provide one another. Depending on teachers' reasons for sharing video, teachers may experience an increase in the amount of peer support they receive or that they provide (or both). Additionally, the effect of video on teacher peer support may differ depending on teacher characteristics. If the teachers who share videos are teachers who had not previously been sources of instructional support to other teachers, their colleagues' new awareness of their instructional strengths may lead the videotaped teacher to receive an increased number of requests for support. At the same time, a teacher who is already an important source of support for other teachers may not experience a similar increase in requests for support after sharing lesson videos.

Summary and Research Questions

Schools in the US have traditionally been characterized by teacher autonomy and isolation, where teachers seldom observe one another's teaching or exchange feedback for the purpose of improving instruction. The situated perspective on teacher learning, which proposes that learning occurs when teachers engage with their colleagues around instructional issues relevant to their context, helps explain how norms of privacy can inhibit instructional improvement. While various organizational and cultural barriers prevent the de-privatization of instruction, video offers a solution to one important structural barrier by removing constraints of time and space. Video may also make it easier for administrators to orchestrate peer support among teachers. However, little is known about the extent to which introducing video technology into a school—without a formal structure for peer video sharing—may facilitate instructional de-privatization.

This study investigates whether introducing video technology into a school, through a video-based teacher evaluation system, can de-privatize teaching, and whether the effect of video on de-privatization differs depending on teacher characteristics. Specifically, this study uses data from a randomized control trial of Best Foot Forward (BFF), a video-based classroom observation system, to ask the following questions:

• Does BFF cause administrators to orchestrate more peer support among teachers?

• Does BFF make teachers more likely to have their teaching seen by other teachers?

• Do effects differ by teacher background characteristics?

• Does BFF cause teachers to give or receive more peer instructional support?

• Do effects differ by teacher background characteristics?

• Does principal orchestration of peer support explain experimental effects on instructional de-privatization?

METHODS
Design, Setting, and Participants

A school-level randomized experiment of BFF was conducted over the 2013-2014 school year involving 85 schools across 4 states and 16 school districts or charter organizations. The project recruited schools by inviting principals to informational webinars and in-person meetings. After principals consented, teachers from their schools were recruited to participate. There were no qualifying characteristics required of principals or schools, but the following requirements were made of participating teachers: 1) they must have had at least one prior year of value-added data and classroom observation scores, 2) they must teach a tested subject

(math, reading, science, or social studies), and 3) they must teach students capable of completing written surveys (i.e. students in third grade or above and without severe disabilities). Participating schools were given a $1000 award; teachers were given a $750 stipend and were allowed to keep the video camera they were provided with to record their lessons.

Participating schools were organized into 11 randomization strata based on their US state, school percent free or reduced-price lunch (FRL), and school proficiency rates on the state standardized math and reading tests. Within each stratum, roughly half of the schools were randomly selected for treatment; the remaining schools were assigned to the business-as-usual control group.

The Intervention: Best Foot Forward (BFF)

The larger purpose of the BFF intervention was to improve the teacher observation and evaluation process in a number of ways. BFF replaced the in-person classroom observations conducted by administrators as part of teachers' formal job evaluations with video-based lesson observations. During each of the three 1-2 month observation windows over the school year, BFF teachers recorded themselves teaching (as many times as they chose) and uploaded videos to a secure server. Teachers then selected one video per observation window from this bank to share with their administrator. Teachers completed a series of reflection questions and rated their video using their state or district rubric. Administrators viewed teachers' chosen videos online through the secure server and formally rated the lesson. Administrators had the option of tagging comments to specific moments in the video. After rating and annotating the video, the administrator shared the scores with the teacher prior to an in-person meeting. During this meeting, the teacher and administrator discussed the administrator's feedback on particular video clips.

Prior to the intervention, principals attended a half-day training in which they learned how to use the online platform and were coached in providing video-based feedback to teachers. Teachers also attended a half-day training in which they learned how to use the equipment to record, upload, and access their ratings and feedback.

MEASURES

All participating teachers and administrators were asked to complete a baseline survey in the fall of 2013 before treatment began, and a post-intervention survey in the spring of 2014. Overall response rates were high (teacher baseline=97%, teacher end-of-year=92%; administrator baseline=95%, administrator end-of-year=91%) and did not differ by condition.

Outcomes. The outcomes in this study were survey items included on the teacher and administrator end-of-year surveys. To measure the extent to which administrators brokered peer support among teachers, we asked administrators: "This past school year, how many times did you request that a teacher connect with another teacher at your school for professional support?" Answer choices were discrete count options ranging from 0 to "10 or more." In our models, this variable is named "Admin Connection Requests."

Consistent with Supovitz (2002), we used two categories of questions to operationalize instructional de-privatization: 1) questions about the extent to which teachers observed each other, or "instructional exposure," and 2) questions about the extent to which teachers exchanged feedback, or "instructional support."

Instructional Exposure. To measure whether participation in BFF made teachers more likely to share a video of their teaching with colleagues, we asked teachers in the spring, "Since January of this year, have you shared a video of your teaching in a professional learning community (PLC) or other collaborative group?" with options for "yes" or "no." This indicator variable is named "Shared Video" in our models. To understand the range of exposure, we asked teachers, "Since January of this year, how many other teachers have seen you teach (either on video or in person)?" (We call this variable "Num. Seen Teach"). To learn of the intensity of exposure, we asked, "Since January of this year, how many different lessons of yours have been seen by other teachers (either on video or in person)?" (We call this variable "Num. Lessons Observed"). For the latter two questions, answer choices were discrete count options ranging from 0 to 5 with a censored option of "more than 5."

Instructional Support. We used two items to measure instructional support. One item, which we call "Support Received," was based on teachers' answers to the question, "This past school year, how many times did you receive professional support from a colleague?" To measure the amount of support provided by study teachers to other teachers, we asked, "This past school

year, how many times did you give professional support to a colleague?" (We call this variable "Support Given"). For each question, answer choices included discrete count options of 0 to 5, and a final choice of "more than 5."

Control Variables. The use of a randomized design justifies causal inference in this study, but we included control variables in our models in order to increase statistical power and adjust for any chance imbalances across treatment and control (Altman, 1985). In all models, we included the following school-level control variables: a binary indicator for whether the school was an elementary school (vs. middle school), percent of the student body eligible for free or reduced-price lunch, percent of the student body that scored proficient on the previous year's state ELA test, percent of the student body that scored proficient on the previous year's state math test[1], and percent of student body that was non-white. As required by the study design, we also included in all models a vector of dummy variables representing the randomization strata.

In the administrator model, we control for administrator experience through a binary variable indicating whether the respondent was above the sample median for years as an administrator (8 years). In the teacher models, we include a similar variable for years of experience teaching (sample median=11 years), which we interact with treatment in some models. For the instructional exposure models ("Shared Video," "Num. Seen Teach," and "Num. Lessons Observed"), we also include a binary indicator for whether the teacher reported at baseline ever having used video to record his or her own lesson ("Since you began teaching [not including pre-service training], have you ever used a video camera to record your own lessons?). Again, we interact this variable with treatment in some models.

ANALYTIC PLAN

Right-censored Poisson regression. As described earlier, many of our outcomes are count variables with right-censoring; this makes them ill-suited for OLS regression. We therefore analyze these outcomes using right-censored Poisson regression (Terza, 1985; Raciborski, 2011). In conventional Poisson regression, the log of the conditional mean of the outcome is modeled as a linear function of the predictors. When the outcome is censored, a traditional Poisson regression model will yield (downwardly) biased and inconsistent parameter estimates (Raciborski, 2011). Right-censored Poisson regression accounts for censoring by treating

the observed outcome variable y as a measure of the unobserved latent variable y^*. If y^* is censored at a value c, then for person i:

$$y_i = \begin{cases} y_i^*, & if\ y_i^* < c \\ c, & if\ y_i^* \geq c \end{cases}$$

For our censored count outcomes ("Admin Connection Request," "Num. Seen Teach," "Num. Lessons Observed," "Support Received," and "Support Given"), we fit right-censored Poisson regression models of the general form:

$$\ln\big(\mathrm{E}(y_i^*|\mathbf{x_i})\big) = \beta_0 + \beta_1 Treatment_i + \sum \beta_j x_i,$$

where $\ln\big(\mathrm{E}(y_i^*|\mathbf{x_i})\big)$ is the natural log of the conditional expected value of the latent outcome for person i, $Treatment_i$ is an indicator for whether person i's school was randomly assigned to treatment, and $\sum \beta_j x_i$, represents the sum of the effects of the control variables described earlier. In model 1, β_1 is the coefficient of interest, representing the causal effect of treatment assignment on the log of the outcome mean (controlling for the other predictors in the model). In this form, β_1 is difficult to interpret; exponentiating its value yields the incidence rate ratio (IRR), or the multiplicative factor by which the treatment affected the outcome (compared to the control group). For interpretive purposes, we convert coefficients to IRRs in text (but report coefficients in their original form in tables); we also include graphs demonstrating the predicted marginal effects (i.e. the treatment/control contrasts expressed by comparing predicted values for prototypical participants with mean values on the control variables).[2]

To test for the treatment interactions described above, we fit models of the general form:

$$\ln\big(\mathrm{E}(y_i^*|\mathbf{x_i})\big) = \beta_0 + \beta_1 Treatment_i + \beta_2 C_i + \beta_3 (C_i \times Treatment_i) + \sum \beta_j x \quad (2)$$

where Ci represents the control variable to be interacted with treatment (i.e. teacher experience or past video use) and other terms are as defined above. In model 2, β_1 represents the main effect of treatment for the subgroup of teachers with a 0 value on C and the sum of β_1 and represent the treatment effect for teachers with a value of 1 on C.[3]

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1 For one school, student proficiency rates were not available; we therefore imputed the district mean proficiency levels for this school and included a missing data indicator in our models. Results are not sensitive to whether we

2 While the IRR makes the treatment main effect more interpretable, we do not report coefficients as IRRs in our tables because when expressed in this way, interaction coefficients can no longer be simply added to main effects coefficients to retrieve subgroup effects.

3 We fit these models using the rcpoisson command (Raciborski, 2011) in Stata 12.

Logistic regression. As described above, we have one binary outcome indicating whether the teacher shared a lesson video with colleagues in a PLC or other collaborative setting. To analyze this outcome, we use the following logistic regression model:

$$\ln\left(\frac{P(y_i=1)}{1-P(y_i=1)}\right) = \beta_0 + \beta_1 Treatment_i + \sum\beta_j x_i, \quad (3)$$

where $\left(\frac{P(y_i=1)}{1-P(y_i=1)}\right)$ is the natural log of the odds that a teacher has shared a lesson video and the other terms are as described above. Again, β_1 is the coefficient of interest, representing the causal effect of treatment assignment on the log odds that a teacher shared a lesson video with his or her colleagues. For interpretability, we also present the predicted proportion of teachers showing a lesson video by condition. Similarly to what we described above for model 1, we add to model 3 an interaction between treatment and the indicator of whether teachers have used video to record their lessons in the past.

Mediation analyses. To test whether the effect of the intervention on de-privatization of instruction was mediated by administrators' brokering of teacher peer support, we add a variable giving the number of connection requests reported by each teacher's administrator to the right-censored Poisson regression models and the logistic regression model. If, with the addition of this control, the treatment effect is no longer significant but the mediator (administrators' connection requests) is, this suggests that the effect of treatment on the outcome may have been brought about by the mediator variable. Note that in order to draw this conclusion, it is necessary to assume that there are no other confounding mediators and that there are no interactions between the effects of treatment assignment and the mediator; if either of these assumptions is not true, mediation effect estimates will be biased (Judd & Kenny, 1981; Valeri & VanderWeele, 2013). The sample sizes in the mediation analyses are slightly smaller than the main impact analyses because teachers whose administrators did not complete the end-of-year survey could not be included in the mediation models.[4]

In all models described above, we cluster standard errors at the school level.

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[4] Some teachers were listed as having been observed by more than one administrator (e.g. a principal and a vice principal). In these cases, we took the mean number of connections reported by each administrator and truncated that mean to an integer, for consistency with the right-censored Poisson models.

RESULTS
Descriptive Statistics and Treatment-Control Balance

In Table 1, we present descriptive statistics by condition for the analytic sample on all school-level, administrator, and teacher variables. Overall, randomization was successful in producing groups that were comparable on observable baseline school characteristics. However, the treatment group was ten percentage points lower (n.s.) than the control group in percentage of schools that were elementary (as opposed to middle schools), and at baseline a somewhat higher proportion of treatment teachers reported that they had videotaped their own lessons in the past (.43 compared to .31, p=0.07).

Descriptively, treatment administrators had higher means on the censored "Admin Connection Requests" outcome variable compared to control administrators, and a higher proportion of treatment administrators' responses were censored (10 or more instances of connecting teachers), with 38% of the treatment group choosing the highest option, compared to 22% of the control group. A significantly higher proportion of treatment teachers reported having shared a lesson video with colleagues in a collaborative setting (the "Shared Video" outcome; .19 in treatment versus .11 in control).

Did BFF cause administrators to orchestrate more peer support among teachers?

In Table 2, we present estimates from the right-censored Poisson regression model predicting the number of times administrators reported having connected a teacher to another teacher for instructional support. The significant Treatment coefficient of .29 corresponds to an incidence-rate ratio of 1.3, indicating that treatment assignment caused administrators to connect teachers 1.3 times as often as they would have, had they been assigned to the control group.

In the upper left panel of Figure 1, we present the predicted number of times that administrators in each condition connected teachers with one another for instructional support, holding all other variables in the model constant at their means. As seen, treatment administrators made 6.3 connections on average, compared to 4.8 connections for control administrators.

Table 1

Descriptive Statistics by Condition for School-level, Administrator, and Teacher Variables (Predictors and Outcomes)

	Control			Treatment			
	Mean	Sd	n	Mean	sd	n	p
School-level Variables							
Elementary	0.64		44	0.54		41	0.36
Percent FRL	54.98	33.36	44	57.33	27.73	41	0.28
Percent Minority	66.24	31.01	44	63.35	30.1	41	0.54
Percent Proficient ELA	70.63	21.83	44	72.21	18.84	41	0.88
Percent Proficient Math	66.51	20.12	44	66.17	18.01	41	0.58
Administrator Variables							
Years Experience	9.49	6.71	45	9.48	6.07	48	0.86
Admin Connection Requests (0 to ≥10)	5	3.32	45	6	3.58	48	0.15
Proportion Censored Admin Connection Requests	0.22		45	0.38		48	0.09
Teacher Variables							
Years Experience	12.02	6.59	147	11.8	6.79	148	0.87
Used Video in Past	0.31		147	0.43		148	0.07
Num. Seen Teach (0 to ≥6)	1.84	1.73	146	1.97	1.85	146	0.68
Proportion Censored Num. Seen Teach	0.06		146	0.1		146	0.23
Num. Lessons Observed (0 to ≥6)	1.78	1.88	147	2.16	1.95	147	0.11
Proportion Censored Num. Lessons Observed	0.11		147	0.12		147	0.75
Support Given (number of teachers; 0 to ≥6)	4.69	1.94	146	4.86	1.77	148	0.43
Proportion Censored Support Given	0.63		146	0.66		148	0.63
Support Received (number of teachers; 0 to ≥6)	4.08	2.11	147	3.97	2.07	148	0.61
Proportion Censored Support Received	0.48		147	0.44		148	0.40
Shared Video (in Collaborative Setting)	0.11		147	0.19		148	0.04

Note. P-value is for test of null hypothesis that treatment-control difference is 0, from linear OLS regression model controlling for randomization block (standard errors are clustered at the school level). Admin Connection Requests=administrator frequency of requesting that teachers connect with other teachers for instructional support. Num. Seen Teach=Number of other teachers who have seen the respondent teach this calendar year (in person or on video). Num. Lessons Observed=Number of respondent's lessons that were observed by other teachers (in-person or on video). Support Received=Number of times teacher reported receiving professional support from a colleague this calendar year. Support Given=Number of times teacher reported giving professional support to a colleague.

Did BFF make teachers more likely to have their teaching seen by other teachers?

In Table 3, we present estimates from logistic regression models predicting whether a teacher reported having shared a lesson video with colleagues in a PLC or other collaborative setting. In column 1, the significant Treatment coefficient of .911 indicates that the odds of a treatment teacher sharing a lesson video were 2.49 times the odds of a control teacher sharing a lesson video. As seen in the upper right panel of Figure 2, this model predicts that 17% of treatment teachers share lesson videos with colleagues, while only 8% of control teachers do (holding all controls constant at their means).

As seen in column 2 of Table 3, the effect of treatment assignment on teachers' video-sharing was not significantly different for teachers who had or had not used video in the past.

In Table 4, we present results from right-censored Poisson models predicting the number of other teachers who had seen a lesson from the focal teacher ("Num. Seen Teach"), and the number of different lessons of a focal teacher's that had been seen by another teacher ("Num. Lessons Observed"). Treatment assignment did not lead teachers to expand the circle of teachers with whom they shared their instruction (column 1), and the treatment effect on this outcome did not vary depending on whether the teacher had used video in the past (column 2).

As seen in column 3, assignment to treatment had a significant main effect on the number of lessons that teachers shared with a colleague, with the treatment coefficient of .259 corresponding to an IRR of 1.3. In column 4, we see that this effect was driven by the subgroup of teachers who had used video to record lessons in the past. The treatment effect for teachers who had not used video in the past was small and not significant (as evidenced by the Treatment coefficient in column 4), but adding the significant coefficient on the Treatment*Used Video in Past interaction to the Treatment coefficient shows that treatment teachers who had used video in the past had 1.83 times as many of their lessons observed by colleagues as did control teachers with past lesson video experience.

Table 2

Right-Censored Poisson Regression Model Predicting Number of Times Administrator Requested that a Teacher Connect with Another Teacher

	(1) Admin Connection Requests b/se
Treatment	0.286*
	(0.143)
N	93

Note. Standard errors clustered at the district level in parentheses. All models control for fixed effects of randomization blocks, whether school is elementary vs. middle school, school % free or reduced-price lunch, school % non-white, school % proficient at ELA, school % proficient at math, and an indicator for whether the respondent is above the sample median for years of experience. Admin connection requests=number of times the administrator reported connecting a teacher to another teacher for instructional support.

Table 3

Logistic Regression Models Predicting Whether Teacher Shared Lesson Video in PLC or other Collaborative Setting

	(1) Shared Video b/se	(2) Shared Video b/se
Treatment	0.911*	0.876~
	(0.452)	(0.502)
Used Video in Past	0.153	0.096
	(0.390)	(0.516)
Treatment*Used Video in Past		0.091
		(0.807)
N	293	293

Note. Standard errors clustered at the school level in parentheses. All models control for fixed effects of randomization blocks, whether school is elementary vs. middle school, school % free or reduced-price lunch, school % non-white, school % proficient at ELA, school % proficient at math, and an indicator for whether the respondent is above the sample median for years of experience.

Table 4.

Right-Censored Poisson Regression Models Predicting De-privatization of Instruction Outcomes

	(1) Num. Seen Teach b/se	(2) Num. Seen Teach b/se	(3) Num. Lessons Observed b/se	(4) Num. Lessons Observed b/se
Treatment	0.087	-0.013	0.259*	0.043
	(0.137)	(0.173)	(0.129)	(0.168)
Used Video in Past	0.257~	0.126	0.148	-0.178
	(0.138)	(0.206)	(0.131)	(0.193)
Treatment* Used Video in Past		0.242		0.561*
		(0.260)		(0.264)
N	292	292	294	294

Note. Standard errors clustered at the school level in parentheses. All models control for fixed effects of randomization blocks, whether school is elementary vs. middle school, school % free or reduced-price lunch, school % non-white, school % proficient at ELA, school % proficient at math, and an indicator for whether the respondent is above the sample median for years of experience. Num. Seen Teach=Number of other teachers who have seen the respondent teach this calendar year (in person or on video). Num. Lessons Observed=Number of respondent's lessons that were observed by other teachers (in-person or on video)

The lower left panel of Figure 1 shows treatment-control contrasts in the predicted number of lessons seen by colleagues separately for teachers who had and had not used video in the past. Teachers with no lesson video experience had roughly the same number of lessons seen by colleagues regardless of their treatment assignment (approx. 1.5 lessons). However, among teachers with lesson video experience, treatment led to a boost from a predicted 1.26 lessons seen to a predicted 2.3 lessons seen.
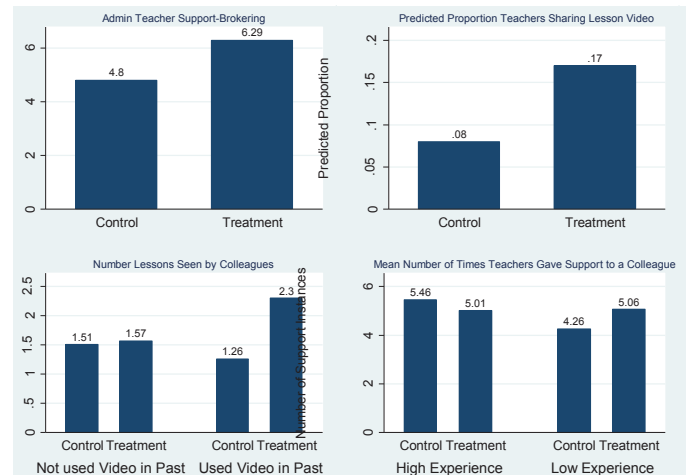
Did BFF cause teachers to give or receive more peer instructional support?

In Table 5, we present estimates from right-censored Poisson regression models predicting the number of times that focal teachers received and gave instructional support. Treatment assignment did not affect the overall amount of support that teachers received (column 1), and this effect did not differ by teacher experience level (column 2).

As seen in column 3, treatment assignment had no main effect on the amount of support that teachers gave to their colleagues (column 3). Column 3 shows that overall, teachers above the sample median for years of experience reported giving more instructional support than did teachers with less experience (1.24 times as many instances of support-giving). In column 4, we find a significant, negatively signed Treatment*High Experience interaction. In this model, the significant coefficient on Treatment of .27 indicates that treatment assignment increased the amount of support that relatively less-experienced teachers gave to their colleagues by a factor of 1.31. Adding the Treatment coefficient to the Treatment*High Experience coefficient, however, also shows that treatment assignment may have decreased the amount of support that more-experienced teachers provided, by a factor of .83 (p=.08). Another way of looking at this result is to note that in business as usual, high experience teachers provide support to their peers at about 1.55 times the rate as do low experience teachers (as implied by the High Experience coefficient in column 4); however, treatment redistributed who provided support, such that experience level no longer predicted how much support teachers provided to others (as indicated by the sum of the High Experience and Treatment* High Experience coefficients in column 4). We return to this finding in the discussion section.

Figure 1

Treatment-control contrasts on model-predicted values for de-privatization outcomes.

Note. All predictions hold control variables constant at their sample means. Top two panels represent statistically significant treatment-control contrasts; bottom two panels represent statistically significant interactions. The treatment-control contrast for "Used Video in Past" in bottom left panel is statistically significant, as is the contrast for "Low Experience" in bottom right panel (contrast for "High Experience" is marginally significant).

Table 5

Right-Censored Poisson Regression Models Predicting De-privatization of Instruction Outcomes

	(1) Support Received b/se	(2) Support Received b/se	(3) Support Given b/se	(4) Support Given b/se
Treatment	-0.020	0.075	0.041	0.270*
	(0.087)	(0.120)	(0.091)	(0.130)
High Experience	0.046	0.138	0.214**	0.441***
	(0.089)	(0.136)	(0.082)	(0.105)
Treatment* High Experience		-0.186		-0.459**
		(0.183)		(0.155)
N	303	303	302	302

Note. Standard errors clustered at the school level in parentheses. All models control for fixed effects of randomization blocks, whether school is elementary vs. middle school, school % free or reduced-price lunch, school % non-white, school % proficient at ELA, school % proficient at math, and an indicator for whether the respondent is above the sample median for years of experience. Num. Seen Teach=Number of other teachers who have seen the respondent teach this calendar year (in person or on video). Num. Lessons Observed=Number of respondent's lessons that were observed by other teachers (in-person or on video)

Table 6

Models Testing "Admin Connection Requests" as Mediator of Treatment Effects on De-privatization Outcomes.

	(1) Shared Video (logistic regression)	(2) Shared Video (logistic regression)	(3) Num. Lessons Observed (Rt-censored Poisson)	(4) Num. Lessons Observed (Rt-censored Poisson)	(5) Support Given, Low Experience (Rt-censored Poisson)	(6) Support Given, Low Experience (Rt-censored Poisson)
	b/se	b/se	b/se	b/se	b/se	b/se
Treatment	0.946*	0.741	0.189*	0.109	0.115	0.032
	(0.455)	(0.502)	(0.088)	(0.080)	(0.123)	(0.136)
Admin Connection Requests		0.105		0.047***		0.035~
		(0.070)		(0.012)		(0.020)
N	262	262	274	274	139	139

Note. Standard errors clustered at the school level in parentheses. All models control for fixed effects of randomization blocks, whether school is elementary vs. middle school, school % free or reduced-price lunch, school % non-white, school % proficient at ELA, school % proficient at math; columns 1 and 2 control for whether the teacher reported at baseline having used lesson video in the past; columns 1-4 include an indicator for whether the respondent is above the sample median for years of experience. Admin Connection Requests=administrator frequency of requesting that teachers connect with other teachers for instructional support.

The lower right panel of Figure 1 shows the predicted treatment-control contrasts on "Support Given" by teacher experience levels. Among more experienced teachers, treatment assignment reduced the number of times teachers provided support in the spring, on average, from 5.46 times to 5.01 times (p=.08). However, among teachers with fewer years of experience, treatment assignment led to an increase in the number of times teachers provided instructional support, from an average of 4.26 times to an average of 5.06 times. Also evident from the figure is the equalizing effect that treatment had on the amount of support that high- and low-experience teachers provided.

Does principal orchestration of peer support explain experimental effects on instructional de-privatization?

We have seen that treatment assignment caused administrators to broker more peer support among teachers. Treatment assignment also made teachers more likely to share a lesson video with colleagues, caused teachers to have more of their lessons observed by colleagues (primarily among teachers who had used video in the past), and caused less experienced teachers to provide more support to their colleagues while causing more experienced teachers to provide less support. Was it the increase in administrators' support brokering that led to these teacher outcomes? In Table 6, we present results to analyses testing for this mediation. Again, note that in this table, the sample

sizes (and therefore effect estimates) do not match those from tables 2-5. The reason is that teachers whose administrators did not fill out the Connection Requests survey question had to be dropped from the mediation analyses (additionally, in the logit models, 13 teachers from one randomization block were dropped due to perfect prediction of outcome).

In columns 1 and 2 of Table 6, we test whether administrators' brokering led teachers to share their lesson videos with colleagues. We know that treatment made teachers more likely to share videos (column 1); however, when both Treatment and Admin Connection Requests are in in the model together (column 2), neither significantly predicts teachers' video sharing. While this does not rule out mediation, the result does not support the mediation hypothesis (however, when randomization blocks are excluded from the model to allow for the inclusion of the teachers dropped due to perfect outcome prediction, Admin Connection Requests significantly predicts video-sharing and the main effect of treatment is not significant, consistent with the mediation hypothesis).

We find some evidence that administrators' brokering mediated the treatment effect on the number of teachers' lessons observed by other teachers. As seen in columns 3 and 4 of Table 6, the significant main effect of treatment disappears when controlling for the (significant) effect of Admin Connection Requests.

In columns 5 and 6 of Table 6, we test for mediation on the "Support Given" outcome for low experience teachers (the subgroup for whom an effect was observed). When Admin Connection Requests and Treatment are included in the model together (column 6), neither is significant[5] (for high experience teachers, Admin Connection Requests did not predict "Support Given"). Table 6 thus presents evidence that is consistent with, but not strongly in support of, mediation.

DISCUSSION

In this study, we found that Best Foot Forward, a video-based teacher evaluation system, contributed to instructional de-privatization. BFF caused school administrators to increase the frequency with which they connected teachers to other teachers for instructional support, made teachers more likely to share lesson videos with colleagues, caused teachers to have more of their lessons observed by colleagues (an effect driven by teachers who had experience recording their lessons prior to the experiment), and caused relatively less-experienced teachers to provide more instructional support to colleagues while seemingly causing more experienced teachers to provide less support (without changing the overall amount of support given across teachers). Additionally, some (albeit weak) evidence suggests that the increase in teacher peer observation and support may have been due, at least in part, to administrators' increased support brokering.

While our study design allows us to make causal inferences about the effect of treatment on these outcomes, we cannot infer causal links among these outcomes. With this in mind, a potential explanatory story emerges about how these findings relate to one another.

One explanation for why BFF increased the frequency with which administrators referred teachers to one another for instructional support may be that the lesson videos provided an artifact for administrators to suggest that teachers share with colleagues. Teachers acted on this brokering and shared their videos with colleagues, leading them to have more of their lessons observed by colleagues either in person or on video. However, some teachers were more likely to take advantage of the opportunity presented by the video availability of sharing their teaching with colleagues. Teachers' past use of video seems to be a reasonably effective indicator that they will take advantage of the opportunity to use video to de-privatize their instruction if given the chance.

Why is it that the treatment did not also increase the number of other teachers who had seen the focal teacher's instruction? This is somewhat surprising, given that the marginal cost of sharing the video with one more person is zero, while the marginal cost of being physically observed by another teacher is rising in the number of teachers (that is, given scheduling challenges, it's difficult to arrange for one teacher to observe another teacher in person; it's even more difficult to schedule 2 or 3 colleagues to observe). The explanation may simply be statistical power; among teachers who had used video in the past, treatment teachers reported having been observed by 1.26 times the number of colleagues as did control group teachers, but this difference was not statistically significant. There may also be a limited number of colleagues with whom a teacher has reason to share his or her instruction, creating a ceiling for the treatment effect. For example, if teachers are sharing videos in order to model grade-level or department-specific teaching practices, we might not expect teachers to expand greatly the circle of colleagues with whom they share their instruction, even if it is easier to do so.

For relatively less experienced teachers, these lesson-sharing processes were associated with an increase in the amount of instructional support they provided to their colleagues. One potential explanation is that, in the absence of BFF, teachers' default when seeking instructional support is to approach their more experienced colleagues. Because BFF increases instructional exposure, other teachers begin to discover the instructional strengths of less experienced teachers, and approach these less experienced teachers for advice. Relatedly, watching lesson videos may have led administrators to realize the instructional strengths of their less experienced teachers and to therefore request that these teachers share lesson videos or provide support to their colleagues. While speculation, it may be that administrators are now selecting teachers to provide support based more on actual observed classroom performance than seniority. Another possible explanation for the positive treatment effect among low-experience teachers is that less-experienced teachers were more comfortable with the video technology and with the web-based platform, and were therefore more likely to use the technology as means of supporting other teachers.

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5 In the "low experience" subgroup model, we lose 13 teachers due to administrator non-response on the mediator; this accounts for why the treatment effect is not significant in column 1, in contrast to the result in Table 5.

LIMITATIONS AND FUTURE RESEARCH

When interpreting these results, it should be kept in mind that administrators volunteered their schools as study sites, and teachers at these schools then volunteered to participate in the study. Because study participants differ from non-participants in that they showed an interest in using video for formal lesson observation, participants may be more tech-savvy, more open to innovations, and more interested in breaking down privatization barriers compared to the general population of administrators and teachers. The results from this study therefore may not generalize to administrators and teachers who are not be interested in video-based observation and evaluation. However, this does not mean that only teachers interested in de-privatizing their instruction stand to gain from a lesson video-sharing. As BFF causes administrators to broker more teacher peer support, and causes teachers to share their instruction more and provide more peer support, teachers who are not participating in BFF can still reap benefits in terms of learning.

While de-privatizing instruction can be an important first step toward instructional improvement, de-privatization alone is not sufficient. Contextual factors will influence the extent to which de-privatization in any particular school leads to fruitful teacher learning (Coburn & Russell, 2008). For example, teachers with access to more expert colleagues will likely receive higher quality advice, and teams in which teachers develop higher levels of trust will likely be more successful in pushing team members toward instructional improvement (Bryk & Schneider, 2002). Along these same lines, reviewing lesson videos of oneself or one's peers does not automatically lead to learning or instructional improvement (van Es et al., 2015); what de-privatization can do is unleash the potential for teachers to help one another improve. While this makes de-privatization a worthy focus of investigation in its own right, it is important to recognize that de-privatization alone may not be sufficient for instructional improvement.

In this study, we have no data on precisely how videos were used when teachers shared them with colleagues, or what learning or instructional changes resulted from the increased support brokering, instructional exposure, and equalized instructional support. Investigating these processes is a natural next step in the study of how video technology can be used to improve instruction through de-privatization. Future research should also examine how video might be used in the context of adopting and diffusing specific school-wide instructional reforms.

CONCLUSION

In US schools, the atomized structure of classrooms and the isolation of teachers thwart the development of a common vision of high quality instruction and a collective culture of instructional improvement. Breaking down these barriers can be an important component of school reform and instructional improvement. Video technology offers a way to facilitate the de-privatization of instruction by making teacher peer observation more convenient and less costly, and by making it easier for administrators to broker peer support among teachers. The results from this study serve as a proof of concept that introducing video technology into a school, and incentivizing teachers to record themselves by allowing them to submit lesson videos in lieu of required in-person classroom observations, can in fact lower the cost of sharing and discussing instruction. These results suggest the potential of video as a tool in efforts to de-privatize and improve instruction.

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