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Separating symbolic and active representation: a mixed methods study of gender and education in China

Xiaoyang Xu and Kenneth J. Meier ⓘ

School of Public Affairs, American University, Washington, DC, USA

ABSTRACT
Bureaucracies representative of the public can affect programme outcomes either through active representation by bureaucrats or symbolic representation via changes in client behaviour. Separating out these different aspects of representation requires understanding the interaction of bureaucrats and clients which is difficult using only quantitative data. Using individual-level quantitative analysis of Chinese education data, we find gender representation exists. Qualitative interviews of teachers, students and school principals, however, indicate that the effects are most likely not from active representation but rather via the symbolic representation through role-model effects.

Although bureaucracies are generally not designed as representative institutions, scholars have explored how bureaucracies can represent the public, applying an elaborate theory in many settings (Bishu and Kennedy 2020; Keiser et al. 2002; Kennedy 2014; Meier 2019). A bureaucracy broadly representative of the public in demographics and social origins (termed 'passive representation') is perceived to reflect the interests and values of citizens; it also can lead to positive outcomes in various policy settings for those who are represented (Guul 2018; Mosher 1968; Keiser et al. 2002; Selden 1997; Wilkins and Keiser 2004).

Passive representation can theoretically generate policy outputs and outcomes that benefit the represented individuals in two ways – active representation and symbolic representation. Active representation means the bureaucrats act to help clients who share similar identities. Past research has examined active representation between bureaucrats and clients in multiple policy areas at different levels of the bureaucracy (Burns 1980; Bradbury and Kellough 2007; Atkins, Fertig, and Wilkins 2014; Meier and Stewart 1992; Hong 2017). Symbolic representation does not rely on the bureaucrat to act in any way but rather on the client to change his or her behaviour because the bureaucrat looks like the client or shares salient identities (Riccucci and Van Ryzin 2017). Symbolic representation focuses on the generation of trust, the willingness of the client to coproduce goods, or the adoption of the bureaucrat as a role model (Meier and Nicholson-Crotty 2006; Riccucci and Van Ryzin 2017; Vinopal 2018).

Despite the growing literature, the existing research has three limitations. First, although precise theory involving the matchup of bureaucratic discretion, the saliency

CONTACT Kenneth J. Meier ✉ kmeier@american.edu

of the identities/demographic characteristics, and policy relevance predicts cases of bureaucratic representation (Keiser et al. 2002; Meier 2019; Wilkins and Keiser 2004), studies have not consistently identified if this occurs through active representation initiated by bureaucrats or through symbolic representation by clients changing behaviours. Second, the overwhelming majority of studies have examined in highly professionalized and Weberian style bureaucracies in the United States and Western Europe raising the question as to how general the theory is relative to different national and bureaucratic contexts (Bishu and Kennedy 2020). Third, the field is dominated by quantitative studies which may not be able to address certain key theoretical questions (Bishu and Kennedy 2020).

Determining whether representation outcomes in education occur through active representation or symbolic representation is important both for education policy and for the study of bureaucracy's role in the policy process in general. To the extent changes result from active representation, programmes can be redesigned and non-representative bureaucrats can be trained to become active representatives (Bradbury and Kellough 2007). If outcomes change because of symbolic representation, changes by bureaucrats are not needed but more diverse bureaucracies are (Riccucci and Van Ryzin 2017).

This paper seeks to illustrate how to separate out representation impacts into symbolic and active representation and addresses this gap in the literature with a mixed methods study of education in China. Using gender as the represented characteristic (see Park 2020; Miller and McTavish 2014), a quality individual level dataset permits us to examine educational outputs (test scores). The quantitative analysis of several thousand middle-school students shows that female students perform better on maths exams when they have female maths teachers, and these relationships are stronger with more in-class contact. To determine if the representation effects result from either active representation by teachers and administrators or symbolic representation, we interviewed teachers and administrators in China. These interviews suggest that female teachers do *not* actively represent the interests of female students and that administrators, both male and female, reject the notion of active representation and prefer to hire male maths teachers even if female candidates are equally qualified. Overall, the qualitative interviews indicate that the favourable outcomes are more likely to result from symbolic representation (students adopting female teachers as role models and changing their own behaviour) rather than active representation, a conclusion collaborated by additional quantitative data.

Representative bureaucracy

Representative bureaucracy theory argues that the representation of minorities within bureaucracy benefits minority clients and improves democratic representation (Mosher 1968; Meier and Capers 2012). Research in representative bureaucracy divides representation into three concepts: passive representation, active representation, and symbolic representation (Keiser et al. 2002; Theobald and Haider-Markel 2009; Riccucci and Van Ryzin 2017). Passive representation results when bureaucrats share identities with the clients (Mosher 1968) and can lead to policy outcomes that benefit the represented clients in two ways, through active representation and symbolic representation. Active representation occurs when bureaucrats act on shared values and seek policy outcomes that benefit the represented group (Riccucci and Van Ryzin

2017). For example, female bureaucrats could use discretion to implement policies that benefit female clients (Wilkins and Keiser 2004; Keiser et al. 2002). Symbolic representation effects result when clients change behaviours in such a way to gain positive benefits via greater coproduction or increased cooperation (Riccucci and Van Ryzin 2017). Scholars have found positive outcomes linked to representation in various substantive areas, including education (Carroll, Wright, and Meier 2019; Meier and Stewart 1992; Smith and Meier 1994; Song 2018), child support agencies (Wilkins and Keiser 2004), employment (Guul 2018), public health (Zhu and Walker 2013), and law enforcement (Hong 2017; Riccucci, Van Ryzin, and Lavena 2014). Null or negative results have also been found in law enforcement (McLaughlin et al. 2020; Wilkins and Williams 2008), housing (for gender Selden 1997), contracting (for gender Fernandez, Malatesta, and Smith 2013), and equal employment (for gender Meier, Pennington, and Eller 2005) among others.

In order for passive representation to link to policy decisions, there are two necessary conditions: the policy area must be salient to the identity that the bureaucrat shares with the client, and the bureaucrat must have discretion in that policy area (Keiser et al. 2002). In the case of gender representation, the link between passive representation to policy outcomes exists on issues where the policy area directly benefits women, the gender of the bureaucrat influences the client-bureaucratic relationship, or the political process has defined the issue as a gendered issue (Keiser et al. 2002; Wilkins and Keiser 2004). When female bureaucrats have adequate discretion in those policy areas, policy outcomes that benefit female clients are expected to occur (Andrews and Johnston Miller 2013; Marvel and Resh 2015; Sowa and Selden 2003). Symbolic representation, in contrast, does not rely on bureaucratic discretion but only on how the client reacts to passive representation. With education bureaucracies, the subject here, the current literature is unable to separate the effects of active representation and symbolic representation.[1] Gender representation is associated with better student performance, but that representation effect could come either from active representation on the part of the teacher or from symbolic representation effects by the student.

Separating active representation and symbolic representation

In this section, we first discuss the theoretical differences between active representation and symbolic representation. We then illustrate how representation occurs in the case of gender. Finally, we apply the theories to the education context and indicate how representation works at the street-level and the management level (Hong 2020).

Although active representation and symbolic representation often appear simultaneously, there are ways to distinguish between them. First, different actors are primarily responsible for the two types of representation. In active representation, bureaucrats initiate actions to help those clients who share the same identities; while in symbolic representation, clients act because they see bureaucrats who look like them and respond. Second, active representation requires that representative bureaucrats act different from non-representative bureaucrats when dealing with the passively represented clients. Guul (2018), for example, found that female employment counsellors made greater effort and spent more time with female clients than male clients. In symbolic representation, what matters is only that the represented client responds differently when the bureaucrat passively represents clients. As an example, Riccucci,

Van Ryzin, and Lavena (2014) found that women's perception of trust, fairness, and job performance increased when the number of women increased in a hypothetical domestic violence agency.

In the education context, street-level bureaucrats, teachers, can trigger both active representation and symbolic representation. First, teachers can use their discretion to actively help those students who share the same identities (Keiser et al. 2002). They can spend more time with a student, encourage the student more, provide more challenging material, or advocate for the student in other ways; all are forms of active representation. Second, students can see those teachers who share the same identities as someone to emulate or please and respond by changing their behaviours in ways that improve performance by working harder or paying more attention; this is symbolic representation.

Similar to the street-level bureaucrats, managers can engender both active representation effects and symbolic effects to their clients. On one hand, school managers have the discretion to design and enact policies and programs intended to help students who they represent, that is, active representation (Carroll, Wright, and Meier 2019; Meier and Stewart 1992). On the other hand, students could see school managers who look like them as role models and aspire to that position or simply desire the manager's approval, which is symbolic representation. Both types of representation can bring positive outcomes for students. Research in representative bureaucracy, however, shows mixed findings for managers. Meier and Stewart (1992) use school data from Florida and find that black school principals do not always affect black students. Johnston and Houston (2018) do not find strong evidence of active representation in the case of female police leadership (but see Andrews and Johnston Miller 2013). Positive results are found for female executives in women's issues departments for female-friendly policies (Dolan 2000), in child support agencies (Wilkins and Keiser 2004), and for minority school managers (Carroll, Wright, and Meier 2019).

To determine whether the relationship between passive representation and policy outputs that benefit the represented client results from active representation or symbolic representation, a study must determine whether or not bureaucratic representatives engage in different actions or absent such actions whether clients gain positive results by changing their own behaviour. These distinctions are difficult to make with most existing quantitative data but can be assessed via qualitative analysis (Beitin 2012) that provides insight as to how representation works (Atkins and Wilkins 2013). Bureaucrats and clients can give their perspectives on their actions during the qualitative interviews, which can help determine whether the policy outcomes are from active representation or symbolic representation. Active representation is a process, and teachers and administrators can explain how they interact with students and what they are seeking to accomplish. In this way, as Atkins and Wilkins (2013) demonstrate for teen pregnancy, qualitative data can illuminate why a quantitative relationship exists (Mele and Belardinelli 2019).

Representation in China

As research on representative bureaucracy starts to move to non-western countries (see Burns 1980; Agyapong 2018; Dhillon and Meier 2020; Song 2018; Zhang 2019; Chen, Chen, and Hu 2019), we select China to apply the theory. China provides

a challenging context for the study of gender representation in the bureaucracy where rhetoric clashes with reality. 'Women hold up half of the sky.' That is a quote from Mao Zedong after he read an article about gender pay disparity in a province-level publication in the 1950s. The Chinese Constitution and public policies promote gender equality and female rights, including as paid maternity leave and child-care facilities (The State Council of PRC). Despite such general pronouncements and the establishment of policies, there are reasons to believe that equal opportunities based on gender have not been realized and gender representation is still relatively limited in China.

Three factors limit the representation process in China: its government system and social structure, existing gender disparities, and persistent gender stereotypes. China has a highly centralized governmental system and a patriarchal social structure. During recent years, the Chinese government has mostly operated with a top-down approach with major decisions typically made at the national level (Chen 2017). Education in China is no exception. It is highly structured and hierarchical. The Department of Education manages local schools. School have only modest discretion in after-school activities, school budgets, bonuses to school teachers, and some of the hiring process. The Ministry of Education establishes the curriculum standards for compulsory education nationally that schools across China must follow (Ministry of Education 2019; Yao and Guo 2018). Discretion on the part of teachers and administrators, as a result, is more limited than in many western nations.

Second, China also has a patriarchal social system and culture that produces multiple gender disparities. Social values that see women in supporting roles rather than managing deeply influence the social system and culture in China and produce barriers for women to succeed in management roles (Woodhams, Xian, and Lupton 2015). Women lack representation within the decision-making entities across the nation. For example, there is only one female among the current ten members of the State Council of China (The State Council of PRC). The ratio of females to males among legislators, senior officials, and managers is 1 to 20 (World Economic Forum 2020). From another perspective, the son preference where boys are preferred over girls still exists in many parts of China. A large number of 'missing women' exist in China because of gender selection abortion and son preference (Qian 2008; Ebenstein 2010). The gender ratio of China at birth is 1 male to 0.89 females in 2020 (World Economic Forum; the ratio in the US is 0.96). The gender gap persists in education. About 74% of females age 25 years and older finished secondary education compared to 82% of males in 2017 (UNDP). The World Economic Forum (2020) ranks China 106 out of 153 countries on its 2020 gender gap index using education, health, economic and political factors and 124th on access to secondary education.

The limits on gender representation in China are exacerbated by the general stereotype that men outperform women and are more competent at both street-levels and management levels. A common belief in many Asian countries is that males outperform females especially in mathematics and science-related fields (Tsui 2007). These stereotypes exist even though there is no clear evidence of the disparity between male and female performance in those subjects in many Asian countries, including China, Singapore, Japan, Taiwan, Hong Kong SAR, and South Korea (TIMSS 2015; Tsui 2007). That stereotype then affects female students and influences the pipeline producing teachers. In Chinese schools, most teachers in liberal arts and humanity related subjects are women, but the gender composition for maths and science teachers in relatively balanced.

These gender biases also apply to managerial positions (Bowen et al. 2007; Cooke 2005). At the school management level, there are many fewer females than males (Ministry of Education, China 2019). Gender discrimination appears in both recruitment and promotion processes for the managerial positions, especially at higher levels (Cao 2001; Cooke 2005; Xie and Zhu 2016). Under-representation exists partially due to the barriers for women to negotiate and network by using 'Guanxi,' which refers to social ties and personal ties, as a powerful tool for career advancement (Leung 2002; Cooke 2005; Granrose 2007; Woodhams, Xian, and Lupton 2015). Female managers in China also perceive difficulties receiving promotions due to pregnancy (Granrose 2007; Xie and Zhu 2016) and have fewer career resources and opportunities than their male counterparts (Leung 2002). Since promotions are linked to higher income and prestige (Cao 2001), gender disparities increase as one moves up the hierarchy.

Nonetheless, gender disparities and the limitations on gender representation do not mean that gender representation cannot happen in China. Female teachers and female school principals have discretion to engage in active representation through interacting with students and designing policies. Female teachers can spend more time with female students, encourage them, and assist them with their course work. Female school principals can also implement policies or design programs to assist female students. Given that female teachers and school principals were once also students, this lived experience (Zamboni 2020) likely shaped their identity. Female teachers and principals who experienced gender bias in the past, as a result, may be more likely to recognize gender discrimination and, thus, engage in active representation.

The obstacles to representation from the overall system, however, might have more influence on active representation than symbolic representation. Since a patriarchical society does not vocally and openly encourage gender representation and advocacy for gender equality, female bureaucrats may face more resistance if they decide to represent. Social norms also place constraints on active representation on behalf of female clients. When the general society does not applaud gender equality, female bureaucrats should have less incentive to act on behalf of female clients. Because the payoff of representing might be lower in China than in a country with greater gender equality, female bureaucrats may try to 'blend in' and behave similar to male bureaucrats for more promotion opportunities, thus reducing the likelihood of active representation (Ferguson 1984; Johnston and Houston 2018).

The contextual obstacles to representation, however, may have less impact on symbolic representation than on active representation since female students can still see their female teachers and school principals as role-models. Although female students are surrounded by gender stereotypes that they cannot perform well in maths and sciences, seeing more female teachers succeed in maths and science subjects can encourage female students to try harder in those subjects. Having female maths and science teachers provide female students positive signals that they too can perform well in maths and sciences; and having female school principals may suggest that they too might become a leader or a manager in the future. Also, the risks for female students are smaller than those for teachers because their response is to become a better student and thus fulfill an accepted role. Thus, symbolic representation may be more likely than active representation to occur in this context and generate better outcomes for female students in China.

With a more bureaucratic structure in the government system, more patriarchy in society, and the existence of heavy gender bias, representation in China is challenging. Under such circumstances, greater contact between teachers and students might be needed to generate representation effects. Guul's (2018) employment counselling study in Denmark indicates that both bureaucrats and clients benefit from greater contact in the representation process. The role of the head teacher in China (see below) means that some maths teachers have more contact with students and greater authority (that is discretion) in the education process (similar to the UK police differences when female officers have front line contact, Andrews and Johnston Miller 2013). In difficult contexts such as Chinese education, this greater contact might matter. Positioning representative bureaucracy theory within the Chinese education context suggests four hypotheses:

Hypothesis 1: The presence of female maths teachers or school principals is positively associated with female students' maths grades.

Hypothesis 2: The increase in the time devoted by female maths teachers to female students is positively associated with an increase in female students' maths grades.

Hypothesis 3: There is symbolic representation by female maths/science teachers.

Hypothesis 4: Female teachers who experienced gender stereotyping growing up would be more likely to engage in active representation.

Research method and data

We implement a mixed method study using qualitative interviews to illuminate relationships found in a quantitative analysis (Mele and Belardinelli 2019). We first use quantitative data to explore whether the representation effects hold in China. Since using only quantitative data cannot distinguish whether the representation effects in this case are from active or symbolic representation, we then proceed to qualitative assessment to determine whether female bureaucrats actively represent the interests of female students. The use of qualitative interviews can give us some understanding of how passive representation is translated into beneficial outcomes. Lastly, we supplement our findings from interviews with quantitative data to look for indications of symbolic representation.

The quantitative data are from the China Education Panel Survey (CEPS), a nationally representative longitudinal survey conducted by the National Survey Research Center at Renmin University of China. The survey includes student test scores and surveys of students, teachers, parents, and school administrators concerning students' health, academic performance, school management, and teacher qualities. The baseline survey is a random sample of approximately 20,000 students in 438 classrooms of 112 schools in 28 county-level units in mainland China in 2013–14 and 2014–15 (CEPS).

To examine the representation effects in the bureaucrat-client relationship, we also interviewed school principals and women and men maths and science teachers from five schools in a sample city of China. We randomly selected interviewees from

four public schools and one private school. In total, there were nineteen female maths and science teachers, nine male maths and science teachers, and five school principals interviewed. We acknowledge that our 33 interviews cannot fully represent all populations of China, however, our interviews show consistent findings. As recommended in the methods literature (Saunders et al. 2018), we stopped gathering interview data at a saturation point when the information we received became highly repetitive and did not provide any new additional insights. Such a process should be adequate given the qualitative data are used to interpret the quantitative findings and are not used to generalize to all teachers and administrators (Beitin 2012; Mele and Belardinelli 2019; Robinson 2014). Of the 33 interviews, 32 were conducted in person; one interview, the pilot interview, was done through a video call. Interviews were in Mandarin and lasted from fifteen minutes to one hour. After the interview, we translated all interviews into English and then sorted responses based on the common themes and our hypotheses for analysis. The research protocol was approved by the American University institutional review board #: IRB-2019-329 (23 April 2019).

The interviewed principals and vice principals vary in gender and the subjects they used to teach to bring multiple perspectives to the interviews. Since the CEPS data were collected at the middle school level, the interviews were also conducted at the middle school level. We also included a small number of interviews at the high school level. Interviews were confidential; we did not collect or record any interviewee's personal information besides their gender and personal experience.

Both the quantitative analysis and qualitative interviews are at the individual level, linking individual students' performance to their maths teachers and school principals. Analysing at the individual level helps us to take a closer look at direct representation effects when clients, street-level bureaucrats, and managers share the same identity. It will not be sensitive to indirect effects of representation such as changes in school policy or contagion effects where the presence of female teachers influences how male teachers perform. The individual data, however, can provide leverage on direct representation and whether it results from active representation or symbolic representation.

Dependent variable

Our quantitative dependent variable is female students' maths scores as an output of the representation effects. The maths exams at different schools vary in terms of difficulty. In order to remove the bias in estimates at the school level, we standardized the maths grades to have a mean of 70 and standard deviation of 10 for each school. This effectively creates a school-level fixed-effect in the models and in the process controls for most of the school-to-school variation in factors that might influence test scores. The maths grade is available for both waves of data, the 2013–14 and 2014–15 school years. We use the OLS regression with year effects and robust standard errors in our estimation.

Independent variables

The key independent variables are the gender of the female students' maths teachers and school principals. All observations in this individual-level analysis are female

students. This research follows the convention in the literature by comparing the outcomes and outputs of female students when they have female or male maths teachers to indicate the representation effects from female maths teachers (Keiser et al. 2002).

We further divided women maths teachers into two groups based on their responsibilities: homeroom teachers and subject teachers. The Chinese school system at primary, middle, and high school levels involves homeroom teachers and subject teachers. Students are assigned to a classroom where they stay for all classes; teachers of various subjects come to the students' classrooms to teach. Each class has an assigned homeroom teacher who manages all aspects of the class, including class discipline, communications with parents, and academic performance. Female maths teachers who are homeroom teachers spend significantly more time with students and have more discretion in class management and as a result should have a greater impact on female students.

The control variables are at three levels. At the student level, we include the socioeconomic status of the students' families and the highest level of education of students' parents. Education research consistently shows a correlation between family income and student performance (McLanahan 2004; Kalil, Ryan, and Corey 2012). At the teacher level, we control for the education levels of teachers and total years of experience. We expect that higher education levels of teachers and parents will be associated with better grades for female students. Other variables involve school management, including how satisfied teachers are about salaries and school management; the teachers' workload is represented by the total class hours, total working hours per week, average number of students in classrooms, and how much social pressure teachers face from the social environment. We hypothesize that when teachers are more satisfied with the school management, experience less pressure, and have lower workloads, girls' grades increase.

At the school level, control variables include the education level of school principals and the location of schools. Since schools in rural areas receive fewer resources than urban ones, city schools may have better grades. We also include several management variables at the school level, including whether the school offers classrooms for students to study after-school. We expect that students in schools that offer night study rooms would have more time to study, so higher grades. The descriptive statistics for all variables are shown in Table 1.

Data analysis: female students' maths grades

Table 2 presents the analysis for girls' maths grades. The regression in Model 1 shows female students with female maths teachers score 2.54 points higher (about one-fourth of a standard deviation) than those with male maths teachers, while holding other variables constant, supporting Hypothesis 1. Model 2 indicates that when female students have female maths teachers as their homeroom teachers, their maths grades are 3.63 points higher; when female students have female maths teachers only as subject teachers (Model 3), their maths grades are 2.32 points higher (all other things equal). That supports Hypothesis 2 that the more time female teachers spend with female students, the higher the maths grades of the students. Homeroom teachers have greater access to students' parents and more discretion in rewards and punishments.

Table 1. In sample summary statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max
Standardized maths score	10,939	70.216	9.98	44.209	93.436
Female school principal	10,939	.14	.347	0	1
Female maths teacher	10,939	.599	.49	0	1
Homeroom teacher	10,939	.296	.456	0	1
Highest education level of students' parents	10,939	4.461	2.004	1	9
Economic status of students' families	10,939	2.809	.59	1	5
Average seats per classroom	10,939	51.322	8.554	25	72
Percentage of teachers with teaching certificates	10,939	.971	.119	0	1
Whether the school offers night study room	10,939	.541	.498	0	1
Teacher retention	10,939	1.503	.814	1	4
Principal degree	10,939	5.316	.835	4	7
Principal experience at current school	10,939	10.471	8.369	0	32
Teacher degree	10,939	5.312	.737	2	7
Teacher, total class hours per week	10,939	13.962	6.936	1	60
Teacher, total working hours per week	10,939	45.967	16.121	0	140
Teacher, years of teaching experience	10,939	13.772	9.782	0	47
Pressure from the public opinions	10,939	3.781	.989	1	5
Teacher, satisfaction, salary	10,939	2.644	1.087	1	5
Teacher, satisfaction, school management	10,939	3.454	.904	1	5
Private school	10,939	.051	.22	0	1
School location	10,939	2.713	1.614	1	5
Year	10,939	2013.315	.465	2013	2014

Subject teachers do not have the same responsibilities or discretion. Since our concerns are representative bureaucracy rather than fully explaining girls' maths scores, we will not interpret the control variables but only note their relationships are consistent with existing literature.

The representation effects hold in this context: female maths teachers are associated with positive outcomes for girls in China.[2] Since female teachers have direct contact with female students, we cannot rule out either type of representation effects – active or symbolic. The outputs could result from active representation since teachers meet and communicate with students each school day; they also could be symbolic representation since sharing a gender identity could encourage female students to invest more time in the class. Before addressing this question in our qualitative analysis, we first turn to whether school principals are also associated with female students' maths scores.

Table 3 tests the impact of female school principals on girls' maths performance when controlling for having female maths teachers. Model 4 indicates that female school principals are negatively associated with female students' performance; students with female school principals score 1.24 points lower in maths, holding other variables constant. When controlling the representation effects of female maths homeroom teachers (Model 5), however, the negative relationship for female school principals is no longer significant. The direct interactions between homeroom teachers and students, and the responsibilities and discretion of homeroom teachers are more powerful than the effects from the school principals. Nonetheless, the negative effects from female school principals on female students cannot be removed by having female non-homeroom maths teachers (See Model 6 in Table 3). The representation effects on students' maths grades do not hold at the management level in the Chinese context.

Table 2. The impact of different female maths teachers on female students' maths grades.

Dependent Variable = Female Students' Math Grades			
	Female students with female maths teachers	Female students with female maths teachers as homeroom teachers	Female students with female maths teachers as non-homeroom teachers
VARIABLES	Model 1	Model 2	Model 3
Female maths teacher	2.539***	3.631***	2.316***
	(0.201)	(0.343)	(0.256)
Student family economic status			
Somewhat poor	1.394**	0.987	1.542**
	(0.552)	(0.909)	(0.689)
Moderate	2.294***	1.670*	2.471***
	(0.524)	(0.860)	(0.657)
Somewhat rich	1.413**	2.000*	1.254
	(0.658)	(1.141)	(0.808)
Very rich	−6.054***	−5.006	−7.974***
	(2.131)	(3.299)	(2.242)
Student highest education level of parents			
Finished elementary education	6.334***	9.628***	4.136*
	(1.846)	(2.690)	(2.407)
Middle school degree	8.239***	10.52***	6.477***
	(1.823)	(2.643)	(2.381)
Technical secondary degree	9.150***	10.86***	7.616***
	(1.855)	(2.722)	(2.414)
Vocational high school degree	8.549***	10.91***	6.834***
	(1.919)	(2.878)	(2.482)
High school degree	9.279***	11.13***	7.722***
	(1.830)	(2.658)	(2.390)
Junior college degree	11.48***	13.33***	9.909***
	(1.849)	(2.703)	(2.412)
Bachelor degree	12.13***	13.43***	10.78***
	(1.839)	(2.679)	(2.400)
Master degree or higher	12.68***	10.91***	12.44***
	(1.975)	(2.946)	(2.545)
Teacher degree			
Junior college degree	−1.880		−2.080
	(2.603)		(2.624)
Bachelor degree (Adult education)	−1.319	1.584***	−1.875
	(2.597)	(0.546)	(2.615)
Bachelor degree	−0.580	2.295***	−0.652
	(2.606)	(0.582)	(2.630)
Master degree or higher	0.955	1.615*	1.428
	(2.671)	(0.919)	(2.729)
Night study room	1.846***	0.804*	2.620***
	(0.231)	(0.424)	(0.278)

(*Continued*)

Table 2. (Continued).

Dependent Variable = Female Students' Math Grades			
	Female students with female maths teachers	Female students with female maths teachers as homeroom teachers	Female students with female maths teachers as non-homeroom teachers
VARIABLES	Model 1	Model 2	Model 3
Average seats per classroom in the school	−0.0390***	0.00947	−0.0777***
	(0.0121)	(0.0218)	(0.0149)
Teacher Managerial Variables			
Total class hours	0.0104	0.0548**	−0.00242
	(0.0153)	(0.0232)	(0.0202)
Total work hours	0.0101*	0.0130	−0.00853
	(0.00582)	(0.00942)	(0.00794)
Teaching experience, year	1.39e-05	0.0798*	0.0415***
	(0.0101)	(0.0420)	(0.0141)
Pressure from public opinion	−0.275***	−0.472**	−0.186*
	(0.0976)	(0.199)	(0.112)
Satisfaction, salary	0.828***	0.789***	0.864***
	(0.0992)	(0.179)	(0.123)
Satisfaction, school management	−0.0880	0.747***	−0.600***
	(0.117)	(0.215)	(0.146)
School Location			
Outskirts of the city/town	−1.210***	−1.763***	−1.038**
	(0.359)	(0.573)	(0.475)
Rural-urban fringe zone of the city/town	−4.141***	−1.832***	−4.794***
	(0.292)	(0.541)	(0.350)
Towns outside of the city/town	−2.682***	−2.935***	−2.860***
	(0.309)	(0.556)	(0.383)
Rural areas	−3.160***	−1.874***	−4.018***
	(0.304)	(0.552)	(0.373)
2014.year	−0.274	−1.226*	−0.314
	(0.202)	(0.692)	(0.240)
Private school	−0.209	−0.428	0.139
	(0.454)	(0.793)	(0.560)
Constant	60.14***	50.49***	65.22***
	(3.363)	(3.282)	(3.817)
Observations	10,939	3,237	7,702
R-squared	0.122	0.131	0.136

Dependent Variable = Female Students' Maths Grades.
Robust standard errors in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The qualitative analysis

Teacher interviews: female maths and science teachers

The teacher interviews consisted of 20 open-ended questions tailored to illuminate the process of representation and factors that may affect the decisions of bureaucrats to represent. We first explored whether the female teachers were aware of gender

Table 3. The impact of female school principals on female students' maths grades.

Dependent Variable = Female Students' Math Grades			
	Female students with female maths teachers	Female students with female maths teachers as homeroom teachers	Female students with female maths teachers as non-homeroom teachers
VARIABLES	Model 4	Model 5	Model 6
Female school principal	−1.238***	−0.619	−1.973***
	(0.299)	(0.583)	(0.394)
Female maths teacher	2.526***	3.874***	2.535***
	(0.205)	(0.363)	(0.255)
Student highest education level of parents			
Finished elementary education	5.823***	9.737***	3.390
	(1.693)	(2.324)	(2.621)
Middle school degree	7.386***	10.49***	5.413**
	(1.669)	(2.264)	(2.604)
Technical secondary degree	8.038***	11.02***	6.361**
	(1.708)	(2.363)	(2.642)
Vocational high school degree	7.763***	10.88***	6.118**
	(1.780)	(2.541)	(2.710)
High school degree	8.195***	10.80***	6.500**
	(1.678)	(2.281)	(2.615)
Junior college degree	10.39***	13.42***	8.682***
	(1.701)	(2.343)	(2.641)
Bachelor degree	11.20***	13.69***	9.725***
	(1.688)	(2.313)	(2.629)
Master degree or higher	11.57***	10.80***	11.17***
	(1.837)	(2.671)	(2.760)
Student family economic status			
Somewhat poor	1.169**	1.008	1.384**
	(0.558)	(0.914)	(0.626)
Moderate	1.987***	1.739**	2.171***
	(0.534)	(0.874)	(0.595)
Somewhat rich	1.155*	2.339**	0.968
	(0.676)	(1.163)	(0.761)
Very rich	−4.753**	−2.218	−8.337**
	(1.946)	(2.675)	(3.366)
Average seats per classroom in the school	−0.0639***	−0.00629	−0.0913***
	(0.0135)	(0.0261)	(0.0161)
Percentage of teachers with teaching certificates	0.773	4.646*	0.00264
	(0.752)	(2.559)	(0.925)
Night study room	1.932***	0.435	2.530***
	(0.258)	(0.513)	(0.291)
If teacher turnover is high			
Somewhat not fit	−0.404	0.977**	−0.838***
	(0.249)	(0.470)	(0.294)
Somewhat fit	−2.508***	−2.640***	−1.860***
	(0.376)	(0.713)	(0.479)
Exactly fit	−2.944***	−4.366***	−2.006***
	(0.486)	(0.889)	(0.602)
School principal degree			
Bachelor degree (Adult education)	−2.302***	−3.281***	−1.734***
	(0.315)	(0.590)	(0.392)
Bachelor degree	−0.768**	−3.064***	−0.0623

(Continued)

Table 3. (Continued).

Dependent Variable = Female Students' Math Grades			
	Female students with female maths teachers	Female students with female maths teachers as homeroom teachers	Female students with female maths teachers as non-homeroom teachers
VARIABLES	Model 4	Model 5	Model 6
	(0.374)	(0.669)	(0.459)
Master degree or higher	−3.730***	−3.712***	−3.039***
	(0.459)	(0.987)	(0.548)
Principal, years working in school	0.0207*	−0.0833***	0.0575***
	(0.0122)	(0.0226)	(0.0143)
Teacher degree			
Junior college degree	−0.249		−1.597
	(2.630)		(2.448)
Bachelor degree (Adult education)	0.490	2.016***	−1.288
	(2.624)	(0.533)	(2.442)
Bachelor degree	1.063	3.516***	−0.441
	(2.635)	(0.589)	(2.462)
Master degree or higher	2.699	1.990**	1.989
	(2.724)	(0.999)	(2.644)
Teacher Managerial Variables			
Total class hours	0.00612	0.0581**	−0.00620
	(0.0162)	(0.0251)	(0.0219)
Total work hours	0.00594	0.00228	−0.0103
	(0.00596)	(0.00966)	(0.00834)
Teaching experience, year	0.00648	0.0838*	0.0330**
	(0.0104)	(0.0439)	(0.0148)
Pressure from public opinion	−0.0983	−0.0799	−0.0870
	(0.102)	(0.219)	(0.119)
Satisfaction, salary	0.856***	0.644***	0.845***
	(0.103)	(0.194)	(0.128)
Satisfaction, school management	−0.209*	0.414*	−0.572***
	(0.122)	(0.246)	(0.148)
School location			
Outskirts of the city/town	−1.623***	−2.617***	−1.525***
	(0.381)	(0.668)	(0.476)
Rural-urban fringe zone of the city/town	−4.882***	−2.873***	−5.576***
	(0.348)	(0.662)	(0.457)
Towns outside of the city/town	−2.870***	−2.599***	−3.173***
	(0.324)	(0.610)	(0.387)
Rural areas	−3.446***	−1.573**	−4.219***
	(0.333)	(0.649)	(0.392)
2014.year	−0.153	−1.073	−0.261
	(0.208)	(0.705)	(0.246)
Private school	0.514	0.666	0.925
	(0.486)	(0.829)	(0.625)
Constant	62.10***	50.34***	68.01***
	(3.382)	(4.001)	(3.933)
Observations	10,602	3,142	7,460
R-squared	0.142	0.165	0.157

Dependent Variable = Female Students' Maths Grades.
Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

stereotypes. Have they ever experienced the stereotype that females underperform in maths and sciences as students and as teachers now? Seventeen out of nineteen female teachers (89.5%) stated that they encountered this stereotype when they were students. One teacher described her experience in high school: 'Our male maths teacher came into our classroom and pointed to us couple girls said, "You girls just can't learn maths well." So I picked the maths major at college.'

Another critical question is whether female teachers agree with this gender bias and if they saw it among their students. We hypothesized that because females are currently teaching the subjects but experienced the gender bias in the past, they would be less likely to hold that bias against their female students. Among the nineteen interviewees, fifteen expressed opinions *consistent* (79%) with gender bias. Those female teachers who believe that boys outperform girls stated that boys have better scientific logic and they understand the topic better. Only four of the interviewed female teachers, disagreed. One interviewee said, 'It's not related to the gender but intelligence.' However, one of the four teachers, who disagreed, believed that female students have better grades because performing well in science and mathematics at the middle school level mostly requires memorization. 'Girls are better at memorization; boys are better at scientific logic.' 'Male students have more potential in science.'

Along with the perceptual questions of gender bias, further questions were asked to examine whether active representation exists. One interview question was 'As a female math/science teacher, do you agree that helping more female students achieve better performance in this subject is a major goal.' Only two interviewees answered, 'yes.' One teacher said, 'I never thought about this. But I think I am doing it and helping more female students'; another said, 'Sometimes, I have those thoughts. There are impacts on us from the social environment. I just don't believe in it.' Among the fifteen respondents who disagree with the statement, eleven of them (73%) mentioned the words 'equally,' 'same,' or 'no difference' in their interviews. They illustrated that they would not treat any student differently because of a student's gender. Nevertheless, those responses may not mean that those teachers treat students of all genders in the same way. Eleven interviewees expressed that they would treat their female students nicer or more gently when girls approach them; this may be an indication of active representation if the male teachers do not act in the same way.

Teacher interviews: male perspectives

To investigate whether female teachers treating girls more gently might be active representation, nine male teachers were interviewed asking the same questions. In total, six male teachers (67%) voluntarily stated in the interviews that they treat female students 'nicer' or 'gentler.' The consistency suggests that this is a uniform response to girls rather than active representation by women teachers.

For the question of whether the male teachers agree with the maths gender bias, all nine teachers agreed. One teacher said, 'I didn't analyse grades by gender before, but boys do have more potential in those subjects.' Several male teachers mentioned that boys have better grades, and boys are more interested in science. 'This is common knowledge.' Among the nine male teachers, all of them endorsed gender bias. One said, 'Males were better in those subjects when I was a student.' Another teacher stated, 'This is common knowledge in the society.'

Based on the interviews of female and male teachers, we can conclude that positive relationships found in the quantitative analysis are unlikely to be the result of active representation, thus suggesting symbolic representation and/or role-model effects as the remaining explanation for the quantitative relationships. Although the female teachers do not act differently or treat female students differently than male students, female students may still change their own behaviours as the result of having or interacting with female teachers. To assess this hypothesis, we further examine student data to learn about their perspectives.

Students' views

The CEPS asks students whether their maths teachers always pay attention to them, if their maths teachers ask them to answer questions in class, and if their maths teachers always praise them. Those three survey questions can indicate of how female students view their maths teachers. Compared to female students with male maths teachers, female students with female maths teachers are significantly more like to perceive their maths teachers pay attention to them (Chi-square 34.03), praise them (Chi-square 184.62), and ask them to answer questions in class (Chi-square 139.94). We then look at students' study time and how they perceive the gender stereotype in maths. Female students who have female maths teachers report spending significantly more time studying per studying during the weekdays than those female students with male maths teachers (Chi-square 49.66). Finally, more female students with female maths teachers than those having male maths teachers disagree with the stereotype that boys outperform girls in maths (Chi-square 11.44).

The findings here suggest that female students with female maths teachers on average hold different attitudes about maths classes and the gender related stereotypes on maths and engage in greater study effort. Such attitude differences and the willingness to exert more effort (coproduction), are consistent with the notion of symbolic representation. In particular, spending more time studying along with the positive reinforcement that they perceive in class is likely to result in better grades in maths. Since the teacher interviews show that female teachers treat female and male students the same, the findings on students' perspectives suggest that female students act differently when they have female maths teachers. The representation effect here is symbolic.

Principal interviews

The interviews of school principals are designed to compare female and male school principals' views on female students' and teachers' performance and to illustrate the context for the other interviews. There were ten questions for each interview, including the teacher selection process, the principals' experience as a teacher, and their views on the performance of female students and teachers in maths and science. The five interviewed school principals and vice principals included two females and three males.

The principal interviews were consistent and illustrated fairly uniform attitudes suggesting strong organizational and professional socialization. All five principals believed that male maths and science teachers outperform female teachers. Two

principals, however, admitted that those students with female teachers sometimes have better grades than those with male teachers. Furthermore, school principals preferred male teachers teaching maths and sciences. One school principal said, 'The society decides this, that male teachers teach science and maths. Because male teachers have better science logic, and female teachers are more sensible and emotional. That is by nature.' One interviewee mentioned that women teachers are facing pressures from both biological changes and family responsibilities including taking care of their children and families. One principal commented, 'Women teachers are getting pregnant and going on maternity leave; older women teachers are going through menopause. Their emotions shift a lot during those "special time-periods." It affects their ability to work.' Principals see an increasing number of women teachers getting pregnant due to the end of the One-Child policy. We did not see any representation activity from the female school principals; they had clear preferences for male teachers and were more concerned with female teachers' ability to work and were sceptical about female teachers' abilities. One interviewee stated, 'Another reason that we prefer male teachers in those subjects is that boys today lack masculinity. They need more positive impacts from male teachers to build masculinity. So we try to offer that to our students. We have increased the numbers of male teachers teaching maths and sciences over recent years.'

Private school principals who have more discretion in terms of hiring teachers and have a larger pool of candidates, indicated they would purposely bring in more male maths and science teachers, even though there is a greater supply of female teachers. One interviewee at the private school said, 'If two job candidates in maths or sciences have equally the same qualifications besides gender, the male candidate will be preferred and selected.' The principals believe that males, in general, are better 'maths thinkers.' One vice principal said, 'Although teachers do not need to teach much in-depth mathematics and science concepts at the middle school level, male teachers can better explain those concepts to students. Women teachers are more likely to be challenged.'

All school principals endorsed the gender bias against female teachers working in their schools. At the same time, they recognized the representation effects from male teachers to male students. All interviewees held the bias that male teachers perform better and are better suited for the position by gender. They also applied those biases through the hiring process when they had discretion to hire new teachers. All school principal interviews also indicated that they held the stereotype towards their female students, although they have female students who have better grades than male students on exams. They believe that males, in general, have more potential in maths and sciences.

Conclusion and discussion

This mixed method research examined active and symbolic bureaucratic representation using the case of Chinese education. Although past research has frequently used only quantitative data to investigate the different types of representation (Bishu and Kennedy 2020), our qualitative interviews help to distinguish between active and symbolic representation in Chinese schools. The quantitative models find gender representation effects in Chinese education. We further use interviews with teachers and school principals to explore whether this positive relationship results from active representation or symbolic representation. The interviews of female and male teachers

show no evidence that female teachers engage in active representation. Additional quantitative data from the study suggest that female students have different attitudes and act differently when they have female maths teachers compared to having male maths teachers, a symbolic representation process.

The suggestive nature of the symbolic representative evidence stands in contrast to stronger findings in regard to the lack of active representation. Female maths teachers and school principals do not appear to actively represent in terms of helping female students and teachers achieve; that is the case even when female teachers and female school principals experienced prior gender bias. Women who experienced bias still reinforced the stereotypes and applied them to their students and employees. The gender bias related to science subjects appears to be deeply rooted in many people's perceptions and was especially strong among school principals who stated clear preferences for male maths and science teachers.

The quantitative analysis of individual-level data indicated that gender representation was associated with positive effects on students' academic performance. Moreover, increasing exposure from female teachers with greater discretion reinforced the representation effects on female students. Female students earned higher maths grades when their homeroom teachers were female maths teachers who had more authority and discretion. However, the representation effects at the street-level and management level differed. Female school principals, as managers, were not associated with any positive effects on girls' maths scores. Qualitatively, the female school principals acted similar to their male counterparts and expressed views inconsistent with active representation, perhaps as the result of organizational socialization and the need to 'blend in' for future career promotion (Johnston and Houston 2018; Wilkins and Williams 2008). Future research should further test how representation effects differ for bureaucrats at different levels in the organization (see Hong 2020; Meier and Stewart 1992; Park 2020).

Rather than illustrating how female teachers acted to represent female students, the interviews with female teachers emphasized treating all students equally regardless of gender. While such treatment may be better than how women are treated by other institutions in China, this appears to be more a professional norm than active representation. Meanwhile, female school principals focused on how male science teachers were better qualified for their positions. In interviews with women teachers and principals, a common viewpoint was that women teachers or students did not perform as well as men. One term that was mentioned in most of the interviews was the 'scientific logic' ability. The preference and recognition of good performance that was given to males was justified not with data but with the general assumption that males had better scientific logic by birth than females, endorsing the myth of the gendered brain that has been debunked by recent research (Rippon 2019). In sum these interviews indicate an absence of active representation.

Interviews also reveal the social pressures women face in their role as teachers. While they are expected to take on more family responsibilities by family members and the general expectations of social culture, women face discrimination at work because this creates the perception that they have less time and energy for work duties. Even though school principals recognized women teachers' teaching performance, the school principals still preferred male rather than female teachers. At the same time, males were criticized for not being 'masculine enough.' While school principals recognized the benefit of having male representatives for boys, they did not show the same willingness to bring that representation to girls.

Our findings in the education context may be generalizable to other service areas with similar characteristics. In policy areas with a great deal of discretion where gender disparities exist such as health care (Zhu and Walker (2013)), social welfare (Guul 2018), police contacts (Hong 2020), and other street-level bureaucracies (Zamboni 2020), the distinctions between active and symbolic representation could be investigated. In such contexts, gender disparities exist and approaching equal treatment means an improvement over the status quo (Meier 2019). Female clients would benefit from receiving the same treatment as their male counterparts, which means less gender discrimination and bias. Our qualitative analysis shows that most of the interviewed female maths and science teachers indicated that they treat female students equally. Female students are not treated worse, although the gender stereotype sees females underperforming males in those subjects, which incentivizes symbolic representation. Similar studies would be useful in bureaucracies that deal with gender-targeted outcomes such as sexual assault, domestic violence, and job discrimination (Meier and Nicholson-Crotty 2006; Wilkins and Keiser 2004). In such cases, agency missions reinforce the idea of active representation and it may be more likely to occur.

This study is not without limitations; it only explores the short-term effects of female representation in one policy area, and we cannot tell if similar findings would result in other policy areas or in contexts such as countries with greater gender equality. In addition, our quantitative analysis illustrates average impact across genders; it does not mean that every female student will perform better with female maths teachers. Similarly, other countries that lack the Chinese policy statements in favour of gender equity should be examined to determine if representation, either active or symbolic, can still exist. Future research needs to study the long-term effects of female bureaucrats; at the present time, we do not know if these positive effects of representation quickly disappear or continue to build over time resulting in future education gains or other changes in life circumstances. In all cases, the distinction between active representation and symbolic representation in various contexts is important (see Riccucci and Van Ryzin 2017) as is the question of whether they can reinforce the influence of each other for even greater impacts.

The current study also had stronger evidence that active representation did not exist than it did that symbolic representation occurred. Future mixed methods studies that increase the number of client respondents and probe for symbolic representation would be valuable. Similarly, qualitative interviews with larger samples of teachers are needed to estimate the extent of both active and symbolic representation. In addition to other policy areas and additional countries, applying the symbolic versus active assessment to other identities such as race, ethnicity, socioeconomic status, language or sexual orientation would be valuable. The salience of these identities varies by place and time and that salience is theoretically linked to both active and symbolic representation. Despite the limitations, this study does illustrate that a mixed methods approach can provide some ability to distinguish between active and symbolic representation in terms of benefits to clientele.

Notes

1. In other policy areas, scholars can occasionally get leverage on separating active from symbolic representation either because the data has reasonable indicators of both (see Guul 2018),

because the results could only result from symbolic representation when the behaviour occurs without bureaucratic action (Meier and Nicholson-Crotty 2006), or in survey experiments that focus only on symbolic responses (Van Ryzin, Riccucci, and Li 2017).

2. We also tested the effects of female teachers on male students (see Appendix). Our finding suggests that male students perform better when they have female teachers than having male maths teachers. However, the effects are not as strong as when female students are having female teachers. Our findings align with the findings of Keiser et al. (2002).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Xiaoyang Xu is a PhD candidate in the Department of Public Administration and Policy, School of Public Affairs, American University. Her research interests include gender and public administration, sector preferences for public service delivery, budgeting and theories of representative bureaucracy.

Kenneth J. Meier is Distinguished Scholar in Residence in the Department of Public Administration and Policy, School of Public Affairs, American University. He is also Professor of Bureaucracy and Democracy, Leiden University (the Netherlands) and Professor Public Management, Cardiff University (UK). His research interests focus on the effectiveness and equity of public programs.

ORCID

Kenneth J. Meier 🔟 http://orcid.org/0000-0002-6378-0855

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Appendix: Models for Male Students and the Influence of Female Maths Teachers

VARIABLES	Male students with female maths teachers	Male students with female maths teachers as homeroom teachers	Male students with female maths teachers as non-homeroom teachers
	Model 1	Model 2	Model 3
Female maths teacher	0.877***	1.388***	−0.0697
	(0.254)	(0.338)	(0.421)
Observations	6,886	3,908	2,978
R-squared	0.018	0.028	0.023

Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Equations control for all independent variables contained in Table 2. Full results available from the authors.