MANIFESTATIONS OF BIAS WITHIN PRESERVICE TEACHERS PROFESSIONAL NOTICING OF CHILDREN'S MATHEMATICAL THINKING

MANIFESTACIONES DE PARCIALIDAD ENTRE LOS MAESTROS PROSPECTIVOS DE LA MIRADA PROFESIONAL DEL PENSAMIENTO MATEMÁTICO DE LOS NIÑOS

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The purpose of this investigation was to examine connections between noticing and bias with a particular focus on how perceptions of race and gender may influence such noticing. Our primary research question was: How and to what extent does bias emerge within preservice teachers' professional noticing of children's mathematical thinking of differing races and genders? Results from this study indicate that bias most frequently occurs within the interpreting component of professional noticing, and that manipulating visual stimuli, such as adding a photo to a professional noticing vignette, influences manifestations of bias across race and gender.

Keywords: Teacher Education-Preservice, Equity and Diversity.

Equity concerns in mathematics have been of interest to researchers for a considerable period of time (Breshlich, 1941, DiME, 2007; NCTM, 2014). More recently, though, there has been renewal of interest regarding the support and flourishing of students from diverse backgrounds within mathematical contexts (Aguirre et al., 2017; Gutierrez & Dixon-Roman, 2011), and such differences in experiences are especially evident in STEM disciplines where students from non-dominant groups have received implicit and explicit messaging regarding their inclusion (or lack thereof) within such disciplinary settings (Goffney, Gutierrez, & Boston, 2018; Museus, Palmer, Davis, & Maramba, 2011). In some instances, inequities arise due to reduced expectations or lack of cultural considerations (Savage, Hindle, Meyer, Hynds, Penetito, & Sleeter, 2011; Zavala, 2014). We aimed to investigate *how and to what extent does bias emerge within pre-service teachers' professional noticing of children's mathematical thinking with respect to differing perceived races and genders?*

Conceptual Framework

Professional Noticing

Professional noticing (of children's mathematical thinking) (PN) has been of interest to mathematics educators for some time (Schack, Fisher, & Wilhelm, 2017; Sherin, Jacobs, & Philipp, 2011). The professional noticing framework incorporates three interrelated components, attending, interpreting and deciding (Jacobs, Lamb, & Phillip, 2010). Although the relationship and temporal ordering among these components is still being explored (Castro-Superfine, Fisher, Bragelman, & Amador, 2017), there appears to be some stability within the literature regarding the general nature of these components (Thomas, 2017). Specifically, *Attending* refers to the attention given to observable aspects of a mathematical context, *Interpreting* refers to the internal mediating and sense-making of that which is attended and *Deciding* refers to an intended response which is informed by some interpretation of a mathematical context.

Equity and Professional Noticing

There is emerging interest in connecting and studying aspects of equity in conjunction with PN (Jong, 2017). PN, as a practice situated within classroom contexts, is inherently braided with equity constructs and frameworks, and study thereof is appropriate and necessary. Jackson, Taylor, and

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Buchheister (2018) synthesized professional noticing with four dimensions of equity (i.e., access, achievement, identity, power) put forth by Gutierrez (2009; 2013) resulting in a framework for intersections between noticing and equity. Louie (2018), investigating relationships between equity concerns and noticing, makes a case that strict cognitive orientations of professional noticing (Schack et al., 2013) may overlook significant cultural dimensions of a mathematical moment. For example, PN may be focused upon equitable concerns such as power distribution and student positioning (Louie, 2018). Such practices are consistent with asset-oriented perspectives where students' backgrounds and their contributions are valued. Further, in the area of asset/deficit perspectives, Harper (2010) presents an anti-deficit framework of research on students of color in STEM by shifting questions to focus on assets. While subtle, the reframing of questions to be anti-deficit can empower how students of color are studied. These findings suggest that biases influence, to some extent, the manner in which teachers enact PN in the mathematics classroom. Thus, investigations of the nature and thresholds of such biases are necessary.

Methods

Measures

To examine emergence of bias (i.e., asset/deficit perspectives), an electronic survey was constructed. The primary element of this survey was an adaptation of a video-based professional noticing measure used by Schack et al. (2013) in their study of preservice teachers' professional noticing capabilities. Rather than using a video clip of a teacher asking a student to solve a story problem as the anchor for professional noticing enactment, we substituted a transcription of the video. Similar to Schack et al., preservice teachers (PSTs) were asked to respond to three prompts, except in this study, the picture was also visible – each aligned with a particular component skill of professional noticing: 1) "Please describe in detail what [Student Name] did in response to the problem" (*attending*), 2) "Please explain what you learned about [Student Name]'s understanding of mathematics" (*interpreting*), and 3) "Pretend that you are [Student Name]'s teacher. What problems or questions might you pose next? Provide a rationale for your answer" (*deciding*). Further, PSTs were prompted to provide some basic demographic data (i.e., gender, ethnicity, age, home state) as well as their familiarity with professional noticing. The transcript case names were *Margaret* (perceived white female), *William* (perceived white male), *Shaquan* (perceived African American male), and *Miguel* (perceived Latino male) (see Figure 1). We limited ourselves to these four cases as we wanted to maximize opportunities to examine differences across gender (i.e., male/female – William/Margaret) and race (i.e., African American/Latino/white – Shaquan/Miguel/William). While more cases would have allowed for additional comparisons (e.g., Latino Female/Latino Male), they would also have necessitated a much larger data set to ensure that each case had an adequate number of survey respondents. Note, a prior study was scored using the same asset/deficit scale, *without a picture* of a child that matches the perceived ethnicity and gender of the name, showed that bias tends to manifest significantly in only the interpreting stage of professional noticing (Thomas et al., 2019).

Figure 1: Case visuals

Participants

The electronic survey was fielded in teacher education programs across 18 states. Target respondents were PSTs who were in various stages of their respective teacher education programs. 315 PSTs initiated the survey, and incomplete surveys were discarded resulting in 170 completed responses with distribution across cases as follows: Margaret (n=44), Miguel (n=39), Shaquan (n=45), William (n=42). We used an electronic apportioning tool to ensure an approximately equivalent distribution of cases across respondents. Among the 170 participants, as one might expect of a preservice teacher sample, the largest gender and racial demographic was 18-24-year-old white females (59% of respondents)

Analysis

The asset/deficit perspective of the participant responses to the three questions were evaluated using a flow-process tool (AMSE, 1947) to determine the presence or absence of asset-oriented or deficit-oriented language describing the child's mathematical strategy. Each response was ascribed one of four different codes – asset, deficit, both [asset and deficit], and neutral. A previous study measuring equity in professional noticing, scored using the same asset/deficit scale, without a picture of a child (Thomas et al., 2019). Note, neutral responses contained no asset/deficit-oriented descriptions of the child's thinking/activity. Two raters used the flow process tool to calibrate with sample data, from a previous data set, until an 80% interrater reliability was achieved. The data from the current study were then blinded and combined into one list and scored independently by the two raters. Per previous studies of PN, rating differenes were resolved via discussion (Jacobs et al., 2010; Krupa, Huey, Lessieg, Casey, & Monson, 2017).

Findings

Adding the feature of a picture of a child produced similar results. The percentage of responses across perspectives with and without picture can be found in Table 1.

Table 1. Percentage of Responses Across Perspectives

		% With Picture	% Without Picture
Attending	Asset	19	6
	Deficit	4	5
	Neutral	75	87
	Both	2	2
Interpreting	Asset	38	31
	Deficit	13	27
	Neutral	24	12
	Both	25	30
Deciding	Asset	2	1
	Deficit	2	3
	Neutral	96	95
	Both	0	1

Delving more deeply into these data, we conducted chi-square tests to determine whether there are any relationships between case, survey type (picture, no picture), and bias categorizations (asset, deficit, neutral, both) (see Tables 3 and 4). Specifically, for each of the four cases, chi-square tests of independence were performed to test whether the different survey types were associated with a different distribution of attending, interpreting, or deciding bias categories. Furthermore, for each of the two survey types, chi-square tests of independence were performed for each noticing facet (attending, interpreting, deciding) to test whether each case was associated with bias categorization.

Table 2. Chi-square independence for each survey type between case and noticing component

Survey Type	Case vs. Attending	Case vs. Interpreting	Case vs. Deciding
No Picture	13.508 (9)	8.061 (9)	7.628 (9)
Picture	7.890 (9)	20.575 (9)*	5.719 (6)

Note. * $p < .05$, ** $p < .01$. Results are reported as χ^2 (df).

Table 3. Chi-square independence for each case between survey type and noticing component

Case	Survey Type vs. Attending	Survey Type vs. Interpreting	Survey Type vs. Deciding
Margaret	7.168 (2)*	9.025 (3)*	3.606 (3)
Miguel	0.935 (3)	4.826 (3)	0.781 (2)
Shaquan	2.430 (3)	1.204 (3)	1.506 (3)
William	7.294 (3)	14.629 (3)**	N/A

Note. * $p < .05$, ** $p < .01$. Results are reported as χ^2 (df).

A test of independence could not be calculated for the William case in the deciding component because all responses for this condition were categorized as "neutral". From these results, for picture survey, we see a significant association between case (Margaret, William, Shaquan, Miguel) and bias categorization within the professional noticing component of interpreting. Further, the Margaret case showed significant association between survey type and the attending bias categorization, and both the Margaret and William cases showed significant association between survey type and the interpreting bias categorization.

Discussion

The mere changing of names (e.g., Shaquan, William, Margaret, Miguel) does not appear to provoke the directly negative biases observed in other studies (Bertrand & Mullainathan, 2004; Hanson, Hawley, Martin, & Liu, 2016). Looking toward the relationship between bias and action, Rudman (2004) describes the relationship between individuals' implicit and explicit biases as connected but somewhat distant. As one's explicit biases exist consciously downstream of one's implicit biases, they are inherently more malleable by the individual. With respect to teacher noticing, implicit biases may (and likely do) influence teacher decision-making (i.e., deciding) and the situating of such biases appears to be within the interpreting component.

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